The Egyptian Journal of Surgery

The official organ of the Egyptian Society of Surgeons

Vol. (33), No. (3), July 2014

Table of contents

Original articles

Case report

Wolters Kluwer Health | Medknow

The Egyptian Journal of Surgery

The official organ of the Egyptian Society of Surgeons

Wolters Kluwer Health | Medknow

The Egyptian Journal of Surgery

The official organ of the
Egyptian Society of Surgeons

Egyptian Journal of Surgery - Published Quarterly
Egyptian Journal of Surgery is the Offical Journal of the Egyptain Society of Surgeons.

GUIDELINES FOR AUTHORS

Last updated September 2014

The Egyptian Journal of Surgery (EJS) welcomes submission of papers on clinical, experimental, cultural and historical topics from authors of diverse clinical and scientific interests and expertise, provided the paper has relevance to surgery and related fields. The EJS in its review of papers will give priority to papers that present valid evidence that can enhance patient safety during surgical care.

Papers are reviewed for publication assuming that its content have not been submitted simultaneously to another journal, have not been accepted for publication elsewhere and have not already been published. Any attempt at dual publication will lead to automatic rejection and may prejudice acceptance of future submissions and may be highlighted within the pages of the Journal.

Papers may be rejected after review in-house on account of lack of originality, a poorly conducted study or absence of a clinical message.

An electronic copy of the manuscript (Microsoft Word) including artwork (jpg) should be submitted to the EJS via the EJS section on the Egyptian Society of Surgeons web site (www.ess-eg.org). A covering letter addressed to the EJS editor requesting submission should be sent with the manuscript

The EJS style follows the Uniform Requirements for Manuscripts Submitted to Biomedical Journals which can be downloaded free from the following site: www.icmje.org

Ethics

Material relating to human investigation and animal experiments must comply with and be approved by local ethics committees. The EJS reserves the right not to publish papers on the grounds that appropriate ethical or experimental standards have not been reached. Written consent must be obtained from the patients, legal guardian or executor for publication of any details or photographs that might identify an individual.

Manuscript Preparation

Manuscripts should not exceed 4000 words using a 12 pt Times New Roman font size, on A4 pages with double spacing and at least 3cm margins. The pages of the manuscript should be numbered including the title page at the top right hand corner. The manuscript should NOT be written with a column formatting style. Each of the following sections should begin on a new page in the following order: title page; abstract; introduction; patients (materials) and methods, results, discussion, acknowledgment; references; tables; legends for illustrations.

Title Page

The title page should contain: (1) Title of the Article, (2) Full name of each author, with highest academic degree(s), (3) Department(s) and institution(s) to which the work should be attributed, and (4) Name, address, phone, fax and e-mail address of author responsible for correspondence.

Abstract

The abstract should be structured outlining the aim, methods, results and conclusions of the paper. The abstract should not exceed 200 words

Keywords

Three words using terms from Index Medicus (MeSH catalogue) wherever possible should be chosen by the author. Keywords should not repeat words from the manuscript title.

Text

The outline of the text should be; (1) Introduction (< 500 words), (2) Patients (Materials) and Methods, (3) Results, (4) Discussion (< 1000 words). To make the discussion more reader friendly please structure it using the following subheadings: summary of main findings, comparison with other studies, strength and limitations of the study, implications for future research and policy.

Tables and graphs

Each table should be on a separate page, must have an identifying number (please use Arabic numerals) and a short descriptive title.

Do not use vertical lines in your tables. All tables should be linked with the text and should supplement, not duplicate, the text. For Footnotes Use the following symbols in the following sequence: *,†,‡,§,||,¶,**,††,‡‡. Graphs should be constructed in black and white with no gridlines. Three dimension graphs will not be accepted.

Illustrations (Figures)

Figures should be submitted in JPG format each on a separate page with its corresponding reference number in the text and legend text. If photographs of people are used, either the subjects must not be identifiable or their pictures must be accompanied by written permission to use the photograph.

Abbreviations and symbols

The full term for which an abbreviation stands should precede its first use in the abstract and text unless it is a standard unit of measurement. Abbreviations are put in parenthesis only after their full term; no need to put abbreviations in parentheses after that. The full term of abbreviations used in a table should accompany the table as a footnote even if mentioned before in the abstract or text. Avoid abbreviations in the title.

References

The EJS reference style follows the Uniform Requirements for Manuscripts Submitted to Biomedical Journals which is based largely on an ANSI standard style adapted by the National Library of Medicine (NLM) for its databases:
Www.nlm.nih.gov/bsd/uniform_requirements.html. Authors are advised to check their references using the PubMed Single Citation Matcher: http://www.ncbi.nlm.nih.gov/sites/pubmedutils/citmatch.

Example for standard journal article

Halpern SD, Ubel PA, Caplan AL. Solid-organ transplantation in HIV-infected patients. N Engl J Med. 2002;347:284-7.

For articles with more than six authors: List the first six authors followed by et al.

Rose ME, Huerbin MB, Melick J, Marion DW, Palmer AM, Schiding JK, et al. Regulation of interstitial excitatory amino acid concentrations after cortical contusion injury. Brain Res. 2002;935:40-6.

Scientific misconduct

The EJS will activate its policies and procedures on scientific misconduct once redundant publication, plagiarism, data fabrication or falsification suspected. The EJS essentially follows the Committee on Publication Ethics (COPE;
www.publicationethics.org.uk) guidelines and flowcharts.

Authorship Agreement

All authors will be requested to sign an authorship agreement form once the submitted manuscript becomes legible for peer review.

ANNUAL SUBSCRIPTION

The Egyptian Journal of Surgery is published four times a year; in January, April, July and October. The annual subscription fees are as follows: Members of ESS: L.E. 100
Institutions: L.E.100
Issues will be mailed to subscribers only.

INFORMATION & CORRESPONDENCE

Any information requests or correspondence including paper submission, subscription order, change of address of subscriber and, advertising in the Journal, should be addressed to:

www.journalonweb.com/ejs

The Information about the Journal is also available at: **www.ejs.eg.net**

Executive Editor:
Prof. Abdel Moati Hussein

Editorial Office:
Conference Organizing Bureau
Tel.: 33023642 33027672
Website: www.cob-eg.org

Editorial Assist:
Mohamed Salah

Influence of standardized histopathological workup on reporting of the resection margin status in pancreatic head cancer

Ahmed M. El-Gendi[a], Saba El-Gendi[b]

Departments of [a]Surgery, [b]Pathology, Faculty of Medicine, Alexandria University, Alexandria, Egypt

presented-atThis manuscript was accepted as poster presentation in the 11th World Congress of IHPBA, 22–26 March 2014, at Seoul, South Korea and in the American College of Surgeons 2012 Annual Clinical Congress, 30 September–4 October 2012, at McCormick Place in Chicago, Illinois, USA

Correspondence to Ahmed M. El-Gendi, MD, MRCS, PhD, Department of Surgery, Faculty of Medicine, University of Alexandria, El Sultan Hussein Street, El-Azarita, Khartom Square, Alexandria 21131, Egypt
Tel: +20 3484 7426, +20 122 240 8223;
fax: +20 354 26676;
e-mail: draelgendi@gmail.com

Received 20 February 2014
Accepted 23 March 2014

The Egyptian Journal of Surgery
2014, 33:131–139

Background
Resection margin (RM) status in pancreatic head adenocarcinoma is assessed histologically, but pathological examination is not standardized. Our aim was to determine the influence of the 'standardized histopathological workup' of pancreaticoduodenectomy specimens on the reporting of the RM status using a 'surgical quality protocol'.

Patients and methods
Starting October 2009, 42 patients underwent pancreaticoduodenectomy using the 'surgical quality protocol' for pancreatic ductal adenocarcinoma and were examined using 'standardized histopathological workup'. We prospectively evaluated and validated its results for 50 months. We evaluated different sites of R1 at 0 and 1 mm resections according to the color code and determined the most frequent site of incomplete tumor resection.

Results
Patients included 14 women and 28 men. Their age ranged from 46 to 74 years, with a median of 60 years. Changing to 'standardized histopathological workup' from traditional pathological examination procedures resulted in an increase in the R1 rate from 14.3 to 64.3% in this prospective series. Fifteen percent of R1 resections showed multifocal margin involvement (i.e. more than one margin involved in a single specimen) for the 0 mm in contrast to 33% for the 1.0 mm margin. The uncinate margin represents the most frequent site with residual tumor mass by far (42% at 0 mm and 43% at 1 mm), followed by the posterior margin. When R1 resection was defined by a positive margin of 0 mm, 48% of the present patients achieved R1 resection. In contrast to when R1 resection was defined by the presence of tumor cells within 1.0 mm, 64% of the present patients achieved R1 resection.

Conclusion
Standardization of the histopathological examination of pancreaticoduodenectomy specimens influences the reporting of RM status. The RM involvement is significantly more frequent than commonly reported. Complete and meticulous surgical resection of the uncinate process *en bloc* with all the peripancreatic tissues between the artery and the pancreatic parenchyma must become the standard surgical approach in pancreatic head resection as it is the most frequent site for residual tumor by far.

Keywords:
histopathological workup, pancreatic cancer, R1 resection, resection margin, uncinate margin

Egyptian J Surgery 33:131–139

1110-1121

Introduction

Surgical resection with negative resection margins (RMs) (R0) remains the only potentially curative treatment for pancreatic ductal adenocarcinoma (PDAC). Because of its late presentation, aggressive tumor biology, and lack of early specific biological markers, only 10–15% of cases are resectable [1].

RM involvement (R1) is generally believed to be, among others (tumor size, degree of differentiation, nodal affection), a critical prognostic indicator to survival in those patients [2–6] and was reported to be an independent predictor of poor long-term survival in several studies [7–23]. However, even patients with tumor-free margins (R0 resection) frequently experience local recurrence and distant metastases. Consequently, more radical approaches have been evaluated, as described by Fortner [24]. Even though there was an initial indication of some survival benefit, follow-up studies have failed to confirm these promising results [25]. This raised the question as to whether such a discrepancy is caused, other than through incomplete lymphadenectomy and perineural invasion, by a misclassification of R1 resections as R0 resections [26]. Quoted R1 resection rates can vary significantly between individual specialist centers (14–85%) [5,6,20,27,28], and it is not known to what extent these differences reflect different pathological practices.

Because RM involvement is generally believed to be determined by the quality of surgery, a low R1 rate is often considered an indicator of high-quality surgery. Recent studies, however, have brought the pathologist as

 DOI: 10.4103/1110-1121.141894

a second player into the field, on the basis of the growing awareness that standardization and meticulousness of the pathological examination have a significant impact on the accuracy of the reported RM status [20,27,28]. The R1 rate is therefore a performance measure not only for the surgeon but possibly also for the reporting pathologist.

The aim of this study was to determine the influence of the 'standardized histopathological workup' of pancreaticoduodenectomy (PD) specimens on the reporting of the RM status using a 'surgical quality protocol' to test prospectively the hypothesis that current histopathological reports underestimate the proportion of R1 pancreatic head resections.

Toward this goal, we first implemented color coding of the RMs and the organ surfaces. Second, we carefully re-evaluated the different sites of R1 resections according to the color code and found the most frequent site of incomplete tumor resection.

Patients and methods

To fulfill our aim and test our hypothesis, we first investigated our rates of curative resections by retrospectively identifying all patients who had undergone pancreatic head resection, either through pylorus-preserving pancreaticoduodenectomy (PPPD) or the Kausch–Whipple procedure because of malignant diseases (PDAC), in the Department of Surgery, Alexandria University, between 2004 and 2009. During this period, all the specimens were examined by the same experienced team of pathologists using conventional histopathological workup, where longitudinal opening of the main pancreatic duct and common bile duct was the preferred dissection method (mainly bivalve slicing). The following margins were examined: common bile duct margin, the proximal duodenal (gastric) margin, jejunal RM, pancreatic neck transaction margin, and the anterior and posterior surface. When present, vascular, lymphatic, and perineural invasion were reported. Histological classification [tumor type, grade of malignancy, pathological tumor–node–metastasis (TNM)] was carried out according to the current World Health Organization and Union for International Cancer Control (UICC) criteria [29]. According to the UICC criteria, the operation was considered potentially curative (R0) if the RMs and organ surfaces were free of tumor cells, whereas histopathologically verified tumor cell infiltration was defined as R1 resection. In cases of macroscopically visible tumor tissue, the resection was classified as R2.

Starting October 2009, we introduced the 'standardized histopathological workup' [27,30,31] to examine all PD specimens. We prospectively evaluated and validated its results for 50 months till December 2013. During this period, 54 consecutive patients with pancreatic head tumors underwent PD and provided an informed consent to their inclusion in the study before surgery. Forty-two out of the 54 patients with true macroscopic margin-free PDAC who underwent PD entered the present study, whereas 12 patients were excluded after surgery because of findings of macroscopic residual tumor (R2 resection), non adherence to the 'surgical quality protocol', and nonductal adenocarcinoma.

Standardized 'quality protocol' for pancreaticoduodenectomy

All of our studied patients received pancreatic head resection with curative intent. All resection procedures were performed by the same experienced surgical team. After a bilateral subcostal incision, assessment of resectability was performed by an examination of the abdominal cavity to exclude any contraindications for resection mainly liver metastases or peritoneal carcinomatosis. The duodenum was kocherized with the dissection plane developed. With extension of the Kocher maneuver, an adequate exposure of the aortocaval area was obtained. The superior mesenteric vein (SMV) was then identified as it passes anterior to the third part of the duodenum by ligating and dividing all the tributaries to the head of the pancreas. A plane is developed anterior to the SMV and portal vein by remaining in the periadventitial layer of the vein. All portal vein tributaries are ligated and divided individually until the portal vein is completely free from the pancreatic head.

The dissection of the retroperitoneal margin was performed by extending the excision of the perivascular neural plexus around the superior mesenteric artery (SMA). This was done by approaching the SMA after retracting the SMV with an eyelid ophthalmic retractor. A part of the inferior medial boundary of the uncinate process was defined by identifying the SMV and the partially exposed SMA and this plane was developed. This plane was extended posteriorly by dissecting the right meridian neural plexuses of the SMA. From there, the SMA was identified and the perivascular plexus on the lateral side was dissected laterally right up to the vessel, and all the tissues between the artery and the pancreatic parenchyma were resected (Fig. 1). The SMA was not dissected from the medial side and the perivascular neural plexus on the medial side was preserved to avoid postoperative diarrhea. The dissection was then extended superiorly along the SMA toward its origin. It was then possible to place the left hand just anterior to the inferior vena cava (IVC) and aorta and retract the uncinate process to the

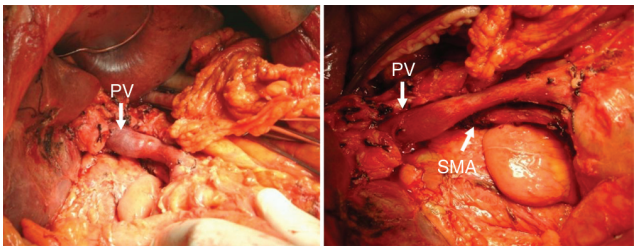
right of the patient, allowing the peripancreatic tissue around the uncinate process to be resected *en bloc*. The dissection of SMA continues along the plane of the adventitia up to the junction of the third and fourth parts of the duodenum. Standard lymphadenectomy plus resection of lymph nodes to the right of the celiac trunk, hepatic artery, and hepatoduodenal ligament were carried out in all patients [25]. After resection of the specimen, the posterior and retroperitoneal margin was grossly inspected for its integrity.

Standardized protocol for pathological examination

All surfaces and RMs of the pancreatic head resection specimen were stained according to a well-established five-color code (Fig. 2): the anterior (ventral) surface was painted yellow, the posterior (dorsal) surface green, the groove of the SMV blue, the pancreatic transection margin red, and the uncinate margin silver. Considerable emphasis was placed on clarifying the status of the RMs. Besides examining the status of RMs in the conventional technique, special attention was directed toward examining the circumferential resection margins (CRM) of the specimen including the anterior, posterior, and medial surfaces (SMV groove), with dedicated study of the status of the retroperitoneal uncinate margin. Isolated tumor involvement of the anterior surface of the pancreatic specimen was not considered an R1 resection in our patient cohort. No cases were classified as R1 exclusively on the basis of perineural invasion at a RM. Similarly, nodal involvement at a RM did not constitute an R1 classification in the absence of direct tumor involvement.

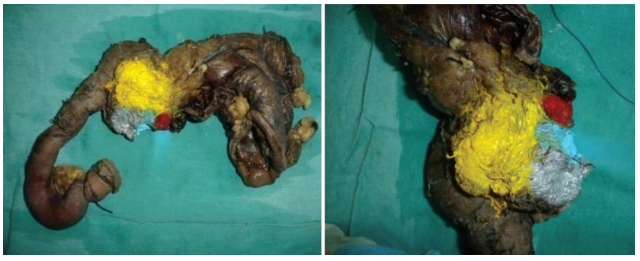
The uncinate process margin that extends along the proximal 3–4 cm of the SMA was identified immediately following resection (Fig. 3) as it was very difficult for the pathologist to identify, especially after formalin fixation, if it has not already been inked by the surgeon while the other parts were being colored after formalin fixation for 24–36 h. All staining procedures were performed by the operating surgeon or by a surgeon present during the procedure. The specimen was serially sliced (0.5–1-cm slices) in a single axial plane, that is, perpendicular to the longitudinal axis of the duodenum [20,27,28], according to the guidelines of the Royal College of Pathologists and the Leeds Pathology Protocol [27,30–32]. Therefore, large slices were obtained (median number 12), allowing the precise study of each colored margin at 0 and 1 mm. R1 resection rates were calculated twice: one with 'R1 resection' defined by a positive margin of 0 mm [33–35] and the other with 'R1 resection' defined by the presence of tumor cells within 1.0 mm [30,36]. Margin involvement (R1) was defined for the 0-mm margin if tumor cells were present at the inked margin; R1 was also defined for 1 mm margin width if tumor cells were present within the margin, independent of the mode of tumor spread. The pathological protocol also included the maximal transverse diameter of the tumor, the TNM classification, the grade of differentiation, the presence or absence of perineural, lymphatic, and/or vascular spread, and the number of lymph nodes retrieved from the specimen, enabling the calculation of the lymph node ratio. Several samples were taken from the tumor in relation to the anterior and posterior surface.

Figure 1



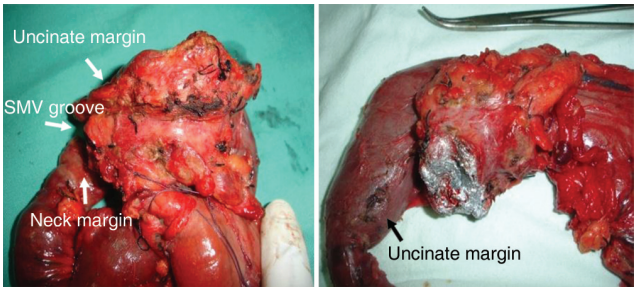
Operative pictures after resection of the pancreatic head showing the portal vein (PV) and superior mesenteric artery (SMA) after excision of the perivascular neural plexus on its lateral surface.

Figure 2



All surfaces and resection margins of the pancreatic head resection specimen were stained according a well-established five-color code: the anterior (ventral) surface was painted yellow, the posterior (dorsal) surface green, the groove of the superior mesenteric vein (SMV) blue, the pancreatic transection margin red, and the uncinate margin silver.

Figure 3



Pancreaticoduodenectomy fresh specimen showing the uncinate margin (silver), superior mesenteric vein superior mesenteric vein groove, and pancreatic neck transaction margin.

Results

To compare the rates of curative and noncurative resections in our department with the published data, we retrospectively identified 78 patients with malignant pancreatic head tumors (PDAC), excluding cases of distal bile duct cancer and ampullary carcinoma, who had undergone either PPPD or a Kausch – Whipple procedure over 5 years' duration. In 61 of these 78 (78%) patients, the operation could be considered potentially curative (R0), whereas the RMs in 17 cancer specimens was infiltrated (R1 = 22%). The most common site of infiltration was at the pancreatic neck transaction margin, followed by the posterior margin. The uncinate process margin was not assessed as a separate margin (Table 1).

Starting October 2009, we introduced the 'standardized histopathological workup' and applied it prospectively until December 2013. During this 50-month period, 42 consecutively resected pancreatic head specimens (PDAC) were processed according to this protocol. The patient population included 14 women and 28 men. Their age ranged from 46 to 74 years, with a median of 60 years. Eighteen patients underwent a Kausch–Whipple procedure, whereas the remaining 24 patients were treated by PPPD. None of our cases required partial or complete resection of the SMV. Clinicopathological data for the entire cohort showed that 81% were classified as T3 tumors (T1: 7%, T2: 12%). Sixty percent of the tumors were moderately differentiated (grade 1: 25%, grade 2: 58%, grade 3: 17%). None of our patients died within 30 days after surgery.

All 42 pancreatic head resections were invasive ductal adenocarcinoma on the final histopathological assessment after excluding those of distal bile duct cancer and ampullary adenocarcinoma. Applying our old conventional protocol for histopathological assessment, 36 cancers were curatively resected (R0 = 86%), whereas six (14%) cases turned out to be R1 resections. These six cases were classified as R1 on the basis of infiltration of the pancreatic neck margin. Applying the standardized histopathological workup and R1 resection at 0 mm, an additional set of 12 specimens had to be considered as R1 resections, resulting in a total percentage of 48% of noncurative operations (R1), reducing the rate of R0 resection to 52%. This is in contrast to when applying the 1 mm margin rule for R1 resection, a set of 21 specimens had to be considered R1 resections, resulting in a total percentage of 64% of noncurative operations (R1), reducing the rate of R0 resection to 36% (Table 1).

Tables 2 and 3 show the breakdown of RM involvement at 0 and 1.0 mm according to the number of involved margins per specimen and the distribution of margin involvement. Our results showed that 15% of R1 resections indicated multifocal margin

Table 1 Histopathological and resection classification data

	Prospective			Retrospective
	Conventional	Standard 0 mm	Standard 1 mm	
Resection [*n*/*n* (%)]				
R0	36/42 (86)	22/42 (52)	15/42 (36)	61/78 (78)
R1/2	6/42 (14)	20/42 (48)	27/42 (64)	17/78 (22)
Site of R1				
Uncinate	ND	10	18	ND
Posterior	0	6	12	6
Anterior	ND	0	3	2
Pancreatic transection	6	6	6	7
Groove SMV	0	1	3	ND
Distal duodenum	0	0	0	1
Proximal duodenal/gastric	0	0	0	2
Common bile duct	0	0	0	1
Number of affected sites				
1	6	17	18	17
2	0	2	3	0
3	0	1	6	0
Total	6	20	27	17
T1 [*n* (%)]		3 (7)		1 (1)
T2 [*n* (%)]		5 (12)		18 (23)
T3 [*n* (%)]		34 (81)		59 (76)
T4 [*n* (%)]		0 (0)		0 (0)
N0 [*n* (%)]		6 (14)		14 (18)
N1 [*n* (%)]		36 (86)		64 (82)

SMV, superior mesenteric vein; ND, not done.

Table 2 Breakdown of resection margin involvement according to the number of involved margins per specimen and the distribution of margin involvement

	Pancreas transaction margin		Anterior surface		Posterior surface		Groove of SMV		SMV		Bile duct		Duodenum		Uncinate	
	0 mm	1 mm	0 mm	1 mm	0 mm	1 mm	0 mm	1 mm	0 mm	1 mm	0 mm	1 mm	0 mm	1 mm	0 mm	1 mm
Case 1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+
Case 2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 3	–	–	–	–	+	+	+	+	–	–	–	–	–	–	–	+
Case 4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 5	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 6	–	–	–	–	+	+	–	–	–	–	–	–	–	–	–	+
Case 7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+
Case 8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 9	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 10	–	–	–	+	–	+	–	–	–	–	–	–	–	–	+	+
Case 11	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 12	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 13	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–
Case 14	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+
Case 15	–	–	–	–	+	+	–	+	–	–	–	–	–	–	–	+
Case 16	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 17	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+
Case 18	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 19	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 20	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	+
Case 21	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 22	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 23	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 24	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 25	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 26	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+
Case 27	–	–	–	–	–	+	–	–	–	–	–	–	–	–	–	–
Case 28	–	–	–	–	+	+	–	–	–	–	–	–	–	–	+	+
Case 29	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+
Case 30	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+
Case 31	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 32	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 33	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 34	–	–	–	+	–	+	–	–	–	–	–	–	–	–	+	+
Case 35	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+
Case 36	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 37	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	+
Case 38	–	–	–	+	–	+	–	–	–	–	–	–	–	–	–	+
Case 39	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Case 40	–	–	–	–	+	+	+	+	–	–	–	–	–	–	+	+
Case 41	–	–	–	–	+	+	–	–	–	–	–	–	–	–	–	–
Case 42	+	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–

SMV, superior mesenteric vein.

involvement (i.e. more than one margin involved in a single specimen) for the 0 mm in contrast to 33% for the 1.0 mm margin. The posterior and medial margins were the most commonly involved margin locations at 0 and 1 mm. Out of the total 20 cases of R1 resection at 0 mm, 17/20 R1 resections showed tumor infiltration at a single site (eight uncinate, six neck, three posterior surface), two patients had tumor infiltration in two stained areas and in one patient tumor infiltration was found in three stained areas.

Out of the total 27 cases of R1 resection at 1 mm, 18/27 R1 resections showed tumor infiltration at a single site (nine uncinate, six neck, three posterior surface), three patients had tumor infiltration in two stained areas, and in six patients, tumor infiltration was found in three stained areas. Interestingly, the uncinate margin was the most common site of infiltration in 10 and 18 of these R1 specimens at 0 and 1 mm, respectively. Uncinate margin infiltration was either alone (n = 8 at 0 mm and n = 9 at 1 mm) or in combination with the posterior surface

and SMV groove (n=1 at 0 mm and n = 3 at 1 mm), in combination with the posterior surface (n = 1 at 0 mm and n=3 at 1 mm), or in combination with the posterior and anterior surface (n = 0 at 0 mm and n = 3). In all, the uncinate margin was determined to be the most frequent site with residual tumor mass by far (n = 10, 42% at 0 mm) and (n = 18, 43% at 1 mm). Invasion of the uncinate margin was present in 42% of specimens at the 0-mm margin and 43% at the 1.0-mm margin.

In summary, if R1 resection is defined by a positive margin of 0 mm [33–35], 48% of the present patients achieved R1 resection. If R1 resection is defined by the presence of tumor cells within 1.0 mm [30,36], 64% of the present patients achieved R1 resection. Pancreatic neck transaction invasion resulted in an additional percentage of R1 resections for any definition of R1 on the inked margins. Thus, the rate of R1 resections was 48% when R1 was defined according to the 0-mm rule and 64% when R1 was defined according to the 1.00-mm rule (ratio: 2.2).

Discussion

RM status is an important prognostic factor in pancreatic cancer [2,37,38]. Although it is assessed histopathologically, there is currently no internationally recognized standard protocol for pathological examination and reporting of pancreatic head specimens, nor a universally accepted definition of CRM positivity. Meaningful comparison of R1 rates between individual centers is further complicated by the lack of standardized terminology for margins, which may explain the wide variation in published R1 rates. Increasing evidence exists to suggest that the standard of histopathological processing and reporting has a significant impact on R1 resection rates [20,27,28]. The hypothesis that R1 resections are commonly under-reported is also supported by the observation that 60–80% of cases with resected pancreatic cancer develop local recurrence [39–41], a finding that seems to be inconsistent with quoted R1 resection rates of less than 20%.

The Leeds [42] and Heidelberg [28] groups were the first to show that the standardization of histopathological study resulted in a significant increase in R1 resection rates, without requiring any change in surgical technique (respectively, from 53 to 85% [43] and 14 to 76% [28]). Thus, a high rate of R1 resection in PDAC is clearly a marker of high-quality pathology and depends, first, on the number of peripancreatic soft tissue RMs examined, second, on the number of blocks analyzed [30,31], and third, on the minimum clearance in millimeters used to define microscopic margin involvement (R1).

In a study published recently by Campbell *et al*. [44], tumor involvement within 1.0 mm of, but not directly reaching, one or more RMs represented 45% of the 79% of RMs identified as positive. In the most recent series, comparisons of R1 rates performed using the UICC criteria (R1: 0 mm definition), which are commonly used in North America [5,33,34], and those achieved using the UK Royal College of Pathologists criteria (R1: 1.0 mm definition) [30] show ratios ranging from 1.3 to 1.8 [28,44–46]. The ratio was 2.2 in the present study. Katz *et al*. [47] reported a ratio of 5.5 (4–22%) in a study in which only the superior mesenteric artery margin (SMAm) was assessed and in which 76% of patients had received preoperative radiochemotherapy; this study also showed that preoperative CT overestimated the SMAm in 73% of patients. Hartwig *et al*. [17] reported a maximum ratio of 8.4 in a study comparing the 0 mm definition with the revised 'R1=1.0 mm' definition (4.8–40.5%).

In our study, retrospective analyses of data from patients treated in our department between 2004 and 2009 with respect to the classification of the pancreatic head resections using the traditional dissection technique showed that the percentage of R1 resections was 21.7%, which is in agreement with the literature [8,11,48,49]. Shifting from traditional pathological examination procedures (mainly bivalving) to serial slicing of the specimen in a single axial plane, that is, perpendicular to the longitudinal axis of the duodenum as advocated in recent studies [27] resulted in an increase in the R1 rate from 14.3 to 64.3% in the prospective series. This is in agreement with a publication of the Heidelberg

Table 3 R1 resection rate for each margin increment (0 and 1.0 mm) and the proportion of patients with at least one, two, or three positive margins

Margin width (mm)	*n*/*n* (%)			
	R1 resection	One positive margin	Two positive margins	Three positive margins
0	20/42 (48)	17/20 (85)	2/20 (10)	1/20 (5)
1.0	27/42 (64)	18/27 (67)	3/27 (11)	6/27 (22)

Table 4 Resection margin status and R1 rates in our study compared with some published literature

References	Number of patients	RM status	R1 rate at 1 mm (%)
Nishimura *et al*. [50]	157	R1, R2	6
Sohn *et al*. [9]	616	R1	12
Neoptolemos *et al*. [7]	541	R1	11
Verbeke *et al*. [27]	26	R1	85
Westgaard *et al*. [14]	40	R1	45
Menon *et al*. [20]	27	R1	82
This study	43	R1	64

RM, resection margin.

group [28] (Table 4). The data also provide further evidence to indicate that robust pathological practice is a more important determinant of R1 classification in pancreatic cancer than operative expertise.

Longitudinal opening of the main pancreatic duct and common bile duct has traditionally been the preferred dissection method. This technique is of limited value for the assessment of the RMs, tumor origin, and tumor extension. Opening of the ducts disrupts the specimen surface along two tracks that run across the entire head of pancreas. This interferes with accurate evaluation of the CRM. As the common bile duct traverses the pancreatic head posteriorly, it is usually opened through the posterior surface, hence disrupting that part of the CRM that is frequently involved [27,51–54].

The axial slicing technique adopted in this study does not prescribe longitudinal opening of the pancreatic or bile duct; hence, the entire surface (or CRM) of the pancreatic head remains intact. Axial slicing is easy to perform, independent of the location and nature of the pathology encountered. A large number of slices are produced – usually between 10 and 13 – allowing extensive views of the lesion and its relation to the entire CRM and key anatomical structures [27]. Interestingly, axial slicing was the standardized dissection technique used in the recent studies that reported an unusually high R1 rate of over 75% [20,27,28]. The frequent identification of margin involvement reported in these studies is at least partially explained by the fact that all parts of the CRM can be inspected in each specimen slice obtained with this technique. This seems to indicate that the dissection and sampling technique has a significant impact on the assessment of the margin status in PD specimens.

Malignant pancreatic tumors often invade the retroperitoneal peripancreatic tissues. The retroperitoneal peripancreatic tissue surrounds the first 3–4 cm of the SMA origin behind the SMV [52,55,56]. Gockel *et al.* [57] have defined this anatomical structure as 'mesopancreas' similar to the mesorectum. Therefore, PD with curative intent should include complete clearance of the peripancreatic retroperitoneal tissue, which represents the most tedious step of PD, with an increased risk of intraoperative bleeding. The importance of the retroperitoneal RM was confirmed by Westgaard *et al.* [14].

When analyzing the distribution of margin involvement in R1 resections for pancreatic cancer and despite the current lack of consensus in terminology to denote the different CRMs, the finding that the uncinate margin represents the most frequently involved margin (42% at 0 mm and 43% at 1 mm), followed by the posterior margin is also consistent with the existing literature [20,27,28,58]. This was followed by the SMV groove CRM and anterior pancreatic surface. This pattern of CRM involvement is in line with Japanese studies [10,59]. Involvement of the pancreatic transection margin was observed in six cases of R1 specimens in the present study, a low rate that may be explained by the impact of intraoperative frozen-section examination of that margin.

The 'uncinate margin' is confusing as it is mainly used synonymously with the medial CRM, but occasionally refers to a true transection margin, produced by the surgeon when dividing the uncinate process as close to the SMA as possible [60,61]. With current standardized surgical procedures, however, the uncinate process remains intact and dissection of the SMA is performed in the soft tissue plane, which corresponds to the medial CRM of the specimen. Owing to morphological changes during formalin fixation, it is of utmost importance to color the uncinate RM directly after surgical resection. If the uncinate margin is not assessed separately, a positive margin here can be misinterpreted as a positive margin in the posterior or SMV groove CRM. We strongly believe that the complete and meticulous surgical resection of the uncinate margin as the structure to the right of the mesenteric artery must become the standard surgical approach in pancreatic head resection.

Although microscopic margin involvement is staged as 'R1' irrespective of which parts of the CRM are involved, detailed CRM mapping is important. It provides feedback both to the surgical and to the radiological teams, to enable improved preoperative assessment of resectability, identification of areas at risk of incomplete resection, and improved surgical technique. Further studies are needed to correlate the data from margin mapping and involvement to show the significance of involvement of each individual CRM in terms of survival and recurrence pattern.

Conclusion

Standardization of the histopathological examination of PD specimens influences the reporting of RM status and represents a more accurate assessment of curative and noncurative resection rates. Our study seems to indicate that RM involvement is significantly more frequent than reported commonly and the rates obviously depend on the definitions of microscopic invasion used. The uncinate margin is a frequent site for positive RMs, which has potential therapeutic implications. Owing to morphological changes during formalin fixation, it is of utmost importance to color

uncinate RM directly after surgical resection. We strongly believe that the complete and meticulous surgical resection of the uncinate process *en bloc* with all the peripancreatic tissues between the artery and the pancreatic parenchyma must become the standard surgical approach in pancreatic head resection. Meanwhile, the standardization of histological examination is not only necessary to provide accurate prognostic information, but may represent a significant step forward in the design of future randomized controlled trials and the optimization of adjuvant treatment strategies.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

References

1 Alexakis N, Halloran C, Raraty M, Ghaneh P, Sutton R. Neoptolemos JP Current standards of surgery for pancreatic cancer. Br J Surg. 2004; 91:1410-1427.

2 Benassai G, Mastrorilli M, Quarto G, Cappiello A, Giani U, Forestieri P, *et al.* Factors influencing survival after resection for ductal adenocarcinoma of the head of the pancreas. J Surg Oncol. 2000; 73:212-218.

3 Han SS, Jang JY, Kim SW, Kim WH, Lee KU, Park YH. Analysis of long-term survivors after surgical resection for pancreatic cancer. Pancreas. 2006; 32:271-275.

4 Moon HJ, An JY, Heo JS, Choi SH, Joh JW, Kim YI. Predicting survival after surgical resection for pancreatic ductal adenocarcinoma. Pancreas. 2006; 32:37-43.

5 Raut CP, Tseng JF, Sun CC, Wang H, Wolff RA, Crane CH, *et al.* Impact of resection status on pattern of failure and survival after pancreaticoduodenectomy for pancreatic adenocarcinoma. Ann Surg. 2007; 246:52-60.

6 Winter JM, Cameron JL, Campbell KA, Arnold MA, Chang DC, Coleman J, *et al.* 1423 pancreaticoduodenectomies for pancreatic cancer: a single-institution experience. J Gastrointest Surg 2006; 10:1199-1210; discussion 1210–1211.

7 Neoptolemos JP, Stocken DD, Dunn JA, Almond J, Beger HG, Pederzoli P, *et al.* Influence of resection margins on survival for patients with pancreatic cancer treated by adjuvant chemoradiation and/or chemotherapy in the ESPAC-1 randomized controlled trial. Ann Surg. 2001; 234:758-768.

8 Oettle H, Post S, Neuhaus P, Gellert K, Langrehr J, Ridwelski K, *et al.* Adjuvant chemotherapy with gemcitabine vs observation in patients undergoing curative-intent resection of pancreatic cancer: a randomized controlled trial. JAMA. 2007; 297:267-277.

9 Sohn TA, Yeo CJ, Cameron JL, Koniaris L, Kaushal S, Abrams RA, *et al.* Resected adenocarcinoma of the pancreas – 616 patients: results, outcomes, and prognostic indicators. J Gastrointest Surg 2000; 4:567-579.

10 Pingpank JF, Hoffman JP, Ross EA, Cooper HS, Meropol NJ, Freedman G, *et al.* Effect of preoperative chemoradiotherapy on surgical margin status of resected adenocarcinoma of the head of the pancreas. J Gastrointest Surg 2001; 5:121-130.

11 Wagner M, Redaelli C, Lietz M, Seiler CA, Friess H, Buchler MW. Curative resection is the single most important factor determining outcome in patients with pancreatic adenocarcinoma. Br J Surg. 2004; 91:586-594.

12 Kuhlmann KF, de Castro SM, Wesseling JG, ten Kate FJ, Offerhaus GJ, Busch OR, *et al.* Surgical treatment of pancreatic adenocarcinoma; actual survival and prognostic factors in 343 patients. Eur J Cancer 2004; 40:549-558.

13 Howard TJ, Krug JE, Yu J, Zyromski NJ, Schmidt CM, Jacobson LE, *et al.* A margin-negative R0 resection accomplished with minimal postoperative complications is the surgeon's contribution to long-term survival in pancreatic cancer. J Gastrointest Surg 2006; 10:1338-1345; discussion 1345–1346.

14 Westgaard A, Tafjord S, Farstad IN, Cvancarova M, Eide TJ, Mathisen O, *et al.* Resectable adenocarcinomas in the pancreatic head: the retroperitoneal resection margin is an independent prognostic factor. BMC cancer. 2008; 8:5.

15 Van den Broeck A, Sergeant G, Ectors N, Van Steenbergen W, Aerts R, Topal B Patterns of recurrence after curative resection of pancreatic ductal adenocarcinoma. Eur J Surg Oncol 2009; 35:600-604.

16 Fatima J, Schnelldorfer T, Barton J, Wood CM, Wiste HJ, Smyrk TC, *et al.* Pancreatoduodenectomy for ductal adenocarcinoma: implications of positive margin on survival. Arch Surg 2010; 145:167-172.

17 Hartwig W, Hackert T, Hinz U, Gluth A, Bergmann F, Strobel O, *et al.* Pancreatic cancer surgery in the new millennium: better prediction of outcome. Ann Surg. 2011; 254:311-319.

18 Ferrone CR, Pieretti-Vanmarcke R, Bloom JP, Zheng H, Szymonifka J, Wargo JA, *et al.* Pancreatic ductal adenocarcinoma: long-term survival does not equal cure. Surgery. 2012; 152(Suppl 1):S43-S49.

19 Bilimoria KY, Talamonti MS, Sener SF, Bilimoria MM, Stewart AK, Winchester DP, *et al.* Effect of hospital volume on margin status after pancreaticoduodenectomy for cancer. J Am Coll Surg 2008; 207:510-519.

20 Menon KV, Gomez D, Smith AM, Anthoney A, Verbeke CS. Impact of margin status on survival following pancreatoduodenectomy for cancer: the Leeds Pathology Protocol (LEEPP). HPB (Oxford). 2009; 11:18-24.

21 Jamieson NB, Denley SM, Logue J, MacKenzie DJ, Foulis AK, Dickson EJ, *et al.* A prospective comparison of the prognostic value of tumor- and patient-related factors in patients undergoing potentially curative surgery for pancreatic ductal adenocarcinoma. Ann Surg Oncol 2011; 18:2318-2328.

22 Rau BM, Moritz K, Schuschan S, Alsfasser G, Prall F, Klar E. R1 resection in pancreatic cancer has significant impact on long-term outcome in standardized pathology modified for routine use. Surgery. 2012; 152:S103–S111.

23 Gnerlich JL, Luka SR, Deshpande AD, Dubray BJ, Weir JS, Carpenter DH, *et al.* Microscopic margins and patterns of treatment failure in resected pancreatic adenocarcinoma. Arch Surg 2012; 147:753-760.

24 Fortner JG. Regional resection of cancer of the pancreas: a new surgical approach. Surgery. 1973; 73:307-320.

25 Michalski CW, Kleeff J, Wente MN, Diener MK, Buchler MW, Friess H. Systematic review and meta-analysis of standard and extended lymphadenectomy in pancreaticoduodenectomy for pancreatic cancer. Br J Surg. 2007; 94:265-273.

26 Buchler MW, Kleeff J, Friess H. Surgical treatment of pancreatic cancer. J Am Coll Surg 2007; 205(Suppl):S81-S86.

27 Verbeke CS, Leitch D, Menon KV, McMahon MJ, Guillou PJ, Anthoney A. Redefining the R1 resection in pancreatic cancer. Br J Surg. 2006; 93:1232-1237.

28 Esposito I, Kleeff J, Bergmann F, Reiser C, Herpel E, Friess H, *et al.* Most pancreatic cancer resections are R1 resections. Ann Surg Oncol. 2008; 15:1651-1660.

29 Wittekind C, Klimpfinger M, Sobin LM. *UICC: TNM Atlas. Illustrierter Leitfaden zur TNM/pTNM-Klassifikation maligner Tumoren*. Berlin, Heidelberg, New York: Springer 2005.

30 Campbell FBM, Foulis AJ. *Minimum dataset for histopathological reporting of pancreatic, ampulla of vater and bile duct carcinoma*. London: Royal College of Pathologists; 2002.

31 Verbeke CS. Resection margins and R1 rates in pancreatic cancer – are we there yet?. Histopathology. 2008; 52:787-796.

32 Verbeke CS, Menon KV. Redefining resection margin status in pancreatic cancer. HPB (Oxford). 2009; 11:282-289.

33 Edge SB, Byrd DR, Compton CC, Fritz AG, Greene FL, Trotti A. *AJCC Cancer Staging Manual*. 7th ed. New York: Springer 2010.

34 Sobin L, Gaspodarowicz M, Wittekind C. *TNM classification of malignant tumors*. 7th ed. New York: Wiley Blackwell 2009.

35 Hruban RH, Pitman MB, Klimstra DS. Tumors of the pancreas. *Atlas of tumor pathology*. Washington: Armed Forces Institute of Pathology 2007.

36 Konstantinidis IT, Warshaw AL, Allen JN, Blaszkowsky LS, Castillo CF, Deshpande V, *et al.* Pancreatic ductal adenocarcinoma: is there a survival difference for R1 resections versus locally advanced unresectable tumors? What is a 'true' R0 resection?. Ann Surg. 2012; 257:731-736.

37 Yeo CJ, Cameron JL, Lillemoe KD, Sohn TA, Campbell KA, Sauter PK, *et al.* Pancreaticoduodenectomy with or without distal gastrectomy and extended retroperitoneal lymphadenectomy for periampullary adenocarcinoma, part 2: randomized controlled trial evaluating survival, morbidity, and mortality. Ann Surg. 2002; 236:355-366; discussion 366–368.

38 Geer RJ, Brennan MF. Prognostic indicators for survival after resection of pancreatic adenocarcinoma. Am J Surg 1993; 165:68-72; discussion 73.

39 Kayahara M, Nagakawa T, Ueno K, Ohta T, Takeda T, Miyazaki I. An evaluation of radical resection for pancreatic cancer based on the mode of recurrence as determined by autopsy and diagnostic imaging. Cancer1993; 72:2118-2123.

40 Westerdahl J, Andren-Sandberg A, Ihse I. Recurrence of exocrine pancreatic cancer – local or hepatic? Hepatogastroenterology. 1993; 40:384-387.

41 Sperti C, Pasquali C, Piccoli A, Pedrazzoli S. Recurrence after resection for ductal adenocarcinoma of the pancreas. World J Surg. 1997; 21:195-200.

42 Verbeke CS, Gladhaug IP Authors' reply: resection margin involvement and tumour origin in pancreatic head cancer (*Br J Surg* 2012; 99: 1036–1049). Br J Surg. 2012; 100:299.

43 Verbeke CS, Gladhaug IP. Resection margin involvement and tumour origin in pancreatic head cancer. Br J Surg. 2012; 99:1036-1049.

44 Campbell F, Smith RA, Whelan P, Sutton R, Raraty M, Neoptolemos JP, *et al.* Classification of R1 resections for pancreatic cancer: the prognostic relevance of tumour involvement within 1 mm of a resection margin. Histopathology. 2009; 55:277-283.

45 Gaedcke J, Gunawan B, Grade M, Szoke R, Liersch T, Becker H, *et al.* The mesopancreas is the primary site for R1 resection in pancreatic head cancer: relevance for clinical trials. Langenbecks Arch Surg 2010; 395:451-458.

46 Jamieson NB, Foulis AK, Oien KA, Going JJ, Glen P, Dickson EJ, *et al.* Positive mobilization margins alone do not influence survival following pancreatico-duodenectomy for pancreatic ductal adenocarcinoma. Ann Surg 2010; 251:1003-1010.

47 Katz MH, Wang H, Balachandran A, Bhosale P, Crane CH, Wang X, *et al.* Effect of neoadjuvant chemoradiation and surgical technique on recurrence of localized pancreatic cancer. J Gastrointest Surg 2012; 16:68-78; discussion 79.

48 Richter A, Niedergethmann M, Sturm JW, Lorenz D, Post S, Trede M. Long-term results of partial pancreaticoduodenectomy for ductal adenocarcinoma of the pancreatic head: 25-year experience. World J Surg. 2003; 27:324-329.

49 Yeo CJ, Cameron JL, Sohn TA, Lillemoe KD, Pitt HA, Talamini MA, *et al.* Six hundred fifty consecutive pancreaticoduodenectomies in the 1990s: pathology, complications, and outcomes. Ann Surg1997; 226:248-257; discussion 257–260.

50 Nishimura Y, Hosotani R, Shibamoto Y, Kokubo M, Kanamori S, Sasai K, *et al.* External and intraoperative radiotherapy for resectable and unresectable pancreatic cancer: analysis of survival rates and complications. Int J Radiat Oncol Biol Phys 1997; 39:39-49.

51 Compton CC, Henson DE. Protocol for the examination of specimens removed from patients with carcinoma of the exocrine pancreas: a basis for checklists. Cancer Committee, College of American Pathologists. Arch Pathol Lab Med. 1997; 121:1129-1136.

52 Luttges J, Vogel I, Menke M, Henne-Bruns D, Kremer B, Kloppel G. The retroperitoneal resection margin and vessel involvement are important factors determining survival after pancreaticoduodenectomy for ductal adenocarcinoma of the head of the pancreas. Virchows Arch 1998; 433:237-242.

53 Chatelain D, Flejou JF. Pancreatectomy for adenocarcinoma: prognostic factors, recommendations for pathological reports. Ann Pathol. 2002; 22:422-431.

54 Luttges J, Zamboni G, Kloppel G. Recommendation for the examination of pancreaticoduodenectomy specimens removed from patients with carcinoma of the exocrine pancreas. A proposal for a standardized pathological staging of pancreaticoduodenectomy specimens including a checklist. Dig Surg. 1999; 16:291-296.

55 Riall TS, Cameron JL, Lillemoe KD, Campbell KA, Sauter PK, Coleman J, *et al.* Pancreaticoduodenectomy with or without distal gastrectomy and extended retroperitoneal lymphadenectomy for periampullary adenocarcinoma – part 3: update on 5-year survival. J Gastrointest Surg 2005; 9:1191-1204; discussion 1204–1206.

56 Noto M, Miwa K, Kitagawa H, Kayahara M, Takamura H, Shimizu K, *et al.* Pancreas head carcinoma: frequency of invasion to soft tissue adherent to the superior mesenteric artery. Am J Surg Pathol. 2005; 29:1056-1061.

57 Gockel I, Domeyer M, Wolloscheck T, Konerding MA, Junginger T. Resection of the mesopancreas (RMP): a new surgical classification of a known anatomical space. World J Surg Oncol. 2007;5:44.

58 Nagakawa T, Nagamori M, Futakami F, Tsukioka Y, Kayahara M, Ohta T, *et al.* Results of extensive surgery for pancreatic carcinoma. Cancer. 1996; 77:640-645.

59 Tsuchiya R, Noda T, Harada N, Miyamoto T, Tomioka T, Yamamoto K, *et al.* Collective review of small carcinomas of the pancreas. Ann Surg. 1986; 203:77-81.

60 Khalifa MA. Intraoperative assessment of the Whipple resection specimen. J Clin Pathol. 2007; 60:975-980.

61 Khalifa MA, Maksymov V, Rowsell CH, Hanna S. A novel approach to the intraoperative assessment of the uncinate margin of the pancreaticoduodenectomy specimen. HPB (Oxford) 2007; 9:146-149.

The femoral artery–femoral vein polytetraflouroethylene graft for haemodialysis patients: when should it be implemented?

Khalid Mowafy[a], Samer Regal[a], Tamer Abd El-Hai[a], Ahmed Zaki[b], Ehab Saad[a]

[a]Department of Surgery, Vascular Surgery Unit, [b]Department of Surgery, General Surgery Unit, Mansoura University Hospital, Mansoura, Egypt

Correspondence to Khalid Mowaphy, MD, Department of Surgery, Vascular Surgery Unit., Mansoura University Hospital, 35516, Mansoura, Egypt
Tel: 0502359588, 0502303525
e-mail: khalid-mowaphy@yahoo.com

Received 6 March 2014
Accepted 12 April 2014

The Egyptian Journal of Surgery
2014, 33:140–145

Background
Patients who are no longer candidates for upper-extremity haemodialysis arteriovenous (AV) grafts or fistulae present a difficult problem. The vascular surgeons at Mansoura University Hospital used a loop AV graft in the thigh in 30 patients with end-stage renal failure during the period from January 2008 to January 2011.

Patients and methods
Patients in this retrospective study underwent femoral AV loop graft placement when there was no alternative access to the upper extremity. The primary and secondary patency rates were determined using the Kaplan–Meier method.

Results
The 30 patients who underwent a femoral AV loop polytetrafluoroethylene (PTFE) graft in the upper thigh had a mean follow-up of 18 months (range 4–36 months). Early access failure due to thrombosis was reported in two patients in the superficial femoral artery ($n = 26$) inflow group and due to infection in one patient in the common femoral artery group ($n = 4$).
The cumulative graft survival was calculated using the Kaplan–Meier analysis method and it was 93% in the sixth month, 87% at the end of the first year, and 71% after 24 months to reach 30% at the end of our study. There were no cases of limb amputation (0%) in our study, nor any incidences of operative deaths in our series.
Although strict aseptic procedures were adopted, the incidence of infection among the studied patients was 16.7% and it was responsible for final graft failure at the end of the study.

Conclusion
Finally, we found that the thigh PTFE graft had the advantage of long length, which enables different cannulation sites, easy use, and high flow, which reduces the thrombosis rate. It was a good alternative to exhausted upper-extremity access. Choice of the lower-extremity femoral AV graft should take into account the patient's comorbidities and peripheral vascular disease. Further research with randomized studies is required to consolidate our results.

Keywords:
haemodialysis, lower-extremity graft, vascular access

Egyptian J Surgery 33:140–145

1110-1121

Introduction

The access procedures and complications related to dialysis are important causes of morbidity and hospitalization among chronic haemodialysis patients. The number of complicated patients on dialysis is increasing, and creating a successful vascular access for these patients is a challenge [1].

An arteriovenous (AV) fistula remains the preferred choice for initial access, but polytetrafluoroethylene (PTFE) grafts have became an accepted alternative as they are easy to use and revise and withstand repeated cannulations for many years [2,3]. However, in the light of the ever-increasing number of patients with end-stage renal disease, the ageing dialysis population and their prolonged longevity, surgeons are increasingly encountered with difficult access problems, such as exhausted upper-extremity access sites and central venous outflow obstruction resulting from previous catheterization [4].

Patients who are no longer candidates for upper-extremity haemodialysis AV grafts or fistulas present a difficult problem. These patients usually have had multiple previous access surgeries, have been in renal failure for extended periods of time, and have multiple, severe medical comorbidities. Surgeons generally agree that upper-extremity haemodialysis options are preferred. There are encouraging reports of good results with femoral AV grafts for haemodialysis as well as reports of relatively poor outcomes with these grafts [5,6].

In January 2008 a femoral artery vein (saphenofemoral junction) loop PTFE graft was first used in our unit in HD patients. This retrospective study details the clinical results obtained in 30 thigh grafts performed until January 2011.

The purpose of this study was to review and analyse the patency rate and specific adverse events complicating lower-extremity vascular access, as identified by

the Society for Vascular Surgery and the American Association for Vascular Surgery, to assess safety and durability and patient factors that influence outcome.

Patients and methods

The Mansoura Vascular Surgery Unit used a loop AV graft in the thigh in 30 patients with end-stage renal failure over a 3-year period (from January 2008 to January 2011); the lower extremity was used when no other permanent access site was available (exhausted upper limbs).

Exclusion criteria

(1) Presence of proximal aortoiliac occlusion.
(2) Presence of diabetic femoropopliteal and tibioperoneal ischaemia.
(3) Previous ipsilateral femoral vein catheterization or a history of DVT.
(4) Patient refusal.

The studied patients were identified through a review of their medical records. Data obtained included demographic information (age and sex), baseline clinical information (type of disease leading to end-stage renal failure, medical comorbidities, number of previous access operations, the reason for femoral access), data on the access operation (date of operation, inflow vessel used, outflow vessel used, size of graft used), and information on the postoperative course (complications, date and reason for graft failure, number and efficacy of graft salvage procedures).

Primary graft failure requires an intervention to restore patency at an access site, including surgical interventions such as thrombectomy. Final graft failure precipitates abandoning an access site. Primary patency continues until primary graft failure. Secondary patency continues until final graft failure.

The median patency values were calculated for 36 months following access construction. Graft patency and patient survival were determined using the Kaplan–Meier method. Groups were compared with the log-rank test.

Graft survival was defined as the period of time from grafting until failure of the graft due to any reason or until patient death. In our study no differentiation was made between primary and secondary patency. Surgical thrombectomy was performed whenever needed and the graft patency rate was determined according to the reporting standards set by the committee of reporting standards for AV haemodialysis access [7].

Grafts that were functioning on last follow-up examination but were discontinued for reasons other than failure, such as death (three patients) or transplantation (one patient), were censored in the survival analysis.

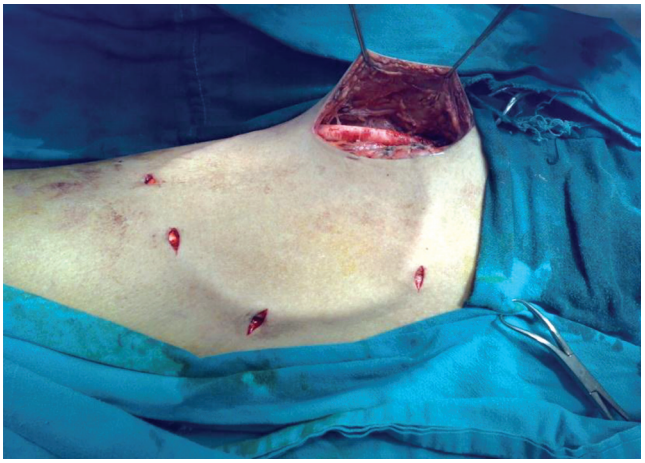
Surgical procedure

All procedures were carried out under either spinal anaesthesia (n = 28) or local anaesthesia. The lower abdomen and the thigh down to the ipsilateral knee were prepared. A bolus of 1 g vancomycin was given 1 h before surgery.

The surgical procedure is as follows: a longitudinal incision of the skin (~6 cm) is made below the inguinal ligament over the anteromedial aspect of the thigh. The superficial femoral artery, below its exit from the common femoral artery, and the saphenofemoral and its branches are exposed. A lateral longitudinal arteriotomy (1–15 mm long) is made into the superficial femoral artery. A PTFE graft (internal diameter 6 mm) is cut obliquely, and its end positioned to the arteriotomy opening. The graft is then tunnelled inferiorly in the subcutaneous plane. The distal end of the loop lies ~8–10 cm superiorly to the knee. At this area a further skin incision is made to ensure that no kinks are present in the graft. The graft is then turned superiorly in the subcutaneous plane until it reaches the exposed saphenofemoral junction. The average length of the loop is ~25–30 cm. The graft is cut obliquely, and a venograft anastomosis is made in an end-to-side manner with the saphenous vein stump at the sapheno-femoral junction and superficial femoral artery (SFJ) (Fig. 1).

After both venous and arterial clamps are removed, immediate thrill should be palpated over the entire graft to assure success of the technique.

Figure 1



A loop arteriovenous (AV) femoral artery–femoral vein polytetrafluoroethylene graft.

In our study, complete aseptic techniques were performed and a bolus of vancomycin (1 g) was given 1 h before surgery and maintained for 2 days postoperatively.

Cannulation of the graft is recommended after 10–14 days, but immediate cannulation can be performed without anticoagulation.

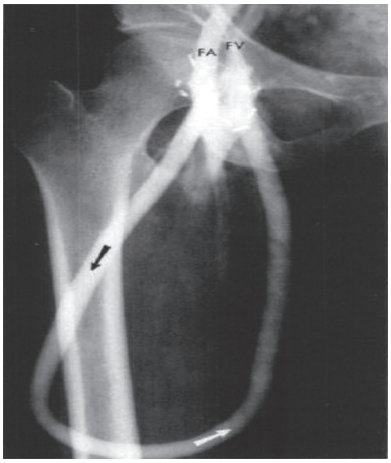
Postoperative low-dose aspirin (81 mg) was given to all patients. Postoperative follow-up after discharge was carried out in the outpatient clinic of the Vascular Surgery Unit, and a failing graft was suspected when venous pressures were high or when prolonged bleeding after decannulation was noted. In such cases a colour duplex screening and CT angiography were performed (two cases) (Fig. 2).

Results

Patient characteristics

In this study, 30 patients underwent femoral AV graft placement: in 29 (96.7%) because of lack of upper-limb venous outflow and in one patient (3.3%) because of lack of arterial inflow as determined on duplex study. The mean age at the time of operation was 50 years (range 35–70 years). Of the 30 patients, 21 were male (70%) and nine were female (30%). The mean follow-up duration was 18 months (range 4–36 months). The mean number of previous access operations was 3.93 (interquartile range 2–6), and 20% (six patients) of patients had undergone five previous procedures and six patients (20%) had undergone three previous procedures (Table 1).

Figure 2



Postoperative CT angiography showing a patent polytetrafluoroethylene graft between the femoral artery and the femoral vein.

In 26 operations the SFA was the inflow for the graft and in 30 operations (100%) the outflow vein was SFJ.

In our study early access failure due to thrombosis was reported in two patients (in the sixth and seventh months) in the common femoral artery (CFA) inflow group (n = 4) and due to infection in one patient (3.8%) in the SFA group (n = 26).

In this study, 22 patients (73.3%) had no ischaemic symptoms postoperatively, nor during the follow-up period, in both groups. In contrast, eight patients (26.7%) suffered from ischaemic symptoms, which were severe and was life-threatening in one patient (3.3%) in the CFA group (n = 4).

No intraoperative mortality and no limp amputation was needed.

Re-exploration was carried out in three patients (10%): because of bleeding in two patients and because of threatened ischaemia in one (3.3%). Graft thrombectomy was carried out successfully for 14 grafts (46.7%) with a mean time of 10 months (range 1–24 months).

Graft survival

Accordingly, the cumulative graft patency was 93% at the end of 6 months, 87% at the end of the first year and 71% after 2 years. Finally it reached 30% at the end of 3 years (Kaplan–Meier, Fig. 3).

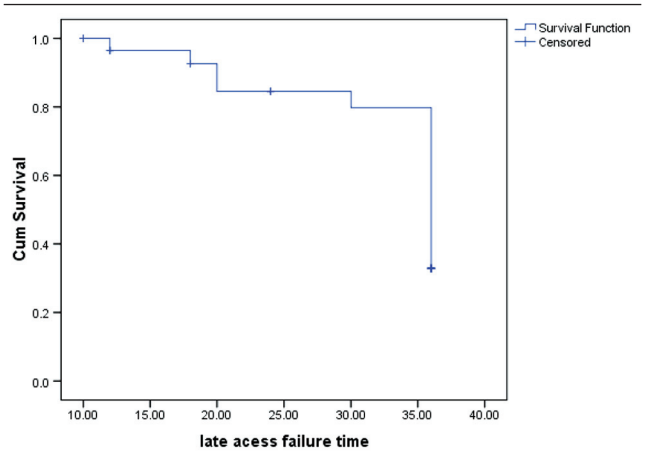
Statistical methods

(1) Clinical data were collected from the patients' clinical records and analysed using statistical package for social sciences, version 11. (IBM SPSS Software http://www.ibm.com/us/en/).

Table 1 Characteristics of the studied patients

Item	n (%)	
Age (years) [mean (SD)]	50.9 (9.6)	
Follow-up [mean (SD)] (months)	18.4 (8.8)	
Number of previous accesses [mean (SD)]	3.9 (0.9)	
Sex		
Males	21 (70)	
Females	9 (30)	
Reason for femoral AV graft	No venous outflow in the upper limb 29 (96.7)	No arterial inflow in the upper limb1 (3.3)
Inflow artery		
SFA	26 (86.7)	
CFA	4 (13.8)	
Outflow vein		
SFJ	30 (100)	

Figure 3



Survival function.

(2) Qualitative data were presented as number and percentage.
(3) Quantitative data were presented as mean and SD.
(4) The Kaplan–Meier method was used to estimate the patency rate for the group. A *P* value less than 0.05 was considered significant.

Discussion

Haemodialysis is dependent upon the construction, maintenance and preservation of a good vascular access. As the longevity of the haemodialysed patient has increased, and as increasing numbers of both elderly and diabetic patients are being chronically dialysed, the problems associated with vascular access have grown. As a result, ~25% of hospitalized days in haemodialysis patients are now related to vascular access malfunction [8].

Unfortunately, autogenous access is often impossible because of the obliteration of important superficial veins by prior medical intervention. After exhausting the other possibilities in the two upper extremities, we used a synthetic graft in the upper extremity. In patients with primarily unsuitable or secondarily surgically exhausted arm sites, a thigh fistula, either native with a saphenous vein or as a bridge graft, can be performed. We have used an alternative by way of a PTFE AV access graft placed in the thigh between the femoral artery and the saphenous vein.

The first PTFE loop femoral AV fistula was performed in January 2008 in our unit and was a success. This was considered when planning for alternative access for failed native AV fistula.

The majority of authors of the reviewed papers agree that vascular access in the lower extremities should be attempted only in select patients, when all other access sites in the upper extremities have been exhausted, there is severe pathology in the central vein trunks and, possibly, when patients are not suitable candidates for peritoneal dialysis. Nevertheless, some authors used patient's preference as one of the criteria for lower-extremity AV access construction, as it allows two-handed self-cannulation, leaves both hands free during dialysis and provides a better cosmetic appearance, especially for young women as the dialysis site is hidden under their skirt [9,10].

In our series, all patients were selected after all upper-limb trials had been exhausted – that is, no venous outflow (29 patients) or poor inflow arteries (one patient). They had to have an intact lower limb arterial and deep venous system and unsuitable long saphenous vein (atretic) due to previous attacks of thrombophlebitis or due to a previous harvest.

Several recently published studies have reported the outcome of prosthetic thigh AV access. The conclusions drawn by these studies differ dramatically. Some suggest that thigh AV access is safe, with excellent long-term patency, whereas others consider it a procedure of last resort, because of the high rate of complications, such as infection and arterial steal [6,11,12].

In a study published in 2006, the secondary patency rate was only 41% at 1 year with more than half of the patients requiring reoperation for graft salvage. These results were attributable to patient selection and referral patterns and severe medical comorbidities. Almost half of the patients had a significant perioperative surgical complication with graft thrombosis (17%); these patients were morbidly obese, which has been reported to be a risk factor for thrombosis and early access failure; 27% of grafts were lost because of infection [13].

The most prohibitive reported shortcomings associated with lower-extremity vascular access are infection and ischaemic complications. In an attempt to avoid placement of a prosthetic material in the potentially contaminated area of the groin and preserve proximal femoral vessels for later use, the upper-thigh loop technique was further modified by placing the graft along a subcutaneous loop channel over the anterior mid-thigh region, increasing the distance to the groin and the urogenital area [14,15].

However, in a recent study by Antoniou *et al.* [16] there was no difference in infection rates between upper and mid-thigh groups of AV access. In our study all grafts

were placed in the groin, and mid-thigh loop grafts may need to be studied further.

In our study, the infection rate was 16.7% (five patients) and graft thrombectomy was performed in 14 patients (46.7%). Re-exploration for graft salvage was performed in three cases: in two cases because of bleeding, which was managed successfully by redo in the veno-anastomotic suture line, and in one patient because of threatened limb ischaemia and steal syndrome, which was managed by refashioning the arterial anastomosis.

There was no amputation related to our thigh graft in any of our patients, and no operative death in our series.

The National Kidney Foundation Guidelines do not favour catheters for haemodialysis access, stating that fewer than 10% of chronic haemodialysis patients should be maintained on catheters [17]. The reason for such disfavour is the poor blood flow through the catheter with resultant inadequate haemodialysis and an increased rate of systemic infection with the need for hospitalization compared with AV grafts [18].

In our experience, the only option is a femoral AV graft or a cuffed tunnelled catheter. The AV graft is generally a better option owing to high rates of infection in chronic indwelling femoral catheters.

In addition, several preventive measures have been proposed to keep infection rate at low levels, including perioperative prophylactic antibiotics and meticulous attention to an aseptic technique at the time of cannulation [19].

In our study a complete aseptic technique was implemented and a bolus of vancomycin (1 g) was given 1 h before surgery and it was maintained for 2 days postoperatively.

It has been suggested that preoperative screening for peripheral arterial disease with a detailed clinical evaluation and duplex ultrasound scanning and/or arteriography, when required, be performed in all patients scheduled for lower-extremity vascular access construction [20].

In our study, eight patients (26.7%) suffered from different grades of ischaemia postoperatively, which was severe and limb threatening in one patient (SFA group) and was re-explored and dealt with by refashioning the arterial anastomosis. Postoperative CT angiography was performed and the patient showed a patent graft and restoration of the infrapopliteal flow in the immediate postoperative period; however, the graft was removed later because of reanastomosis ischaemic symptoms.

In our study, all grafts used were 6 mm in diameter to decrease the incidence of ischaemia especially in diabetic patients. Other series used the 4–7 mm stepped graft where the 4 mm limb to the artery and 7 mm end to the vein, but we used the 6 mm diameter PTFE graft in all our patients. In our series we did not use the split 4–7 mm PTFE grafts.

Finally, we found that the thigh PTFE graft had the advantage of long length, which enabled different cannulation sites, easy use and high flow, which reduces graft thrombosis. The loop technique helps to dissipate high arterial pressure throughout the graft, and this also reduces thrombosis. The disadvantage of this technique includes the high risk of amputation if the graft is excised because of infection as the possibility of risk of arterial ligation is higher than that of repair of the arteriotomy.

Conclusion

Lower-extremity vascular access is increasingly used as an alternative access site in patients unsuitable for upper-extremity AV access creation and when the saphenous veins are unsuitable for femoral artery saphenous vein fistula creation. Our review has shown that it has acceptable results in terms of patency. Autogenous access was also found to be associated with fewer infective complications compared with prosthetic AV access, although at the expense of increased ischaemic complication rates. It seems that the type of lower-extremity vascular access should be chosen by taking into account the patient's comorbidities, such as peripheral arterial disease. However, because of the retrospective nature of most of the studies included in this systematic review and the great variability in the reporting outcomes, our results should be approached with caution. Further research with randomized controlled trials is required in the future.

Finally, we found that thigh PTFE graft has the advantage of long length, which enables different cannulation sites, easy use and high flow, which reduces the thrombosis rate. It is a good alternative to exhausted upper-extremity accesses; choice of the lower-extremity femoral AV graft should take into account the patient's comorbidities and presence of peripheral vascular disease. Further research with randomized studies is required to consolidate our results (Tables 2–4).

Table 2 Patients' medical comorbidities and causes of renal failure in our studied group

Causes of renal failure (%)	
DM	20
Hypertension	20
Obstructive uropathy	16.7
Unknown	16.7
Polycystic kidney	10
Glomerulonephritis	3.3
Systemic lupus erythromatosis (SLE)	13.3
Patients comorbidity (%)	
Hypertension	46.7
DM	36.6
Coronary artery disease	16.6
Obesity (BMI>40)	6.6

DM, diabetes mellitus.

Table 3 Graft salvage procedures

Procedures	*n* (%)
Graft thrombectomy	14 (46.7)
Lymphocele drainage	2 (6.7)
Re-exploration	3 (10)

Table 4 Causes of graft removal (late access failure)

Graft removal cause	*n* (%)
Rethrombosis with failed thrombectomy	6 (20)
Infection	5 (16.7)
Excess bleeding	2 (6.7)
Threatened ischaemia	1 (3.3)

Acknowledgements

Conflicts of interest

None declared.

References

1 Brescia MJ, Cimino JE, Appel K *et al.* Chronic haemodialysis using venipuncture and surgically created arteriovenous fistula. N Eng J Med 1966; 275: 1089-1092.

2 Fan P, Schwab J Vascular access: concepts for the 1990s. J Am Soc Nephrol 1992; 3: 1-11.

3 Schuman ES, Gross GF, Hayes JF *et al.* Long term patency of polytetrafluoroethylene graft fistulas. Am J Surg 1988; 155: 644-646.

4 Antoniou GA, Lazarides MK, Georgiadis GS Lower-extremity arteriovenous access for haemodialysis: a systemic review. Eur J Vasc Endovasc Surg 2009; 38:365-372.

5 Tashjian DB, Lipkowitz GS, Madden RL, *et al.* Safety and efficacy of femoral-based haemodialysis access grafts. J Vasc Surg 2002; 35: 691-693.

6 Cull JD, Cull DL, Taylor SM *et al.* Prosthetic thigh arteriovenous access: outcome with SVS/AAVS reporting standards. J Vasc Surg 2004; 39: 381–386.

7 Sidawy AN, Gray R, Besarab A *et al.* Recommended standards for reports dealing with arteriovenous haemodialysis accesses. J Vasc Surg 2002; 35:603-610.

8 Albers FJ Causes of haemodialysis access failure. Adv Renal Replace Ther 1994; 1:107-118.

9 Khadra MH, Dwyer AJ, Thompson JF Advantages of polytetrafluoroethylene arteriovenous loops in the thigh for haemodialysis access. Am J Surg 1997; 173:280-283.

10 Bhandari S, Wilkinson A, Sellars L Saphenous vein forearm grafts and gortex thigh grafts as alternative forms of vascular access. Clin Nephrol 1995; 44:325-328.

11 Tashjian DB, Lipkowits GS, Madden RL *et al.* Safety and efficacy of femoral-based haemodialysis access grafts. J Vasc Surg 2002; 35: 691-693.

12 Flarap S, Hadimeri H Arteriovenous PTFE dialysis access in the lower extremity: a new approach. Ann Vasc Surg 2003; 17:581-584.

13 Englesbe MJ, Al-Holou WN, Mayer AT *et al.* Single centre review of femoral arteriovenous grafts for haemodialysis. World J Surg 2006; 30: 171-175.

14 Bagul A, Kaushik M, Kay MD *et al.* An alternative vascular access technique for haemodialysis; the loop mid-thigh graft. Ann R Coll Surg Engl 2006; 88:500-501.

15 Scott JD, Cull DL, Kalbaugh CA *et al.* The mid-thigh loop arteriovenous graft: patient selection, technique, and results. Am Surg 2006; 72: 825-828.

16 Antoniou GA, Luzarides MK, Georhiadis GS *et al.* Lower extremity arteriovenous access for haemodialysis: a systematic review. Eur J Vasc Endovasc Surg 2009; 38:365-372.

17 National Kidney Foundation, DOQI clinical practice guidelines for vascular access 2001. New York: National Kidney Foundation. Available at: www.kidney.org [Last accessed on 2014 Mar 15].

18 Oliver MJ, Callery SM, Thorpe KE *et al.* Risk of bacteremia from temporary haemodialysis catheters by site of insertion and duration of use: a prospective study. Kidney Int 2000; 58:2543-2545.

19 Ryan SV, Calligaro KD, Dougherty MJ Management of haemodialysis access infections. Semin Vasc Surg 2004; 17:40-44.

20 Miller CD, Robbin ML, Barker J *et al.* Comparison of arteriovenous grafts in the thigh and upper extremities in haemodialysis patients. J Am Soc Nephrol 2003; 14:2942-2947.

Outcomes of brachiobasilic arteriovenous shunting with superficialization as a vascular access for renal dialysis: an early experience in Benha University

El-Sayed A. Abd El-Mabood[a], Mokhtar A. Bahbah[a], Ayman M. Adbelmofeed[a], Hazem E. Ali[a], M. Hamed Abd El-Fattah[b], Mohamed I. Hasan[c]

Departments of [a]General Surgery, [b]Anesthesia and Intensive Care, [c]Radiology, Benha University, Benha, Egypt

Correspondence to El-Sayed A. Abd El-Mabood, MD, Department of General Surgery, Benha University, 3A Elharamen Pharmacy Street, Benha, Egypt
Tel: +0133265694;
e-mail: elsayedafifi@yahoo.com

Received 20 March 2014
Accepted 2 April 2014

The Egyptian Journal of Surgery
2014, 33:146–153

Purpose
The aim of the study was to assess outcomes of brachiobasilic arteriovenous fistula (BBAVF) under ultrasound (US)-guided supraclavicular block with or without superficialization and of brachiocephalic arteriovenous fistula in patients with vessels unsuitable or failed for a forearm fistula.

Patients and methods
The study included 75 patients diagnosed with end-stage renal failure. They were divided into three equal groups (n = 25) according to the site of fistula: group 1 underwent BBAVF (one-stage), group 2 underwent BBAVF (two-stage with 1-month interval), and group 3 underwent brachiocephalic arteriovenous fistula, all with end-to-side anastomosis under US-guided supraclavicular block.

Results
There was significant difference in the diameter of arm veins between the first two groups and the third group (P = 0.01), especially using supraclavicular block. Despite group 1 had the longest operative time (82.02 ± 11.39), it had the shortest duration of maturation and the best mean flow rate (ml/min) (P = 0.0004 and 0.004, respectively). The frequency of early postoperative complications — that is, primary access failure and early thrombosis (first 10 days) — and late complications — that is, late thrombosis more than 10 days and pseudoaneurysm — was less in group 1 (P = 0.05).

Conclusion
Despite one-stage BBAVF takes long operative time, it appears to be the most ideal vascular access, with high success rate, shortest duration of maturation, best mean flow rate, and less postoperative complications, and surgical redo with its complications is also less especially using US-guided supraclavicular block.

Keywords:
arteriovenous fistula, outcomes, renal dialysis, superficialization, ultrasound-guided supraclavicular block

Egyptian J Surgery 33:146–153

1110-1121

Introduction

In recent years, the number of patients requiring hemodialysis (HD) has been rapidly increasing globally; arteriovenous fistula (AVF) is the most frequently used method in patients with end-stage renal failure (ESRF) for HD [1].

The Kidney Disease Outcome Quality Initiative recommends autologous radiocephalic or brachiocephalic arteriovenous fistula (BCAVF) as a primary method of choice in HD patients and basilic vein transposition as a secondary option [2].

Placement of an autogenous AVF for dialysis is an important step in end-stage renal disease patients. Dialysis access is a lifeline for such patients; hence, its maturation and continued function are crucial for overall well-being [3].

Fistula maturation is a general term used to refer to multiple processes that occur from the time of surgical fistula construction HD access until the time the AVF becomes functional [4].

The desired end result of fistula maturation is a high-flow, large-caliber, superficial vessel with robust wall structure suitable for repeated reliable dialysis needle access [5]. Criteria for assessment of maturation have been proposed as the role of sixes, which states that, by 6 weeks after surgical creation, the fistula should measure 6 mm or greater in diameter, 6 mm or less deep from the skin surface, with flow of 600 ml/min or more and a usable length of 6 cm or more; these parameters are relatively easy to quantitate and provide a useful starting point for assessment of fistula maturity [6].

 DOI: 10.4103/1110-1121.141899

The first step in the process of creating a high-quality functional AVF is a well-performed surgical construction utilizing the artery–vein pair based upon appropriate clinical and/or ultrasound (US) preoperative vascular assessment [7]. Patients with chronic renal failure may suffer from serious complications that represent a great challenge to the anesthesiologists. Complications such as congestive heart failure, systemic hypertension, electrolyte imbalances, metabolic acidosis, coagulopathy, unpredictable intravascular fluid volume status, and anemia obligate the anesthesiologist to avoid general anesthesia with its heroic risks in these patients and to think for alternative methods [8].

Brachial plexus block is often used in chronic renal failure patients to provide anesthesia for the creation or revision of AVF for HD access. It provides analgesia, sympathetic blockade, optimal surgical conditions, and adequate duration of postoperative block that prevents arterial spasm and graft thrombosis. It provides higher blood flow in the radial artery and AVF than is achieved with infiltration anesthesia [9].

Many approaches can be used for brachial plexus block: axillary, supraclavicular, and infraclavicular approaches. They were commonly performed by blind techniques or neurostimulation, which may be associated with high failure rate and serious complications. Nowadays, the intraoperative use of ultrasonography has become more popular and much easier. Its use in these blocks increases the success rate and decreases complications [10].

Patients and methods

After local ethical committee of Benha University approval and obtaining written fully informed patients consent, the current study was conducted at the General Surgery Department, Benha University Hospital from March 2011 to August 2013 so as to allow 6-month follow-up period for the last case operated on. This prospective randomized controlled study was conducted on 75 patients diagnosed with ESRF ASA III, including 43 (57.3%) male patients and 32 (42.7%) female patients with age strata; most patients were aged between 40 and 60 years (n = 45, 60%). Patients were randomly allocated using a computer-generated random number table into three equal groups according to the site of fistula: group 1 that underwent brachiobasilic arteriovenous fistula (BBAVF) (one-stage) (n = 25), group 2 that underwent BBAVF (two-stage with 1-month interval) (n = 25), and group 3 that underwent BCAVF (n = 25), all with end-to-side anastomosis under US-guided supraclavicular block, if failed local infiltration anesthesia. Postoperative follow-up was 3–6 months.

All patients presenting were subjected to detailed clinical evaluation, laboratory assessment, and arterial and venous duplex US imaging study with vessel mapping for assuring the preparation.

Patients with both patent basilic and cephalic veins greater than 3 mm of diameter as well as with triphasic arterial inflow were randomly arranged to the BBAVF and BCAVF groups by computerized allocation. All fistulae were placed in patients with vessels unsuitable for a forearm fistula or with a failed forearm fistula.

Exclusion criteria in this study included previous BBAVF or BCAVF, age younger than 18 years, less than 3 mm of diameter of the brachial artery at the elbow, absence of radial or ulnar artery pulses, less than 3 mm of diameter of the basilic and cephalic veins in any location in the upper arm, inability to obtain patient consent or refusal of the patient to undergo US-guided supraclavicular block, and history of hypersensitivity reaction to local anesthesia or coagulation disorder.

Operative procedure

All procedures were performed under US-guided supraclavicular block performed by an anesthesiologist and radiologist using US machine (Chison L45607S, China) with curved-array probe (7.5 MHz).

The patient was placed in the supine position with head tilted to the opposite side; the skin was disinfected; transducer was positioned in the transverse plane superior to the midpoint of the clavicle, tilted inferior to obtain the cross-section view; a 25–27-G needle was used, with insertion not more than 1 cm to avoid injury to the brachial plexus; and the needle place was confirmed by motor response or nerve stimulation using (0.5 mA, 0.1 ms) injection of 25–30 ml of l-bubivacaine. Intraoperative duplex ultrasonography was used to assess the diameter of vein before and after block.

In group 1, the incision was performed through the basilic vein located in the medial condyle of the humerus and axillary area. The vein was carried over the fascia by tying the lateral branches during release of the basilic vein, whereas the medial cutaneous nerve of the forearm was preserved. The basilic vein in the antecubital fossa was anastomosed to the brachial artery end-to-side, using 6-0 or 5-0 polypropylene continuous sutures. Following evaluation of the presence of thrill, the fascia and other layers were closed, lifting the vein and protecting the nerve. One and a half month was allowed for the anastomosed graft to heal before the possible trauma of HD injection [11–13] (Fig. 1).

In group 2, the incision was made through the basilic vein located in the medial and lateral condyle of the humerus and was anastomosed to the brachial artery laterally using 6-0 or 5-0 polypropylene continuous suture. The incisions were closed in the anatomical layers after the presence of thrill was evaluated. In the next stage at 1 month, an incision was made through the basilic vein located in the medial condyle of the humerus and the axillary area. The vein was carried over the fascia by tying the lateral branches during the release of the basilic vein, whereas the medial cutaneous nerve of the forearm was preserved. Following the evaluation of the presence of thrill, the fascia and other layers were closed in anatomical layers, lifting the vein and protecting the nerve. Patients whose wounds had healed after 40 days underwent HD [14–16] (Fig. 2).

In group 3, BCAVFs were created by making a transverse incision just proximal to the elbow as previously described elsewhere. The cephalic vein was dissected free and transected at the level of elbow. Subsequently, the anastomosis was performed as described in BBAVF. Additional care was taken to secure hemostasis at the end of the procedure. The systemic heparin was not used either intraoperatively or postoperatively [11,17] (Fig. 3).

Technical success was defined as the presence of a palpable thrill on the fistula at completion of the procedure and 24 h postoperatively.

Outcome items

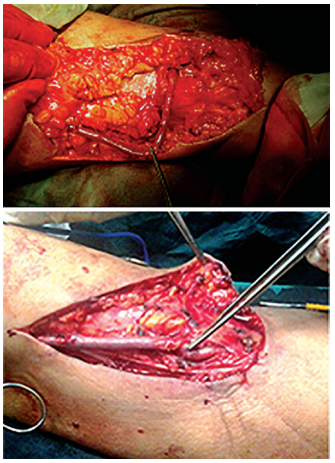
Postoperative follow-up was performed for duration of maturation (mean) (days), mean flow rate (ml/min), and complications, either early complications that included primary access failure (by early thrombosis), bleeding, or hematoma or late complications that included late thrombosis, pseudoaneurysm (circumscribed dilatation, either fusiform or saccular, of a vascular access more than twice of diameter of the preceding and following segments of access; when the aneurysm becomes rapidly enlarged, inflamed, or symptomatic, ligation was undertaken to prevent rupture and bleeding) [13], steal syndrome, or wound infection.

All interventions were recorded, such as mechanical thrombectomy, aneurysm ligation, and successful endovascular treatment, but when failure is inevitable surgical revision was performed.

Statistical analysis

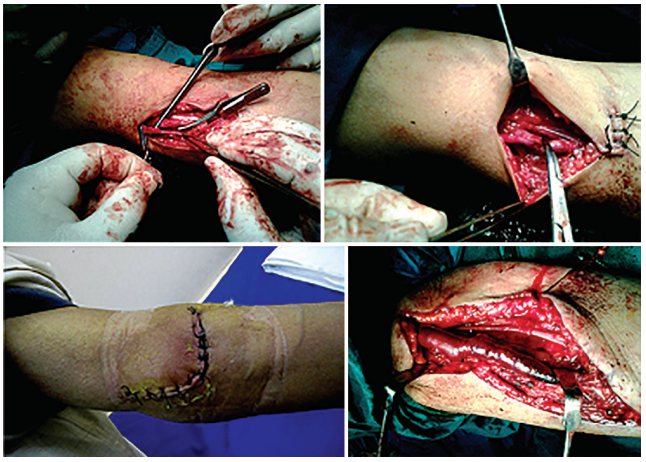
Analysis of data was performed using SPSS version 16 (Bristol university; UK). Quantitative data were presented as mean and SD and were analyzed by analysis of variance test. Qualitative data was presented as numbers and percentages and were analyzed using the χ^2-test. *P*-value less than 0.05 was considered significant and *P*-value less than 0.01 was considered

Figure 1



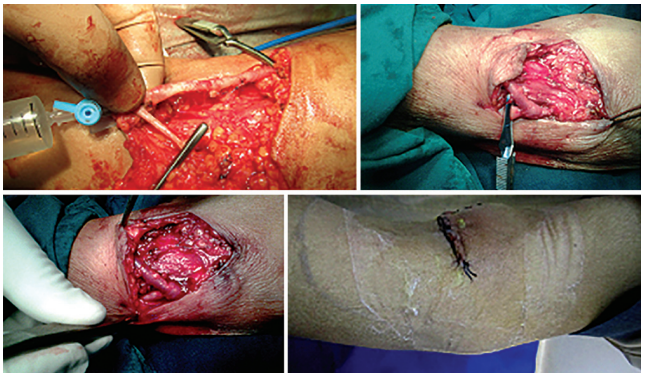
Brachiobasilic arteriovenous fistula (one-stage).

Figure 2



Brachiobasilic arteriovenous fistula (two-stage): first stage and second stage.

Figure 3



Brachiocephalic arteriovenous fistula.

highly significant, whereas *P*-value greater than 0.05 was considered insignificant.

All data were recorded in the following images: Fig. 1 for group 1, Fig. 2 for group 2, and Fig. 3 for group 3.

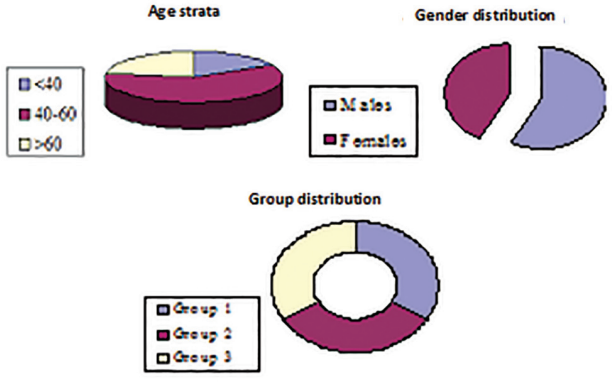
Results

This study included 75 patients who were diagnosed with ESRF, 43 (57.3%) male patients and 32 (42.7%) female patients with age strata; most patients were aged between 40 and 60 years (n = 45, 60%). Patients of this study were divided into three equal groups according to the site of fistula: group 1 that underwent BBAVF (one-stage) (n = 25), group 2 that underwent BBAVF (two-stage with 1-month interval) (n = 25), and group 3 that underwent BCAVF (n = 25). Associated morbidities — that is, diabetes, hypertension, or smoking — had no significance (Table 1 and Graph 1).

Most of the fistulae of this study were located at nondominant arm, group 1: 20 (80%), group 2: 21 (84%), and group 3: 19 (76%), and most of them were performed in the first month after dialysis, group 1: 24 (96%), group 2: 22 (88%), and group 3: 24 (96%). There were some patients who had previous access dialysis (Table 2 and Graph 2).

Diameter of the arm veins was greater than 3 mm with respect to the first two groups (P = 0.01): basilic vein, 3.9 ± 0.88, and cephalic vein, 3.44 ± 0.14; this can be explained by the fact that cephalic vein is more superficial, and hence is more exposed to the repeated intravenous injection, more fibrosis, and narrowing, but basilic vein is deep. After US brachial plexus block, there was dilatation of the vein diameter significantly, especially the basilic one (4.21 ± 0.93) (P = 0.0033, highly significant); this depends on the fact that cephalic vein is exposed to fibrosis, and hence

Graph 1



Preoperative data.

Table 1 Preoperative data

Preoperative data	Group 1	Group 2	Group 3	χ^2	P
Age (years)					
<40	13 (17.3)				
40–60	45 (60)				
>60	17 (22.7)				
Sex					
Male	43 (57.3)				
Female	32 (42.7)				
Site of AV fistula	BBAVF (one-stage) (n = 25)	BBAVF (two-stage with 1-month interval) (n = 25)	BCAVF (n = 25)		
Diabetes	6 (24)	8 (32)	9 (36)	0.8	0.6
Hypertension	12 (48)	17 (68)	15 (60)	2.08	0.35
Smoking	4 (16)	5 (20)	3 (12)	0.59	0.74

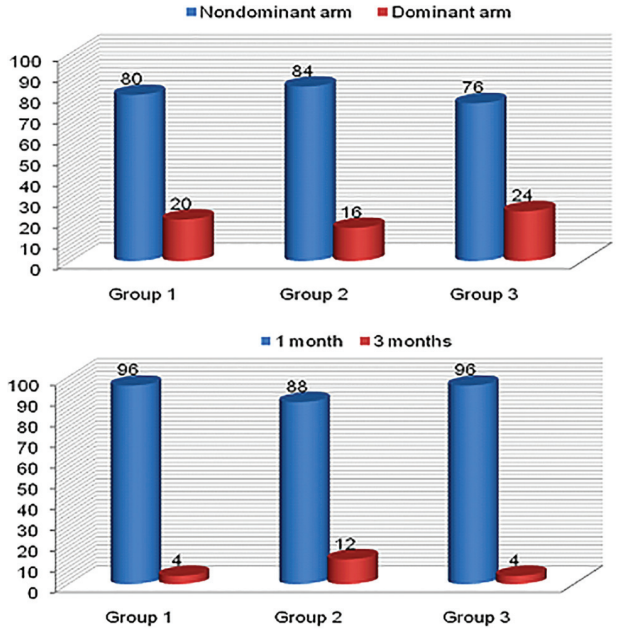
AV, arteriovenous; BBAVF, brachiobasilic arteriovenous fistula; BCAVF, brachiocephalic arteriovenous fistula.

Table 2 Fistula characteristics of patients with brachiobasilic arteriovenous fistula and brachiocephalic arteriovenous fistula

Fistula characteristics of patients	Group 1	Group 2	Group 3	χ^2	P
Location of AVF [n (%)]					
Nondominant arm	20 (80)	21 (84)	19 (76)	0.5	0.77
Dominant arm	5 (20)	4 (16)	6 (24)		
Timing of AVF in advance of dialysis [n (%)]					
1 month	24 (96)	22 (88)	24 (96)	1.7	0.42
3 months	1 (4)	3 (12)	1 (4)	1.7	0.42
Previous access dialysis	3 (12)	4 (16)	2 (8)	0.76	0.68

AVF, arteriovenous fistula.

Graph 2



Fistula characteristics of patients with brachiobasilic arteriovenous fistula and brachiocephalic arteriovenous fistula. AVF, arteriovenous fistula.

has less elasticity and distensibility — that is, basilic vein is better for anastomosis especially with the use of brachial plexus block [18]. However, there was no difference in brachial artery diameter before and after brachial plexus block (Table 3).

All patients underwent end-to-side anastomosis, with longest operative time in group 1 (82.02 ± 11.39), followed by group 2 (62.34 ± 3.17), and then group 3 (59.68 ± 9.16) (P = 0.00000045, highly significant compared with BCAVF). However, postoperative early revision was performed in three (12%) patients in group 1, one (4%) patient in group 2, and two (8%) patients in group 3; hence, the revision was insignificant (P = 0.58). Early revision was performed for massive leaking anastomosis or very narrow anastomosis affecting distal pulsation that might end by distal gangrene (Table 4).

Patients passed postoperative period and followed up for duration of maturation (mean) (days) (known by dialysis injection without hematoma or leaking), with group 1: 42 ± 14 days, group 2: 69 ± 23 days, and group 3: 45 ± 13 days; the maturation was highly significant toward group 1 (P = 0.0004). The mean flow rate (ml/min) was measured by duplex ultrasound, with group 1: 330 ± 26, group 2: 299 ± 32, and group 3: 310 ± 21; the rate was highly significant toward group 1 (P = 0.004) (Table 5).

Early postoperative complications — that is, primary access failure (very narrow anastomosis or early thrombosis) and early thrombosis (first 10 days) — were less in group 1; primary access failure was observed in one (4%) patient in group 1, three (20%) patients in group 2, and seven (28%) patients in group 3 (P = 0.05). Similar results were found in early thrombosis (P = 0.02). However, there was no significance in other early postoperative complications — that is, bleeding or hematoma — in all groups (P = 0.58 and 0.76, respectively) (Table 6 and Graph 3).

However, late postoperative complications — that is, late thrombosis more than 10 days and pseudoaneurysm — were less in group 1; late thrombosis was observed in two (8%) patients in group 1, six (24%) patients in group 2, and nine (36%) patients in group 3 (P = 0.05). Similar results were found in pseudoaneurysm (P = 0.05). However, there was no significance in other late postoperative complications — that is, steal syndrome or wound infection — in all groups (P = 0.85 and 0.8, respectively) (Table 7 and Graph 4).

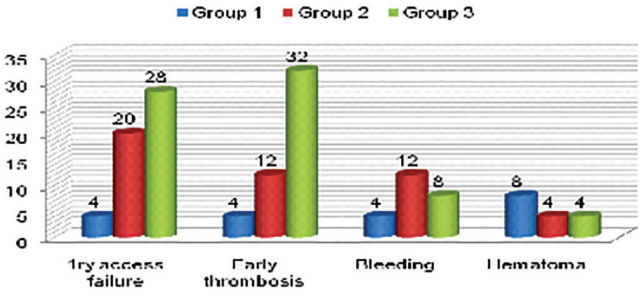
Finally, the success rate of AVF was significant (P = 0.03) in group 1, 23 (92%), with highest number of successful cases, followed by group 2, 18 (72%), and then group 3, 15 (60%); the patients with complications were treated well either by only mechanical thrombectomy (Fig. 4) (P = 0.03) or by aneurysm ligation (P = 0.15) or endovascular treatment (P = 0.7). However, in patients with inevitable failure, surgical revision was the treatment (P = 0.02) (Table 8 and Graph 5).

Table 3 Vascular characteristics of patients with brachiobasilic arteriovenous fistula and brachiocephalic arteriovenous fistula

Vascular characteristics of patients	Group 1	Group 2	Group 3	*F*	*P*
Diameter of vein before block (mm)	3.9 ± 0.88		3.44 ± 0.14	2.6	0.01
Diameter of vein after block (mm)	4.21 ± 0.93		3.54 ± 0.12	3.09	0.0033
Diameter of vein after local infiltration (mm)	3.9 ± 0.87		3.44 ± 0.14	2.6	0.01
Diameter of brachial artery before block (mm)	4.83 ± 1.5		4.85 ± 1.1	0.05	0.95
Diameter of brachial artery after block (mm)	4.83 ± 1.5		4.85 ± 1.1	0.05	0.95

Data are presented as mean ± SD.

Graph 3



Postoperative early complications in brachiobasilic arteriovenous fistula and brachiocephalic arteriovenous fistula.

Table 4 Perioperative characteristics in patients with brachiobasilic arteriovenous fistula and brachiocephalic arteriovenous fistula

Operative characteristics	Group 1	Group 2	Group 3	Test	*P*
Operative time (min)	82.02 ± 11.39	62.34 ± 3.17	59.68 ± 9.16	F = 11.4	0.00000045
Postoperative early revision	3 (12)	1 (4)	2 (8)	χ^2 = 1.08	0.58

Data are presented as mean ± SD and numbers (percentages are given in parentheses).

Table 5 Postoperative data in patients with brachiobasilic arteriovenous fistula and brachiocephalic arteriovenous fistula

Postoperative data	Group 1	Group 2	Group 3	*F*	*P*
Duration of maturation (days)	42 ± 14	69 ± 23	45 ± 13	4.5	0.0004
Mean flow rate (ml/min)	330 ± 26	299 ± 32	310 ± 21	2.9	0.004

Data are presented as mean ± SD.

Table 6 Postoperative early complications in brachiobasilic arteriovenous fistula and brachiocephalic arteriovenous fistula

Postoperative early complications	*n* (%)			χ^2	*P*-value
	Group 1	Group 2	Group 3		
Primary access failure	1 (4)	3 (12)	7 (28)	5.9	0.05
Early thrombosis	1 (4)	3 (12)	8 (32)	7.7	0.02
Bleeding	1 (4)	3 (12)	2 (8)	1.08	0.58
Hematoma	2 (8)	1 (4)	1 (4)	0.52	0.76

Table 7 Postoperative late complications in brachiobasilic arteriovenous fistula and brachiocephalic arteriovenous fistula

Postoperative late complications	*n* (%)			χ^2	*P*
	Group 1	Group 2	Group 3		
Late thrombosis>10 days	2 (8)	6 (24)	9 (36)	5.8	0.05
Pseudoaneurysm	1 (4)	3 (12)	7 (28)	5.9	0.05
Steal syndrome	3 (12)	2 (8)	2 (8)	0.31	0.85
Wound infection	1 (4)	2 (8)	2 (8)	0.4	0.8

Table 8 Postoperative access intervention/first year in brachiobasilic arteriovenous fistula and brachiocephalic arteriovenous fistula

Postoperative access intervention	*n* (%)			χ^2	*P*
	Group 1	Group 2	Group 3		
None (successful AVF)	23 (92)	18 (72)	15 (60)	6.9	0.03
Only mechanical thrombectomy	1 (4)	4 (16)	8 (32)	6.8	0.03
Aneurysm ligation	0 (0)	1 (4)	2 (8)	3.6	0.15
Successful treatment	1 (4)	1 (4)	2 (8)	0.5	0.7
Failed AVF needed surgical revision	1 (4)	3 (12)	8 (32)	7.7	0.02

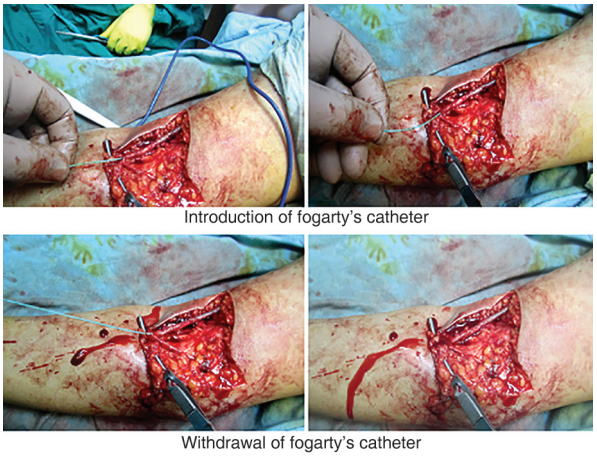
AVF, arteriovenous fistula.

Discussion

Patients with ESRF must receive HD to survive until they undergo renal transplantation. AVF surgery to supply extracorporeal blood flow has been performed for many years during HD [18]. The optimal flow rate is at least 200 ml/min with an easy-to-use device, providing sufficient supply in a durable and safe procedure [19,20]. For this purpose, arteries and veins of the upper limbs are mostly used.

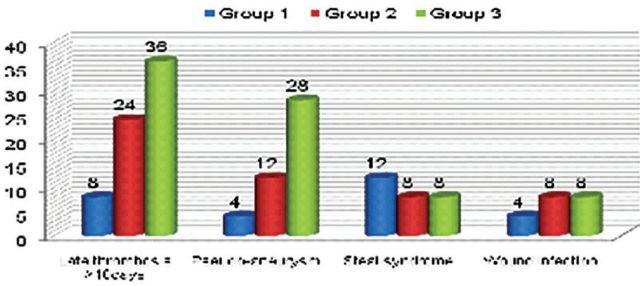
There are several theoretical advantages of selecting the basilic vein over the cephalic vein when considering AVF creation [21]. Unlike other veins in the arm, the basilic vein is naturally deep, protected from damage caused by previous venepuncture, and has a larger diameter [22]. However, these anatomical advantages lead to a more demanding, complex surgical dissection and prolong surgery. To manage these technical factors, the procedure is often performed under general anesthesia [23]. In this study, general anesthesia was replaced by US-guided brachial plexus block, which provided very satisfactory sensory and motor block in patients with chronic renal failure undergoing creation of AVF of the distal upper extremity [24].

Figure 4



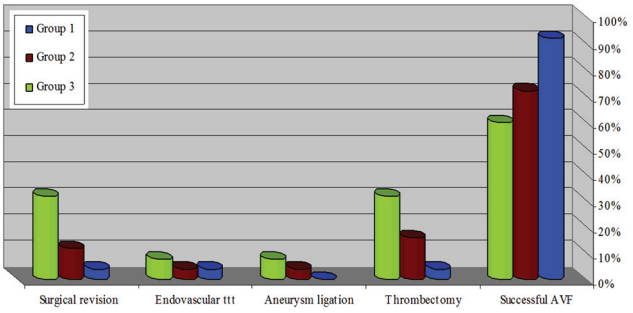
Mechanical thrombectomy.

Graph 4



Postoperative late complications in brachiobasilic arteriovenous fistula and brachiocephalic arteriovenous fistula.

Graph 5



Postoperative access intervention/first year in brachiobasilic arteriovenous fistula and brachiocephalic arteriovenous fistula. AVF, arteriovenous fistula; ttt, treatment.

This block provided very good analgesia that extended for a long time postoperatively. Patients were satisfied with this block, and no complications were reported. In addition, this helps a lot when a local cause such as swelling, infection, or obesity prevents the use of either of them. Hence, the other approach would work [25]. Moreover, brachial plexus block can induce dilatation of veins especially the basilic vein as the cephalic vein being exposed to repeated venepuncture; it is more fibrosed with less dispensability [26] in addition to this block gives the advantages of local anesthesia; safety, decrease len gth of hospitalization, and relatively low cost [27].

The proper location of AVFs and shunts must allow for the identification of landmarks to ensure successful needle access. Traditionally, AVFs located too deeply are superficialized with a formal surgical procedure. This procedure necessitates a larger incision and requires an extended healing time before the fistula may be accessed [28]. The current study evaluated the clinical outcomes of three types of upper arm vascular access; group 1 underwent one-stage BBAVF with superficialization and group 2 underwent two-stage BBAVF [29]. BBAVF upper arm fistulas had a substantially lower primary failure rate (suitability failure) and less early thrombosis — group 1, one (4%), and group 2, three (20%) — compared with BCAVFs — group 3, seven (28%) (P = 0.05) [30]. These results were mentioned by Silva *et al.* [31,32] who had reported a markedly lower primary failure rate of BBAVF.

One-stage BBAVF was superior to two-stage BBAVF because of its lower rate of postoperative early and late complications and higher early fistula maturation with better flow rate, despite its disadvantage of long operation time that needs general anesthesia, which was overcome by US-guided brachial plexus block in this study. This was due to larger diameter of the basilic vein observed in patients who underwent one-stage BBAVF, which led to decrease in postoperative complications and helped fistula maturation; this was mentioned by Kakkos *et al.* [1].

There were many factors affecting the fistula maturation in addition to vein diameter; postoperative hematoma and venous hypertension may be more important than the diameter of the vein. There was no significance in this finding in the three groups (P = 0.76 and 0.85, respectively) [22,33,34].

With respect to auxiliary interventions, the rate of intervention in group 1 was significantly less: only mechanical thrombectomy in one (4%) patient (P= 0.03) and surgical revision in one (4%) patient (P = 0.02). There was no statistically significant difference in auxiliary interventions due to pseudoaneurysm (P = 0.15) and steal syndrome (P = 0.85) between the three groups.

In conclusion AVF formation using BBAVF is a compelling procedure for the surgeon to avoid possible complications, including loss of function, infection, distal ischemia, and venous edema. Despite one-stage BBAVF takes long operative time, it appears to be the most ideal vascular access, with high success rate, less duration of maturation, best mean flow rate, and less postoperative complications — that is, primary access failure, thrombosis, or pseudoaneurysm — especially using US-guided supraclavicular block. One-stage BBAVF performed under US-guided supraclavicular block is of special importance in obese patients, and surgical redo with its complication is also less.

Acknowledgements

Conflicts of interest

None declared.

References

1 Kakkos SK, Haddad GK, Weaver MR, Haddad RK, Scully MM. Basilic vein transposition: what is the optimal technique? Eur J Vasc Endovasc Surg 2010; 39:612–619.

2 Foundation NK. KDOQI clinical practice guidelines and clinical practice recommendations for 2006 updates: hemodialysis adequacy, peritoneal dialysis adequacy and vascular access. Am J Kidney Dis. 2006; 48 (Suppl 1):1–322.

3 Meier GH: Hemodialysis Access: *Failing and Thrombosed Cronenwett: Rutherford's Vascular Surgery,* 7th ed. 1127-1136 Copyright © 2010 Saunders, an Imprint of Elsevier.

4 Besarab A, Work J: Clinical practice guidelines for vascular access. Am J Kidney Dis 48 Suppl.; 2006; 1:177: 247.

5 Depner T, Daugirdas J: Clinical practice guidelines for hemodialysis adequacy. Am J Kidney Dis; 48 Suppl.; 2006; 1:1: 90.

6 Mandolfo S, Borlandelli S, Ravani P, Imbasciati E. How to improve dialysis adequacy in patients with vascular access problems. J Vasc Access; 2006; 7: 53–59.

7 Stijnen T, Tordoir J, Burgmans J, *et al.* Radio-cephalic wrist arteriovenous fistula for hemodialysis: meta-analysis indicates a high primary failure rate. Eur J Vasc Endovasc Surg; 2004; 28: 583–589.

8 Holt NF. Renal disease. In: Hines RL, Marschall KE, editors. *Stoelting's anesthesia and co-existing disease*, 6th ed.; 2012; 339–356.

9 Sahin L, Gul R, Mizrak A, *et al.* Ultrasound-guided infraclavicular brachial plexus block enhances postoperative blood flow in arteriovenous fistulas. J Vasc Surg 2011; 54:749–753.

10 Arcand G, Williams SR, Chouinard P, *et al.* Ultrasound-guided infraclavicular versus supraclavicular block. Anesth Analg 2005; 101:886–890.

11 Mackrell PJ, Cull DL, Carsten III CG. Hemodialysis access: placement and management of complications. In: Hallett Jr JW, Mills JL, Earnshaw JJ, Reekers JA, editors. *Comprehensive vascular and endovascular surgery*. 1st ed. Edinburg: Mosby; 2004. 361–390.

12 Sidawy AN, Gray R, Besarab A, Henry M, Ascher E, Silva M Jr, *et al.* Recommended standards for reports dealing with arteriovenous hemodialysis accesses. J Vasc Surg 2002; 35:603–610.

13 Diskin C, Stokes TJ, Dansby LM, Radcliff L, Carter TB. Doxycyline may reduce the incidence of aneurysm in hemodialysis vascular accesses. Nephrol Dial Transplant 2005; 20:959–961.

14 Ascher E, Hingorani A, Gunduz Y, Yorkovich Y, Ward M, Miranda J, *et al.* The value and limitations of the arm cephalic and basilic vein for arteriovenous access. Ann Vasc Surg 2001; 15:89–97.

15 Rao RK, Azin GD, Hood DB, Rowe VL, Kohl RD, Katz SG, *et al.* Basilic vein transposition fistula: a good option for maintaining hemodialysis access site options? J Vasc Surg 2004; 39:1043–1047.

16 Choi HM, Lal BK, Cerveira JJ, Padberg FT, Silva MB, Hobson RW, *et al.* Durability and cumulative patency functional patency of transposed and nontransposed arteriovenous fistulas. J Vasc Surg 2003; 38:1206–1212.

17 Segal JH, Kayler LK, Henke P, Merion RM, Leavey S, Campbell DA. Vascular access outcomes using the transposed basilic vein arteriovenous fistula. Am J Kidney Dis 2003; 42:151–157.

18 Gelabert HA, Freischlag JA Hemodialysis access. In: Rutherford RB, editor. *Vascular surgery* 7th ed. Philadelphia: WB Saunders; 2010. 1466–1477.

19 Madran H, Ozgur B, Kursad S, Sakarya A, Erhan Y, Aydede H. Vascular interventions in chronic hemodialysis. Türkiye Klinikleri Kalp Damar Cer Derg. 2001; 2:38–47.

20 Saritas B, Okyay K, Yilmazturk H. Perforating vein-brachial artery anastomosis as an alternative to conventional arterio-venous fistulae for hemodialysis: mid-term follow-up results. Türkiye Klinikleri J Cardiovasc Sci. 2010; 22:200–205.

21 Dix FP, Khan Y, Al-Khaffaf H. The brachial artery-basilic vein arteriovenous fistula in vascular access for haemodialysis – a review paper. Eur J Vasc Endovasc Surg 2006; 31:70–79.

22 Woo K, Farber A, Doros G, Killen K, Kohanzadeh S. Evaluation of the efficacy of the transposed upper arm arteriovenous fistula: a single institutional review of 190 basilic and cephalic vein transposition procedures. J Vasc Surg 2007; 46:94–101.

23 Fitzgerald JT, Schanzer A, Chin AI, McVicar JP, Perez RV, Troppmann C. Outcomes of upper arm arteriovenous fistulas for maintenance hemodialysis access. Arch Surg 2004; 139:201–208.

24 Fredrickson MJ, Patel A, Young S, Chinchanwala S. Speed of onset of 'corner pocket supraclavicular' and infraclavicular ultrasound guided brachial plexus block: a randomized observer-blinded comparison. Anaesthesia 2009; 64:738–744.

25 Koscielniak-Nielsen ZJ, Frederiksen BS, Rasmussen H, *et al.*. A comparison of ultrasound-guided supraclavicular and infraclavicular blocks for upper extremity surgery. Acta Anesthesiol Scand 2009; 53:620–626.

26 Sandhu NS, Manne JS, Medabalmi PK, Capan LM. Sonographically guided infraclavicular brachial plexus block in adults: a retrospective analysis of 1146 cases. J Ultrasound Med 2006; 25:1555–1561.

27 Perlas A, Lobo G, Lo N, *et al.* Ultrasound guided supraclavicular block: outcome of 510 consecutive cases. Reg Anesth Pain Med 2009; 34:171–176.

28 Cull DL, Taylor SM, Carsten CG, *et al.* The fistula elevation procedure: a valuable technique for maximizing arteriovenous fistula utilization. Ann Vasc Surg 2002; 16:84–88.

29 Francis DM, Lu Y, Robertson AJ, Millar RJ, Amy J. Two-stage brachiobasilic arteriovenous fistula for chronic haemodialysis access. ANZ J Surg. 2007; 77:150–155.

30 Oliver MJ, McCann RL, Indridason OS, Butterly DW, Schwab SJ. Comparison of transposed brachiobasilic fistulas to upper arm grafts and brachiocephalic fistulas. 2001; Kidney Int 60: 1532–1539.

31 Silva MB, Hobson RW, Pappas PJ, Araki CT, Goldberg MC, Jamil Z, Padberg FT. Vein transposition in the forearm for autogenous hemodialysis access. J Vasc Surg 1997; 26:981–988.

32 Silva MB, Hobson RW, Pappas PJ, Jamil Z, Araki CT, Goldberg MC, *et al.* A strategy for increasing use of autogenous hemodialysis access procedures: impact of preoperative noninvasive evaluation. J Vasc Surg. 1998; 27:302–307.

33 Wolford HY, Hsu J, Rhodes JM, Shortell CK, Davies MG, Bakhru A *et al.* Outcome after autogenous brachial-basilic upper arm transpositions in the post-National Kidney Foundation Dialysis Outcomes Quality Initiative era. J Vasc Surg. 2005; 42:951–956.

34 Berman SS, Gentile AT: Impact of secondary procedures in autogenous arteriovenous fistula maturation and maintenance. J Vasc Surg 2001; 34:866–871.

Modified Gant–Miwa approach versus modified Thiersch's stitch for the management of rectal mucosal prolapse in children: how to decrease recurrence?

Taher H. Elwan, El-Sayed A. Abd El-Mabood, Hazem E. Ali

Department of General Surgery, Benha University, Benha, Egypt

Correspondence to El-Sayed A. Abd El-Mabood, MD, Department of General Surgery, Benha University, 3A Elharamen Pharmacy Street, Benha, Egypt
Tel: +0133265694;
e-mail: elsayedafifi@yahoo.com

Received 20 March 2014
Accepted 23 April 2014

The Egyptian Journal of Surgery
2014, 33:154–159

Purposes
The aim of this study was to assess the early outcomes and advantages of a modified Gant–Miwa approach for the treatment of rectal mucosal prolapse in children and determine how this modification helps decrease recurrence when compared with modified Thiersch's stitch in a prospective and randomized setting.

Background
Recurrence of rectal mucosal prolapse after rectal mucosal prolapse repair through the anus represents a problem for the surgeon and the patient. Although there are many trials to prevent this recurrence, a definite solution has not been found yet.

Patients and methods
The study included 60 children with rectal mucosal prolapse (mean age 3.6 ± 1.2 years) who were divided into two groups: group A ($N = 30$), comprising patients who underwent the modified Gant–Miwa operation, and group B ($N = 30$), comprising patients who underwent a modified Thiersch's prolene stitch.

Results
The modified Gant–Miwa operation was a successful approach with which to decrease constipation [2.0 (6.6%) vs. 9.0 (30%) cases; $P < 0.05$] and recurrence [1.0 (3.3%) vs. 5 (16.6%); $P = 0.0002$] to a great extent, although it was followed by more anal soiling in the first 2 weeks (11.3 ± 0.7 vs. 3.7 ± 0.2; $P > 0.05$).

Conclusion
The modified Gant–Miwa operation was a successful approach for decreasing early postoperative morbidity, especially constipation and recurrence, and thus incidences of surgical redo because of complications were also fewer, despite it being associated with more anal discharge especially in the first 2 weeks.

Keywords:
modified Gant–Miwa approach, modified Thiersch's stitch, outcomes, prolene suture, rectal mucosal prolapse

Egyptian J Surgery 33:154–159

1110-1121

Introduction

The rectum is located in the last 20 cm or so of the large bowel. It is the temporary storage area for bowel motions. Rectal prolapse was described as early as 1500 BC [1,2]. Rectal prolapse occurs when a mucosal or full-thickness layer of rectal tissue slides through the anal orifice. Problems related to fecal incontinence, constipation, and rectal ulceration are common [1,3,4].

The precise cause of rectal prolapse has not been defined; however, a number of associated abnormalities have been found. As many as 50% of prolapse cases are caused by chronic straining at defecation and constipation. A deep pouch of Douglas, a shallow sacral curvature, weakness of the pelvic floor, and decreased resting anal sphincter pressure have also been associated with rectal prolapse [5,6].

The symptoms of rectal prolapse depend on severity, but can include pain and discomfort, blood and mucus discharge from the anus, difficulty in passing a bowel motion, protrusion of the rectum through the anus, leakage of liquefied feces, particularly following a bowel motion or fecal incontinence, or reduced ability to control the bowel [7,8].

Rectal prolapse was more common 50 years ago than now, and this decreased occurrence is thought to be due to improved nutrition and hygiene in industrialized countries [5,6,9]. Prolapse of the rectum may involve only the mucosa for not more than 1.25–3.75 cm [1,2,5], which is the least serious form and is most common in the pediatric population, or it may involve all layers of the rectum protruding through the anus (procidentia) [9–12]. Most cases of childhood prolapse occur in patients younger than 4 years, with the highest incidence in the first 2 years of life [13–15].

Treatment depends on many individual factors, such as age of the person, severity of the prolapse, and

 DOI: 10.4103/1110-1121.141900

whether or not other pelvic abnormalities are present (such as prolapsed bladder). Patients who present with a prolapsed rectum should undergo manual reduction. Conservative management is appropriate in selected patients. Treatment should be directed at the underlying cause. After treating the underlying cause, conservative management is usually successful. Cases of difficult reduction and patients with recurrent episodes are less likely to respond to conservative measures [16].

Surgical treatment is reserved for patients who do not improve with conservative management or suffer from complicated rectal prolapse (e.g. recurrent rectal prolapse, painful episodes, ulceration, rectal bleeding) [17].

The present study added a modification to the Gant–Miwa approach by performing three stays sutures (absorbable suture material, polyglycolic acid) passed separately to plicate the mucosa from the dentate line to the end of the anal mucosal prolapse at 3, 7, and 11 o'clock positions.

Patients and methods

The study was conducted after obtaining approval from the local ethical committee of Benha University and written fully informed patient consent. It included 60 children with rectal mucosal prolapse (mean age 3.6 ± 1.2 years) from Benha University Hospital who were suitable candidates for surgery during the period between October 2012 and March 2014. A prospective, randomized trial was conducted to compare surgical treatment outcomes of rectal mucosal prolapse in children using the modified Gant–Miwa approach (group A; *N* = 30 cases) with management outcomes using the modified Thiersch's prolene stitch (group B; *N* = 30 cases) (Table 1 and Graph 1); the study population consisted of 33 (55%) female and 27 (45%) male children (Graph 2).

Inclusion criteria

The children included in this study were suffering from rectal mucosal prolapse resistant to conservative measures (such as treatment for constipation or diarrhea, treatment for parasitic infestation and intestinal infections, correction of malnutrition, and prevention of the wrong squatting position) or from complicated rectal mucosal prolapse (e.g. painful episodes, ulceration, rectal bleeding).

Exclusion criteria

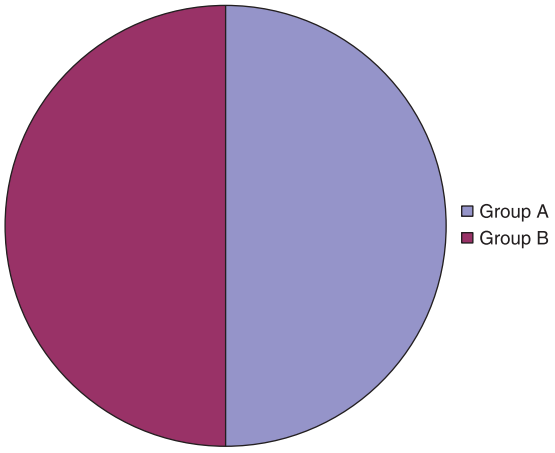
Children suffering from complete rectal prolapse or who were unfit for general anesthesia were excluded from this study.

All children were subjected to the following: full history taking to ascertain the number of prolapses and possibility of its reduction; a clinical examination [a general one performed in a meticulous way, including airways, vital signs, back, abdominal and skeletal examination (body weight), for determining fitness for surgery, and a local examination to detect the type of prolapse as well as for determining whether the patient was suffering from a partial prolapse of the rectal mucosa and the submucosa (but not the entire wall) (protrusion from the anus for more than 1.25–3.75 cm) or from a complete prolapse of the entire wall (protrusion more than 3.75 cm), with such

Table 1 Distribution of cases

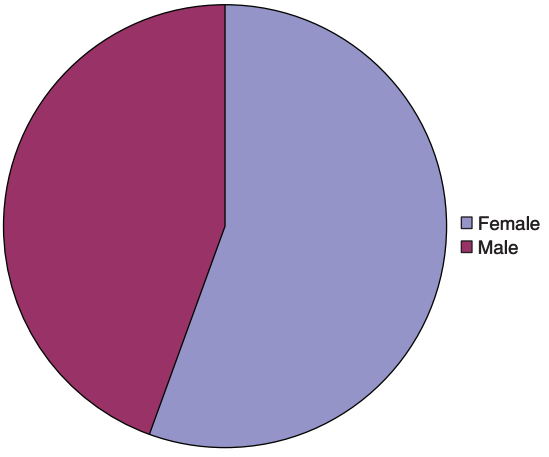
Groups	Group A [*N* (%)]	Group B [*N* (%)]
	30 (50)	30 (50)
Approach	Modified Gant–Miwa	Modified Thiersch's

Graph 1



Distribution of cases.

Graph 2



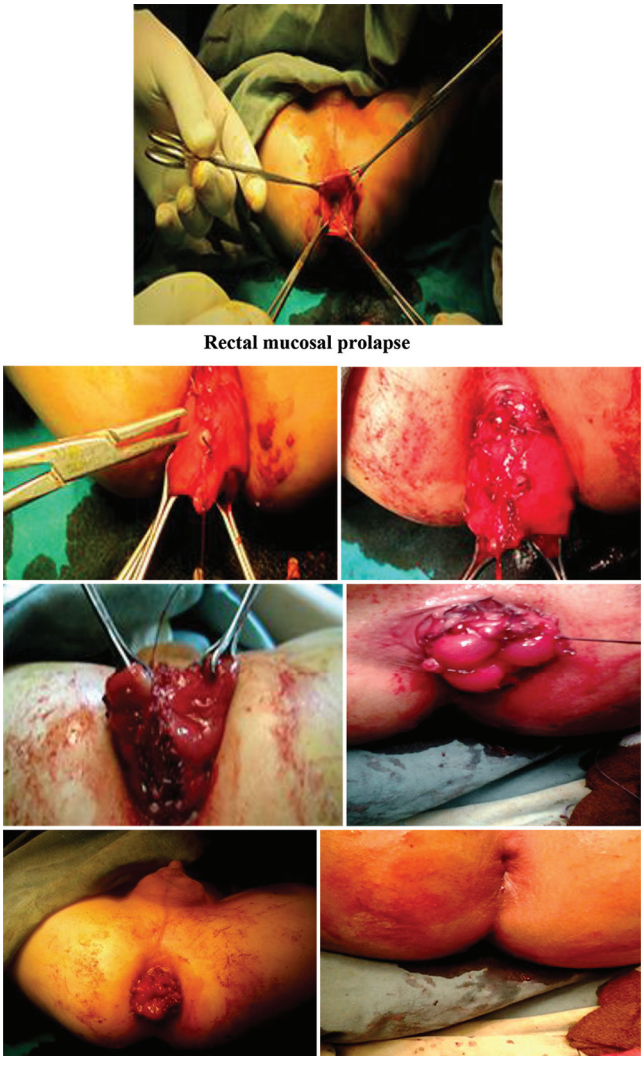
Sex distribution.

children being excluded]; and routine preoperative laboratory tests such as complete blood count, blood sugar level, and renal function tests.

Operative procedures

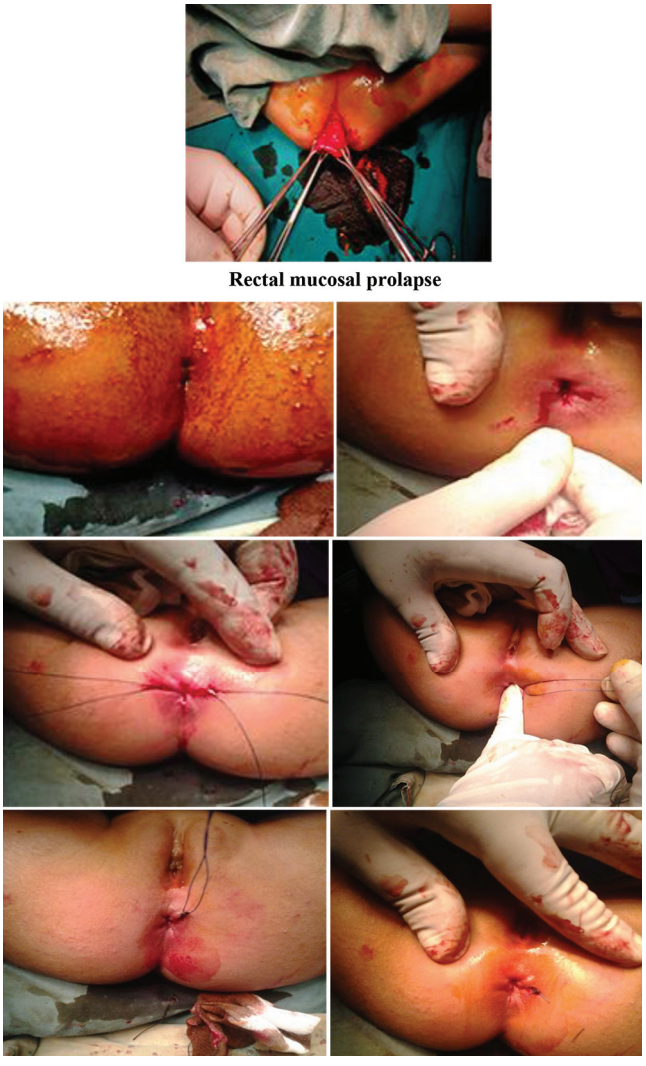
Both techniques in this study were implemented with the child under general anesthesia, in lithotomy position. In the modified Gant–Miwa approach traction was applied of the rectal mucosa through the anus, following Babcock's method; then three vertical stays sutures (absorbable suture material, polyglycolic acid) were passed separately to plicate the mucosa from the dentate line to the end of the anal mucosal prolapse at 3, 7, and 11 o'clock positions; this was followed by another mucosal plication using multiple transverse separate submucosal stitches that were arranged in lines (2-mm intervals) around the artery forceps grasping the rectal mucosa without incising the mucosa until the rectal mucosa was shortened and reduced; finally the three stays sutures were tied. All patients undergoing this procedure were categorized under group A (Fig. 1) [18]. In the modified Thiersch's prolene or nylon stitch technique, a 0.5-cm-long vertical incision in the midline at 1 cm anterior to the anal verge at 12 o'clock position and another 0.5-cm-long incision at 1 cm posterior to the anal verge in the skin and subcutaneous tissue at the 6 o'clock position were made. Then a zero nylon suture attached to a big curved needle (⅓rd circle, 50 mm) was introduced into the anterior incision subcutaneously backwards around the anal verge on one side, the tip of which emerged from the posterior incision. The needle was pulled out, and introduced into the same incision going anteriorly, subcutaneously, around the anal verge on the other side of the anus until the needle appeared from the anterior incision. The suture was tied over the terminal phalanx of the little finger of the assistant and was removed after 1–4 months. All children who underwent this procedure were categorized under group B (Fig. 2) [11,12,19].

Figure 1



Modified Gant–Miwa approach.

Figure 2



Modified Thiersch's prolene stitch.

Outcome items

Postoperative outcomes included incidence of anal discharge (soiling), as noted by the parents in the underwear of the child, constipation – that is, difficulty in defecation or fecal impaction during the first 6 weeks – and recurrence after removal of Thiersch's stitch after 4 months.

Statistical analysis

Data were analyzed using SPSS version 16 (Bristol University, Bristol, UK). Qualitative data are presented as numbers and percentages and compared between groups using *Z*-tests. *P*-values greater than 0.05 were considered insignificant; *P*-values less than 0.05 were considered statistically significant; and *P*-values less than 0.01 were considered highly statistically significant.

Results

The basal data of the two groups did not differ significantly. This study included 60 children; the number of patients was the same in the two groups (30 cases in each group) with a mean age of 3.6 ± 1.2 years. Indications for surgery were failed conservative measures or complicated partial rectal prolapse. Types of reduction of rectal prolapse were spontaneous, manual, or irreducible (Table 2 and Graph 3). All patients were fit for surgery. None of the patients were lost to follow-up, and data collection was complete.

The postoperative recurrence rate was significantly lower in children of group A [*N* = 1 case (3.3%)] compared with children of group B [*N* = 5 cases (16.6%); *P* = 0.0002; Table 3 and Graph 4).

Anal discharge in group A was significantly higher than in group B. This was known by observing the child's underwear for soiling, especially during the first 2 weeks (anal discharge: 11.3 ± 0.7 vs. 3.7 ± 0.2; *P*<0.05), after which there was no significant difference between the two groups (2.1 ± 0.3 vs. 1.9 ± 0.6; *P*>0.05; Table 4 and Graph 5).

As regards constipation, there were significantly fewer complaints by parents of children in group A compared with group B especially during the first week (2.0 vs. 9.0 cases; *P*<0.05; Table 5 and Graph 6).

In group A, two patients who developed constipation responded well to rectal enema and mild laxatives; however, among the nine patients in group B who developed constipation, six responded well to rectal enema and mild laxatives, whereas three patients did not respond to this conservative treatment and required their stitch to be opened and redone on a bigger-sized finger or dilator (Table 6and Graph 7).

Table 2 Types of reduction of partial rectal prolapse

Spontaneous [*N* (%)]	Manual [*N* (%)]	Irreducible [*N* (%)]
43 (71.7)	13 (21.6)	4 (6.7)

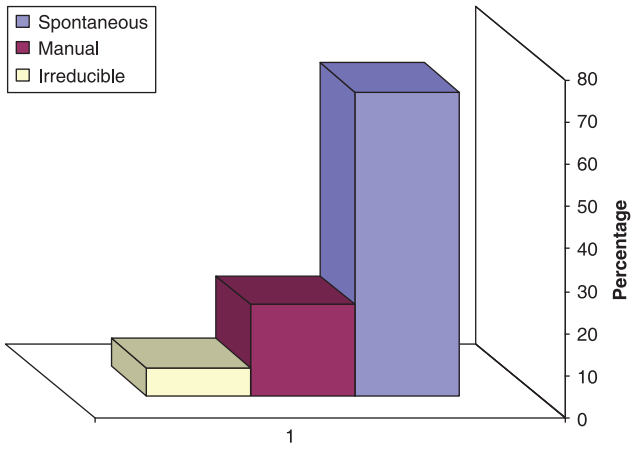
Table 3 Recurrence rate

Group A [*N* (%)]	Group B [*N* (%)]	*t*-value	*P*-value
1 (3.3)	5 (16.6)	4.496	0.0002 (high significance)

Table 4 Anal discharge assessment by observation

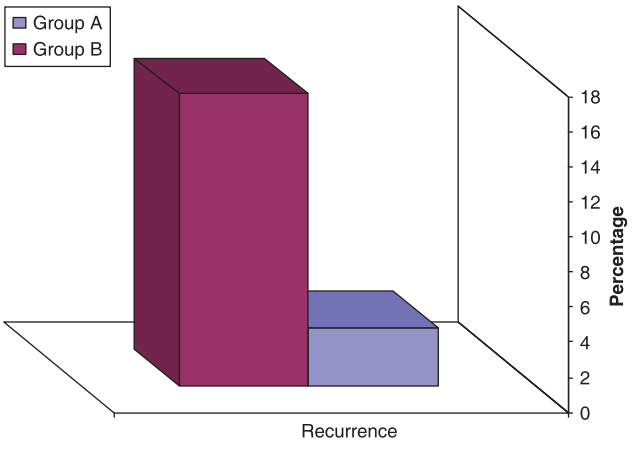
Anal discharge	Group A	Group B	*P*-value
First 2 weeks	11.3 ± 0.7	3.7 ± 0.2	<0.05 (significant)
After that	2.1 ± 0.3	1.9 ± 0.6	>0.05 (nonsignificant)

Graph 3



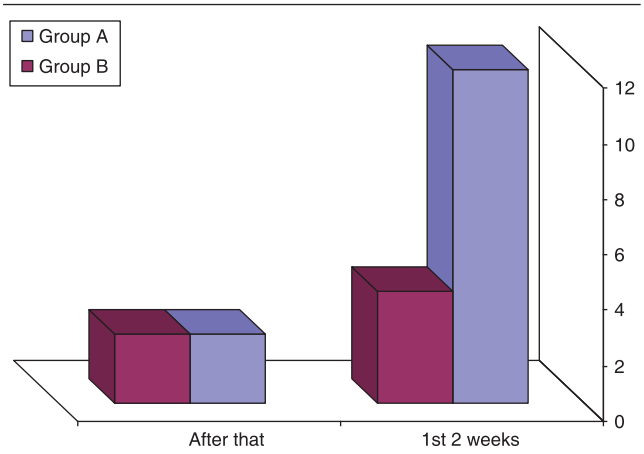
Type of reduction of rectal prolapsed.

Graph 4



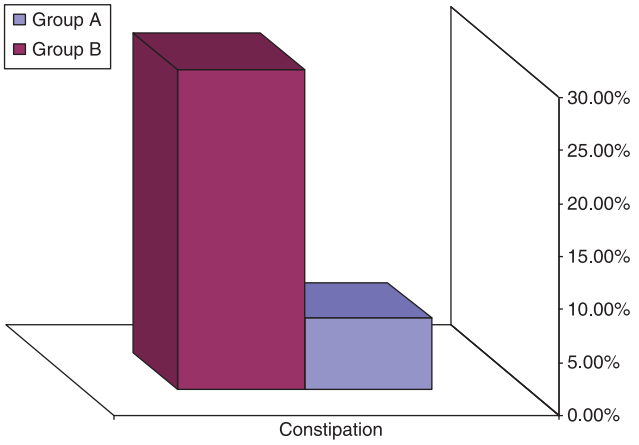
Recurrence rate.

Graph 5



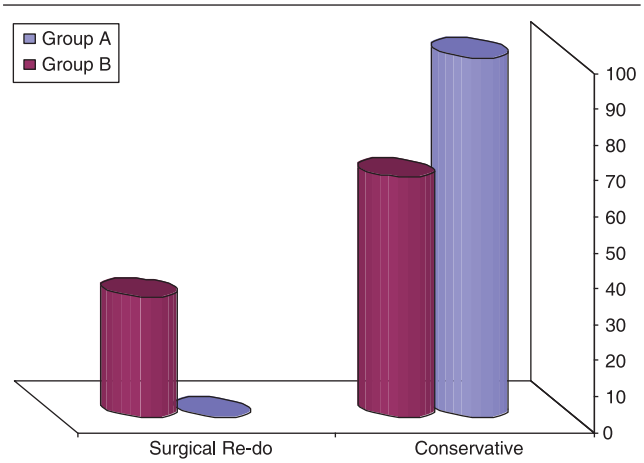
Anal discharge assessment by observation.

Graph 6



Constipation (difficult defecation) during the first week.

Graph 7



Constipation management.

Discussion

Treatment depends on many individual factors, such as the age of the person, the severity of prolapse, and whether or not other pelvic abnormalities are present (such as prolapsed bladder). Patients who present with a prolapsed rectum should undergo manual reduction. Conservative management is appropriate in selected patients. Treatment should be directed at the underlying cause. After treating the underlying cause, conservative management is usually successful. Cases of difficult reduction and patients with recurrent episodes are less likely to respond to conservative measures [16].

Surgical treatment of rectal prolapse has unpredictable results, regardless of the approach. Perineal operations are safer than abdominal ones but carry a higher likelihood of recurrence of the prolapse. Functional results probably depend more on the initial severity of the disorder than on the type of operation. Surgical correction of rectal prolapse should be performed through the anus, as this procedure is less stressful on the body [20].

Perianal sutures placed subcutaneously and mucosal plication all act to create a mechanical barrier to contain the prolapse and provoke an inflammatory response on the perirectal tissues to generate a fibrosis rather than a toneless sphincter [21,22].

The present modified Gant–Miwa procedure by three stays sutures (absorbable suture material, that is, polyglycolic acid) passed separately to plicate the mucosa from the dentate line to the end of the anal mucosa at 3, 7, 11 o'clock; that finally tied after original Gant–Miwa procedure gave more support to the rectum that led to improvement; success rate (97.8%) in addition to importance of original Gant–Miwa procedure that induce more broad fibrous ring than the Thiersch's operation with a success rate of 71–92% [18].

The Thiersch's operation or sling procedure uses synthetic materials to create a perianal sling to support the rectum. It has a success rate of about 85–93%. This procedure is a good choice for children because

Table 5 Constipation (difficult defecation or fecal impaction) during the first week

Groups	Constipation [*N* (%)]	Total number of cases	*P*-value
Group A	2 (6.6)	30	<0.05 (significant)
Group B	9 (30)	30	

Table 6 Constipation management

Groups	Group A [*N* (%)]	Group B [*N* (%)]
Conservative	2/2 (100)	6/9 (66.7)
Surgical redo	0/2 (0)	3/9 (33.3)

it can be done with self-absorbing sutures to provide temporary relief of symptoms until the base pathology is managed [23].

Perianal sutures of Thiersch's operation provoke an inflammatory response on the perirectal tissues to generate a narrow fibrous ring; therefore, it is considered a palliative procedure as it does not cure the prolapse itself. In contrast, the modified Gant–Miwa procedure cures the prolapse with good functional results, and with overall patient satisfaction [24].

Both procedures can be performed with minimal morbidity and short hospital stay, often in an outpatient setting, with no mortality and almost no serious complications [21,22].

Conclusion

The present study concluded that the modified Gant–Miwa operation is a successful approach in children with rectal mucosal prolapse who are nonresponders to conservative treatment to decrease early postoperative morbidity, especially constipation and recurrence, to a great extent ($P = 0.0002$) during the follow-up period compared with modified Thiersch's stitch. Thus, incidences of surgical redo due to complications were also fewer, although the modified Gant–Miwa approach was associated with more anal discharge especially during the first 2 weeks.

Acknowledgements

Conflicts of interest

None declared.

References

1 Glasgow SC, Birnbaum EH: Preoperative anal manometry predicts continence after perineal proctectomy for rectal prolapse. Dis Colon Rectum; 2006; 49:1052–1058.

2 Fazio VW: Current therapy in colon and rectal surgery. Mosby, Philadelphia, 2005; 131–134.

3 Singh S, Pandey A, Kureel N, Ahmad I, Srivastava K: Complicated rectal prolapse in an infant. J Pediatr Surg. 2010; 45: 31-33.

4 Laituri CA, Garey CL, Fraser JD, Aguayo PN Ostlie DJ, Peter SD: 15-Year experience in the treatment of rectal prolapse in children. J Pediatr Surg. 2010; 45:1607-1609.

5 William NS, Norman SW, Christopher JK editors; Anal canal and rectum in Bailey and Love`s short practice of surgery, 25th ed.. Chapmen and Hail. London. 2008; 1219-1249.

6 Fallouji MR: Rectal prolapse in postgraduate surgery, the candidate`s guide 2nd ed. F. Charles Brunicardi; 1998: 278-280.

7 Van Heest R, Jones S, Giacomantonio M: Rectal prolapse in autistic children. J Pediatr Surg. 2004; 39:643-644.

8 Villarreal M, Brum P: Rectal prolapse in a neonate with Shigella diarrhea. Arch Argent Pediatr 2010; 108:e17-e19.

9 Schwartz SI, Storer EH, Goldberg SM, Nivatrongs S, editors, Rectal prolapse in principles of surgery. Chapter 29, 9th ed. 2010; McGraw-Hill Book Company, New York; 1220-1222.

10 Johansen OB, Wexner SD, Daniel NK. Perineal rectosigmoidectomy in the elderly. Dis Colon Rectum 2001; 36: 767-772.

11 Michael A, Choti M, in: JL Cameron editor Rectal prolapse Current surgical therapy. 5th ed. John Cameron. 1999: 175-176.

12 Behram R, Kleigman R, Jenson H: In: Dehrna A. and Kleigman R. Rectal prolapse. Nelson textbook of pediatrics. 16th ed. Philadelphia, PA: WB Saunders and Co; 2000.

13 Hoxter B. Rectal procidentia. Perspect Colon Rectal Surg, 1992 ; 5: 51-64.

14 Luukkonen P, Mikkonen U, Jarvinen H: Abdominal rectopexy with sigmoidectomy vs. rectopexy alone for rectal prolapse: a prospective, randomized study. Int J Colorectal Dis 1992; 7: 219-222.

15 Browse NL. Rectal prolapse in an introduction to symptoms and signs of surgical disease, ELBS. London, 1985; 389-390.

16 Norton C: Fecal incontinence and biofeedback therapy. Gastroenterol Clin North Am. 2008;37:587-604.

17 Antao B, Bradley V, Roberts P, Shawis R: Management of rectal prolapse in children. Dis Colon Rectum. 2005;48:1620-1625.

18 Yamana T, Iwadare J: Mucosal plication (Gant–Miwa procedure) with anal encircling for rectal prolapse: A review of the Japanese experience. Dis Colon Rectum. 2003; 46(Suppl):S94-S99.

19 Dudly JM, Johnstone RF, Rintoul WE: in RF Rintoul editor. Operations on rectum and anal canal, Farquharson's textbook of operative surgery. 7th ed. Farquharson 1986; Farquharson; 460-462.

20 Wyelei CG: Injection treatment of rectal prolapse. J Pediatr Surg 1989: 14:62-64.

21 Kay. N, Zachar B: The treatment of rectal prolapse in children with injection of 30% saline solution induce fibrosis. J Pediatr Surg, 1987; 5:334.

22. Dutta BN, Das AK: Principle of treatment of prolapse of rectum in children with injection agents. J Indian Med Assoc,1997; 16:275-276.

23. Lomas MI, Cooperman HG: Correction of rectal prolapse by Thiersch operation. Dis Colon Rectum. 1992; 15:416-419.

24. Saleem MM, Al-Momani HS: Acute scrotum as a complication of Thiersch operation for rectal prolapse in a child. BMC Surg. 2006; 6:19.

Carcinoid lung tumors

Waleed M. Hussen, Abdulameer M. Hussein

Department of Thoracic and Cardiovascular Surgery, College of Medicine, University of Baghdad, Medical City Teaching Hospital, Baghdad, Iraq

Correspondence to Waleed Mustafa Hussen, MS, Department of Thoracic and Cardiovascular Surgery, College of Medicine, University of Baghdad, Medical City Teaching Hospital, 12114 Bab Al-Mudham, P.O. Box 61335, , Baghdad, Iraq
Tel: + 009647700531836;
e-mail: dr_waleedmustafa@yahoo.com

Received 29 April 2014
Accepted 6 May 2014

The Egyptian Journal of Surgery
2014, 33:160–163

Background
Carcinoid lung tumor is a low-grade malignant neoplasm. They tend to grow slower than other types of lung cancers. They are made of special kinds of cells called neuroendocrine cells.

Aim
To study cases of carcinoid lung tumor admitted, evaluated and surgically managed at the Department of Thoracic Surgery of the Medical City Teaching Hospital in Baghdad, Iraq.

Patients and methods
This is a retrospective and comparative study of 18 patients with pulmonary carcinoid tumors admitted to the Thoracic Department of the Medical City Teaching Complex during 15 years (1996–2010). Their ways of presentation, radiological findings, bronchoscopic appearance and modalities of surgical resection were evaluated.

Results
Ten of the patients were female and eight were male. Their age ranged between 20 and 58 years. Cough and shortness of breath were the most common symptoms. Imaging studies were mostly of collapsed lobe or lung. All the patients underwent bronchoscopy, the appearance of which was diagnostic, but biopsy ended with severe bleeding controlled with difficulty. All the patients underwent successful pulmonary resection.

Conclusion
Surgery offers the most fruitful outcome in pulmonary carcinoid tumor.

Keywords:
carcinoid lung tumors, lobectomy, pnemonectomy, pulmonary carcinoid

Egyptian J Surgery 33:160–163

1110-1121

Introduction

Carcinoid tumors are an uncommon group of pulmonary neoplasms. They tend to grow slower than other types of lung cancers. They are made up of special kind of cells called neuroendocrine cells, which in some respect are like nerve cells and in other ways like cells of endocrine (hormone-producing) glands. These cells are scattered throughout the body and can be found in different organs, for instance lung, stomach and intestine. Uncontrolled growth of these cells leads to the development of carcinod tumors. Pulmonary carcinoid tumors represent 10% of all carcinoid tumors and 1–2% of all lung tumors [1].

It arises from Kultchisky Amine Precursor Uptake Decarboxylation (APUD) cells in the bronchial epithelium. Carcinoid tumors are divided histopathologically into typical carcinoid tumors and atypical carcinoid tumors. Typical carcinoid tumors are the least malignant and the most indolent of the spectrum of pulmonary endocrine tumors that include atypical carcinoid tumors, large-cell undifferentiated carcinoma and small-cell carcinoma (most malignant). Typical carcinoids and atypical carcinoids are distinguished by their histologic features. Both tumors consist of small nests or interconnecting trabeculae of uniform cells separated by a prominent vascular stroma and numerous thin-walled blood vessels. In terms of histological features predictive of prognosis, typical carcinoids show no evidence of necrosis and less than two mitoses per 10 high-power fields (HPFs), whereas atypical carcinoids have areas of necrosis or 2–10 mitoses per 10 HPF [2].

The carcinoid syndrome occurs in ~10% of carcinoid tumors [3] and manifests when vasoactive substances from the tumors enter the systemic circulation escaping hepatic degradation. This is the case when carcinoid tumors metastasize to the liver or they arise for example in the bronchus. These tumors release too much of the hormone serotonin and several other chemicals that cause the blood vessels to open (dilate) [4]. The most important clinical finding is flushing of the skin, usually of the head and the upper part of the thorax [5]. Diarrhea and abdominal cramps are also characteristic features of the syndrome. When the diarrhea is intensive, it may lead to electrolyte disturbance and dehydration. Other associated symptoms are nausea and vomiting. Bronchoconstriction affects a smaller number of patients and often accompanies flushing. The presence of carcinoid syndrome or other paraneoplastic syndromes in the absence of lymph node or distant metastases does not seem to affect the prognosis adversely [6].

 DOI: 10.4103/1110-1121.141901

Patients and methods

Eighteen patients with pulmonary carcinoid tumor were admitted, evaluated and managed successfully in the Thoracic and Vascular Department of the Medical City Teaching Complex during a 15-year period.

After full history taking and detailed physical examination, all patients were sent for plain chest radiography and computed tomography (CT) imaging. All patients underwent rigid bronchoscopy under general anesthesia, and the typical appearance of the lesion was documented. After full preoperative preparation, these patients underwent formal posterolateral thoractomy, and the collapsed lobe or lung was resected. Patients had a smooth postoperative course, and were discharged in a good condition. Patients were followed up during the following years and no recurrence was observed.

A special formula was used to divide patients with regard to the age of presentation, sex, clinical presentation, radiological findings, bronchoscopic appearances and methods of surgical treatment.

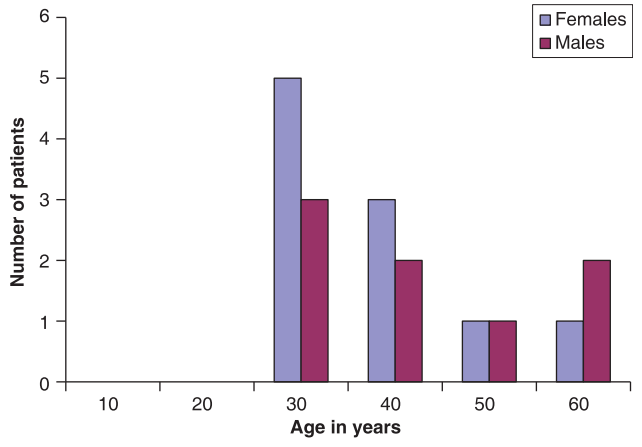
Results

Ten of our patients were female (55.55%) and eight patients were male (44.44%).

The youngest patient was a 25-year-old woman, the oldest being a 58-year-old man. The majority of the patients (eight cases) were between 20 and 30 years old; the distribution of these patients with regard to age and sex is shown in Fig. 1.

Most of the patients presented with cough (75%), shortness of breath or recurrent wheezy chest (50%) and recurrent chest infection (32.5%). Hemoptysis was seen in four patients (22%). Carcinoid syndrome was so rare that it was seen in only one female patient who presented with pyrexia, facial flushing, tachycardia, night sweat and diarrhea. The 24-h urine level of 5-hydroxy indoleacetic acid, the end product of serotonin metabolism, which is specific to carcinoid tumors, was not available in our laboratories at the time of this study.

Figure 1



Age and sex distribution of patients.

Chest radiography was performed for all the patients as the primary imaging modality; Table 1 shows the radiological findings of these cases.

CT was performed in all of the patients, which showed an endobronchial tumor mass localized to one lobe, two lobes or to the main bronchus, which coincides with the findings of chest radiography.

Rigid bronchoscopy under general anesthesia was performed in all of the patients, and the characteristic bronchoscopic appearance of a cherry-red-colored, smooth, polypoid, vascular tumor that bleeds easily and profusely was seen in almost all the patients. Biopsy was performed in three patients, followed by severe bleeding that was controlled with difficulty. In two of these patients, bronchoscopic resection was performed, and the severe bleeding that followed was controlled efficiently but with difficulty. In these patients, the asymptomatic period lasted for about 2 years followed by recurrence that necessitated surgical resection of the involved lobe or lung.

Preoperative assessment for fitness for general anesthesia with regard to the blood investigation and pulmonary function tests were performed so that all the patients were in the optimum condition before surgery.

Surgery was performed for all the patients under study by the formal posterolateral thoracotomy, and the affected parts of the lung (lobe, lobes or lung) were resected and sent for histopathological confirmation. The modalities of the surgical resection are illustrated in Table 2.

All the patients ran an uneventful postoperative course with only mild wound infection in two patients, which was treated conservatively. No mortality was observed.

Table 1 Chest radiograph findings

Findings	*n* (%)
Collapsed left lung	7 (38.88)
Collapsed left upper lobe	3 (16.66)
Collapsed right middle and lower lobe	3 (16.66)
Collapsed right upper lobe	2 (11.11)
Collapsed right lung	2 (11.11)
Collapsed right middle lobe	1 (5.55)

Table 2 Types of pulmonary surgical resection

Type of surgery	*n* (%)
Left pnemonectomy	7 (38.88)
Left upper lobectomy	3 (16.66)
Right middle and lower lobectomy	3 (16.66)
Right upper lobectomy	2 (11.11)
Right pnemonectomy	2 (11.11)
Right middle lobectomy	1 (5.55)

The histopathological report obtained in 17 patients confirmed the mass to be a carcinoid tumor with a tumor-free resected margin, and the excised lymph nodes were tumor free; in only one female patient with a preoperative attack of carcinoid syndrome, the histopathology turned out to be an atypical carcinoid tumor of intermediate grade, and this is the only patient who was referred to the oncologist for consideration of postoperative radiotherapy.

Most of the patients were symptom free during the follow-up period, with only two of them lost to follow-up.

Discussion

Carcinoid tumors are uncommon low-grade malignancies, most commonly seen in the gastrointestinal tract, with the lung being the second most common site [7].

The small number of patients confirmed that it is an uncommon condition, and this coincides with others studies by Hamid *et al*. [8] who reported 21 patients with pulmonary carcinoid, and Akiba *et al*. [9] who reported 32 patients.

Female patients were affected more often than male patients in our study, with a ratio of 1.25 : 1, and this coincides with some studies [10], but is in contradiction to other studies reporting a higher incidence among men [9], whereas Hamid *et al*. [8] reported equal sex incidence.

The majority of our patients 13 (72.2%) presented between 20 and 40 years of age, which coincides with other studies [8,11].

Cough, dyspnea and hemoptysis were the most common symptoms, and this coincides with other studies [8,12].

Chest radiography was performed in all the patients, and all of the patients have the abnormal finding of collapsed lobes or lung, whereas Hamid *et al*. [8] described an abnormal chest radiograph in only 16 patients out of 21 patients (76.2%).

The CT findings showed an intrabronchial mass localized to a lobe or to a main bronchus associated with collapsed consolidation of the affected area of the lung with no pleural effusion or infiltration.

Bronchoscopy was the main tool of diagnosis, with the typical bronchoscopic appearance of the carcinoid tumor obstructing the left main bronchus or the left upper lobe in 10 (55.5%) out of 18 patients. Other studies showed the right main bronchus to be predominately affected [8]. Ronchod and Levine [13] reported that the right middle lobe is the most commonly affected.

Bronchoalveolar lavage fails to confirm the presence of malignant cells, which is in agreement with other studies [8,13]. The biopsy performed in three patients was confirmatory to the presence of carcinoid tumor, but was unfortunately followed by severe bleeding that was controlled with difficulty in contradiction to the study conducted by Hamid *et al*. [8] in which endobronchial biopsy was the mainstay of diagnosis.

Surgery was the mainstay of treatment with aggressive resection as pneumnectomy was performed in nine out of 18 patients (50%), left pneumnectomy in seven and right pneumnectomy in two patients, followed by lobectomy in six patients and bilobectomy in three patients.

A lobectomy was the main surgical procedure in other work [14,15].

In contrast to our radical resection, Ismail *et al*. [14] adopted the policy of parenchyma-sparing or tissue-saving operations as the treatment of choice for carcinoid in 29 out of 83 patients (34.9%), whereas Elhassani's personal experience in the surgical management of carcinoid tumor consisted of bronchotomy or sleeve resection of the bronchus whenever possible, and lobectomy or pneumonectomy if there was tumor extension to the lung parenchyma, if the lesion has caused permanent irreversible pulmonary suppuration and if there was intrathoracic nodal involvement [15]. Harpole *et al*. [11] did not recommend bronchoscopic resection, as this procedure was followed by recurrence of the tumor in two cases in their study.

Postoperative complications were seen only in two patients in the form of wound infection.

The recent use of endobronchial ultrasound in the diagnosis of peripheral pulmonary carcinoid tumors has been reported by Steinfort *et al*. [16] emphasizing the high diagnostic rate and very low incidence of adverse events; however, this facility is not available in our center currently.

All our patients showed complete recovery with no mortality.

Conclusion

Early detection of bronchial carcinoid tumor using endobronchial ultrasound or future tumor markers, a more conservative surgical procedure such as sleeve resections or wedge resections, can be adopted with the hope of saving more healthy lung tissues.

Acknowledgements

Conflicts of interest

None declared.

References

1 Gould PM, Bonner JA, Sawyer TE, *et al.* Bronchial carcinoid tumors, importance of prognostic factors that influence patterns of recurrence and over all survival. Radiology 1998; 208:181–185.

2 S Chong, KS Lee, MJ Chung, J Han, J Kwon, TS Kim Neuroendocrine tumors of the lung: clinical, pathologic, and imaging findings, Radio Graphics, 2006; 26:41–57.

3 Warrell DA *et al.* (2003). Oxford textbook of medicine (4th ed.). UK: Oxford University Press.

4 Hande KR In Goldman L, Schafer AI, eds Carcinoid syndrome. Cecil medicine. 24th ed. Philadelphia, PA: Saunders Elsevier; 2011.

5 E.Goljan, Rapid review pathology, 2nd ed. Tulsa, Oklahoma, USA: Mosby Elsevier,

6 Cote ML, Wenzlaff AS, Philip PA, Schwartz AG Secondary cancers after a lung carcinoid primary: a population-based analysis. Lung Cancer 2006; 52:273–279.

7 Modlin IM, Lye KD, Kidd M A 5-decade analysis of 13.715 carcinoid tumor. Cancer 2003; 97:934–959.

8 Hamid RJ, Kian KH, Ali D, *et al.*: Pulmonary carcinoid tumor. Tanaffos. 2002; 1:51–56.

9 T Akiba, T Naruke, H Kondo, *et al.*, Carcinoid tumor of the lung: clinicopathological study of 32 cases, Jpn J Clin Oncol 1992; 22:92–95.

10 Paladugu RR, Benfield JR, Pak HY, *et al.* Bronchopulmonary Kulchitzky cell carcinomas: a new classification scheme for typical and atypical carcinoids. Cancer 1985; 55:1303–1311.

11 Harpole DH, Feldman JM, Buchanan S, *et al.* Bronchial carcinoid tumors: a retrospective analysis of 126 patients. Ann Thorac Surg 1992; 54:50–55.

12 Todd TR, Cooper JD, Weissberg D, *et al.* Bronchial carcinoid tumors: twenty years experience. J Thorac Cardiovasc Surg 1980; 79:532–535.

13 Ronchod M, Levine GD Spindle-cell carcinoid tumors of the lung: a clinicopathological study of 35 cases. Am J Surg Pathol 1980; 4:315–330.

14 Ismail C, Salih T, Irfan T *et al.* Surgery in bronchial carcinoid: experience with 83 patients. Eur J Cardiothorac Surg 2002; 21:883–887.

15 Elhassani NB: Bronchial carcinoid tumors, Ann Saudi Med 1988; 8:35.

16 Steinfort DP, Finlay M, Irving LB Diagnosis of peripheral pulmonary carcinoid tumor using endobronchial ultrasound. Case report. Ann Thorac Med 2008; 3:146–148.

Functional outcomes of superficial and conservative total parotidectomy: a 4-year experience from Benha, Egypt

Mohamed A. Mansour, El-Sayed A. Abd El-Mabood, Nasser A. Zaher

Department of General Surgery, Benha University, Benha, Egypt

Correspondence to El-Sayed A. Abd El-Mabood, MD, Department of General Surgery, Benha University, 3A Elharamen Pharmacy Street, Benha, Egypt
Tel: +0133265694 ;
e-mail: elsayedafifi@yahoo.com

Received 1 May 2014
Accepted 13 May 2014

The Egyptian Journal of Surgery
2014, 33:164–170

Purposes
The aim of this study was to find out the frequency of the functional outcomes related to superficial and conservative total parotidectomy.

Background
Functional outcomes especially facial nerve injury and Frey's syndrome during parotid surgery represent annoying problem, as it is associated with cosmetic problems and multiple physician visits; 'to minimize these outcomes' remains in question.

Patients and methods
The study included 52 patients; 6 (11.5%) were below 35 years of age, 28 (53.8%) were between 35 and 50 years of age, and 18 (34.7%) were above 50 years of age. All patients underwent clinical evaluation, laboratory assessment, ultrasound, computed tomography scan, and MRI examination. All patients underwent either superficial or conservative total parotidectomy.

Results
In this study, immediately postoperatively, facial nerve injury was observed in 20 patients; in this series, 14 (70%) developed temporary facial palsy, whereas 6 (30%) developed permanent facial paralysis. Cervical branch was the most commonly injured nerve 8 (40%). Symptomatic Frey's syndrome was observed in 5 (9.6%), and parotid leak was observed in 11 (27.5%); all were observed in superficial parotidectomy as sialocele in 5 (12.5%), glandular fistula in 4 (10%), and ductal fistula in 2 (5%).

Conclusion
Facial nerve injury is more common in total conservative parotidectomy than in superficial parotidectomy. Early detection of nerve injury is quite helpful to reduce the facial deformity by early reconstruction and other procedures. However, parotid leak is only observed in superficial parotidectomy; most of this leak can be managed conservatively except ductal fistula. Symptomatic Frey's syndrome is more common in superficial parotidectomy.

Keywords:
facial nerve, functional morbidity, parotidectomy, parotid gland tumors

Egyptian J Surgery 33:164–170

1110-1121

Introduction

The parotid gland is the most common site for salivary tumors. Most tumors arise in the superficial lobe and present as slow-growing, painless swellings below the ear, in front of the ear, or in the upper aspect of the neck. Less commonly, tumors may arise from the accessory lobe and present as persistent swellings within the cheek. Rarely, tumors may arise from the deep lobe of the gland and present as parapharyngeal masses [1–3].

Symptoms include difficulty in swallowing and snoring. Clinical examination reveals a diffuse firm swelling in the soft palate and tonsil. Some 80–90% of tumors of the parotid gland are benign, the most common being pleomorphic adenoma [4–6].

All tumors of the superficial lobe of the parotid gland should be managed by superficial parotidectomy. There is no role for enucleation, although a benign lesion is suspected. The aim of superficial parotidectomy is to remove the tumor with a cuff of normal surrounding tissue [7–9].

Superficial parotidectomy is the commonest procedure for parotid gland pathology, but total conservative parotidectomy is performed if the mass involves the deep lobe or with low-grade carcinoma. Surgery is performed under endotracheal general anesthesia, which may or may not be accompanied by hypotensive anesthesia to facilitate dissection, improve the visual surgical field, and reduce blood loss [10–12].

Conservative parotidectomy is an effective and well-established technique for the treatment of parotid gland pathology, but there are many complications such as visible scars, bleeding, parotid leak, retromandibular depression, Frey's syndrome, and facial nerve injury, which is the most annoying complication [13].

Parotid surgery has always been engaged with facial nerve dissection, trauma, and reconstruction. Around

 DOI: 10.4103/1110-1121.141902

5–7% of the parotid masses are malignant and some of them have the possibility of perineural invasion [14].

The facial nerve is a very important nerve that exits through the skull base below the ear lobule and travels through the parotid gland, separating it into superficial and deep lobes. The hazardous course of the facial nerve through the parotid has evoked considerable risk for nerve injury [15].

The incidence of symptomatic Frey's syndrome after superficial parotidectomy is 10–48% [16]. Many techniques have been tried to reduce the incidence of Frey's syndrome. In all the surgical methods, the aim is based on forming a barrier between the sweat glands in the skin and the postganglionic nerve fibers lying open – that is, the sternocleidomastoid muscle flap [17], the temporoparietal fascia flap [18], and politetrafloroetilen [19].

Parotid leak includes fistula or sialocele; parotid fistula is a communication between the skin and a salivary duct or gland, through which saliva is discharged. In glandular fistulas, discharge is less and tends to heal spontaneously with conservative treatment, whereas ductal fistulas continuously discharge saliva and spontaneous healing is very rare [20].

However, sialocele is a collection of saliva beneath the skin that may lead to swelling over or adjacent to the parotid gland and may occur if the duct leaks but no fistula forms. This may also result when the glandular substance of the parotid is disrupted but the parotid duct is intact. This condition usually resolves with intermittent aspiration and compression and rarely requires drain placement [21].

Patients and methods

After local ethical committee of Benha university approval and obtaining written fully informed patients consent, the current study was conducted at General surgery Department, Benha University Hospital from January 2010 to December 2013 so as to allow 6 months follow-up period for the last case operated on. This prospective randomized controlled study was conducted on 52 patients diagnosed with parotid gland swelling, 32 (61.5%) women and 20 (38.5%) men with age strata; most patients were aged between 35 and 50 years.

All patients presenting were subjected to detailed clinical evaluation, laboratory assessment, ultrasound, computed tomography scan, and MRI examination.

Inclusion criteria in this study included patients fit for general anesthesia. Exclusion criteria in this study included previous parotid gland surgery, facial nerve palsy, or irresectable parotid gland swelling.

All patients underwent either superficial or conservative total parotidectomy. Postoperative follow-up was 6 months.

Operative procedure

Oral endotracheal anesthesia is essential; the patient is placed in the supine position. The head is extended by elevating the shoulders and rotated to the contralateral side, draping the head separately from the body. Exposure (and protection) of the eye, cheek, and mouth in the operative field, as well as the endotracheal tube and its connections is ensured. Muscle relaxants are not appropriate, such that nerve stimulation may be conducted intraoperatively.

Skin incision is initiated anterior to the ear just above the tragus. It is carried inferiorly to the level of the lobule and then angled posteriorly under the lobule and directed anteriorly for a suitable distance in the upper neck.

The incision is carried out through skin and subcutaneous tissue, developing the plane between the cartilaginous external canal and the posterior aspect of the gland. Allis clamps on subcutaneous tissues provide traction of the flaps. The sternomastoid muscle is identified and its anterior border exposed as the tail of the gland is dissected and reflected away from the muscle. Sacrifice of the greater auricular nerve is expected unless its course meanders to the mastoid process. Dissection is continued in this plane, incising attachments to the mastoid, until the posterior belly of the digastric muscle is visualized below the digastric groove. The anterior flap is elevated in the plane of the parotid capsule; with the concern that terminal branches of the facial nerve are at risk, the dissection should continue beyond the anterior margin of the gland. The facial nerve must be thereafter identified just distal to its emergence from the stylomastoid foramen. A variety of landmarks have been described that facilitate the exposure of the main trunk, such as the cartilaginous part of the external canal and the tympanomastoid sulcus. When the volar aspect of the fifth finger is placed deeply on the junction of cartilaginous and bony external auditory canal and wedged against the bone cephalad, the main trunk is found below the inferior border of the finger, a few millimeters above the exposed superior border of the posterior belly of the digastric muscle as it enters its groove in the mastoid bone.

Good traction on the reflected parotid tissue is essential, as a clamp (first curved but after exposure of the facial nerve, straight clamp) is used to elevate and incise the

overlying tissue in layers. Meticulous hemostasis and good illumination are essential. A small arterial branch often located just lateral to the nerve must be identified and ligated. With careful layer-by-layer dissection and knowledge of the anatomy, a nerve stimulator is often unnecessary. Minor twitching of the facial muscles due to mechanical stimulation of the facial nerve is likely in nonparalyzed patient, which can be of assistance in the dissection. Neurologic injury to CN VII can result from desiccation, as well as from mechanical trauma; the former is easily avoided if moist sponges are applied during the dissection.

A single closed suction drain is brought out by a separate stab wound; fine sutures are used for a layered closure. A pressure dressing is not needed. The suction drain can often be removed by day 3–5 postoperatively. Bedside assessment of facial nerve function after the patient awakens from anesthesia is appropriate.

The conduct of a routine conservative total parotidectomy, tumor extension deep to the main trunk or one of its branches, may require a major intraoperative decision. All major nerve branches should be fully exposed before tumor removal is attempted. This maneuver is accomplished by elevation and gentle retraction of the overlying nerves. With presentations of abutment below the main trunk or smaller distal branches, nerve displacement inferiorly and superiorly abets tumor resection. When a deep tumor involves the isthmus, excision is usually achieved by retracting the upper CN VII division superiorly and the lower division inferiorly. Apraxia of CN VII due to stretching is common in this situation [22–24].

Outcome items

Postoperative follow-up was performed for functional outcomes of the parotid gland surgery, which included facial nerve injury (i.e., by asking patient to raise his eyebrow by frontalis muscle, close his eye by orbicularis oculi muscle, blow his cheek by buccinator muscle, show his teeth by retractor anguli oris muscle, and whistle by orbicularis oris muscle), symptomatic Frey's syndrome (i.e., gustatory sweating, during meals the cheek becomes sweaty, red, and hot), and parotid leak (i.e. sialocele or fistula) that was classified by the injury classification system into three regions: (a) posterior to the masseter or intraglandular (site A), (b) overlying the masseter (site B), and (c) anterior to the masseter (site C) [25].

None of the patients were lost to follow-up, and data collection was complete.

Statistical analysis

Analysis of data was performed using SPSS, version 16 (Bristol University, Bristol, UK). Quantitative data were presented as mean and SD and were analyzed using one-way analysis of variance test. Qualitative data were presented as numbers and percentages and were analyzed using the χ^2 and Fisher exact tests. *P*-value less than 0.05 was considered significant, whereas *P*-value less than 0.01 was considered highly significant. However, *P*-value greater than 0.05 was considered insignificant.

All data were recorded in Fig. 1.

Results

The study included 52 patients, 32 (61.5%) women and 20 (38.5%) men with age strata; most patients were aged between 35 and 50 years. They were diagnosed with parotid gland swelling located in superficial lobe in 46 (88.5%) patients and in deep lobe in 6 (11.5%) patients. All patients were fit for surgery confirmed by American Society of Anesthesiologists grade (ASA): ASAI [*n* = 36 (69.2%)], ASAII [*n* = 10 (19.3%)], and ASAIII [*n* = 6 (11.5%)] (Table 1).

Patients underwent either superficial parotidectomy in 40 (76.9%) cases with a mean operative time of 1.2 ± 0.3 h or total conservative parotidectomy in 12 (23.1%) cases with a mean operative time of 2 ± 0.2 h (Table 2). No intraoperative complications or mortality were recorded.

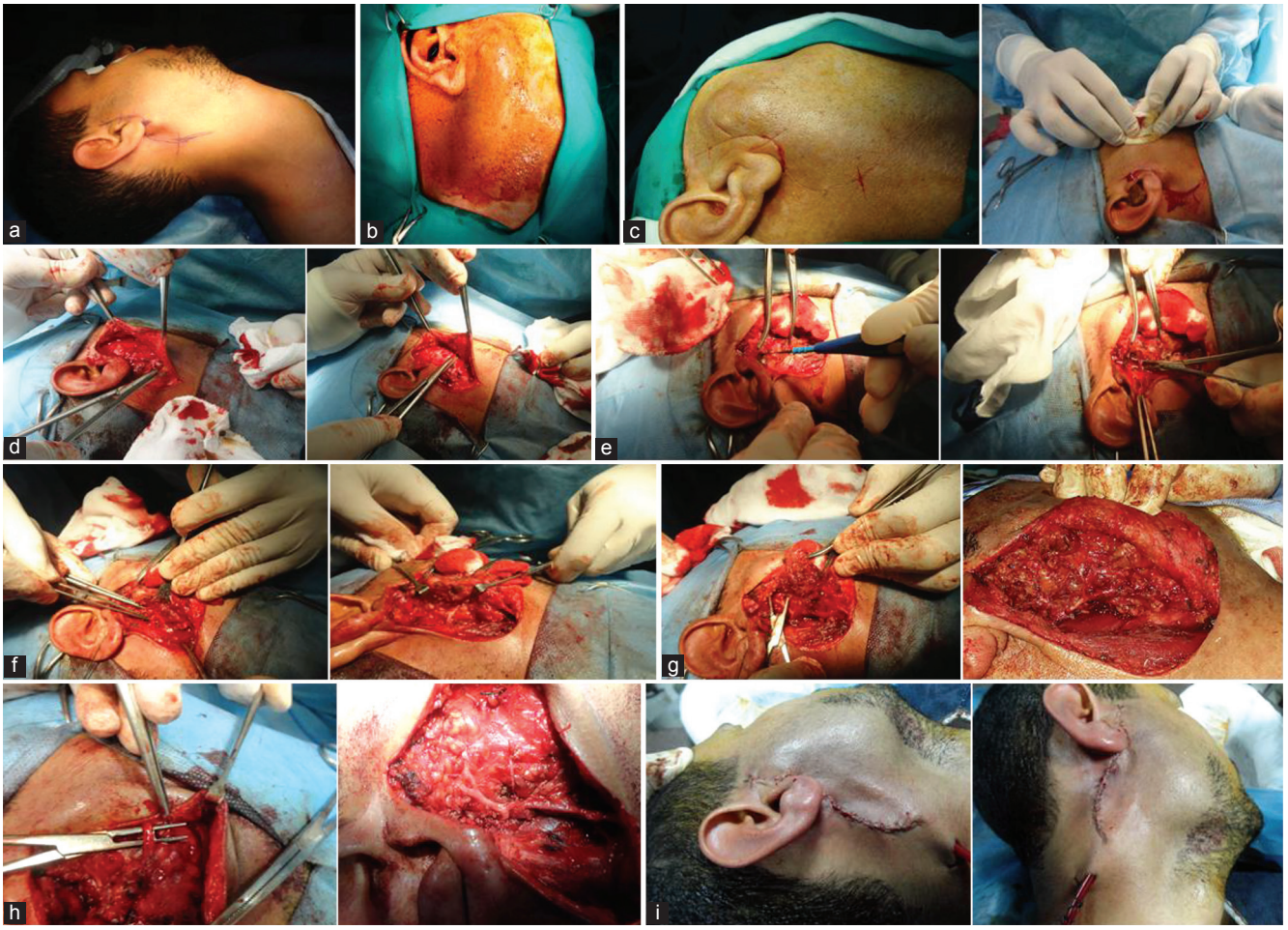
The site of tumor origin was in the lower pole, 34 (65.3%); middle of the gland, 12 (23.2%); or the upper pole, 6 (11.5%). The mean tumor diameter was 3.6 ± 0.7 cm. Thirty-two patients had pleomorphic

Table 1 Preoperative data

Data	Findings [*n* (%)]
Age (years)	
Below 35	6 (11.5)
Between 35 and 50	28 (53.8)
Above 50	18 (34.7)
Sex	
Female	32 (61.5)
Male	20 (38.5)
American Society of Anesthesiologists grade (ASA)	
ASA_I	36 (69.2)
ASA_{II}	10 (19.3)
ASA_{III}	6 (11.5)
Location	
Superficial lobe	46 (88.5)
Deep lobe	6 (11.5)

Data are presented as number; ranges and percentages are in parentheses.

Figure 1



(a) Skin incision marking, (b) drapes, (c) incision, (d) the skin flap dissection until the anterior border of parotid, (e) parotid is dissected from the external auditory canal and anterior border of SM muscle, (f) identification of facial nerve trunk, (g) straight mosquito forceps is used to separate facial nerve branches, (h) parotid duct identification and ligation, (i) skin closed and a drain is left behind. SM, sternomastoid.

Table 2 Operative data

Types of parotid surgery	Procedure in	Operative time (h)
Superficial parotidectomy	40 (76.9)	1.2 ± 0.3
Total conservative parotidectomy	12 (23.1)	2 ± 0.2

Data are presented as mean+SD and number; ranges and percentages are in parentheses.

adenoma; surgical margin showed microscopic infiltration in 2 (3.9%) patients. Three patients (5.7%) showed perineural invasion and six patients (11.5%) showed vascular invasion. Seven patients (13.4%) had histologically positive lymph node metastases in the resection specimen (Table 3).

The frequency of postoperative functional outcomes — that is, facial nerve injury ($N = 20$) was: 14 patients had temporary facial palsy – 8/40 (20%) patients in superficial parotidectomy and 6/12 (50%) patients in total conservative parotidectomy ($P = 0.004$) — and six patients had permanent facial paralysis after 6 months follow-up that was in need for grafting: 2/40 (5%) patients in superficial parotidectomy and 4/12 (33.3%) patients in total conservative parotidectomy ($P = 0.002$). However, symptomatic Frey's syndrome was observed in five patients: 4/40 (10%) patients in superficial parotidectomy and 1/12 (0.8%) patients in total conservative parotidectomy ($P = 0.125$) (Table 4).

The distribution of diseases with respect to facial nerve injury was: epidermoid carcinoma was associated with the highest percentage of facial nerve injury, 2/2 (100%), followed by mucoepidermoid carcinoma, 4/6 (66.6%); however, chronic sialadenitis was not associated with facial nerve injury (Table 5).

With respect to the frequency of postoperative different branches of facial nerve injury following surgery, cervical branch was the most common injured, 8/20 (40%), and the main trunk injury was observed in 2/20 (10%); however, no injury was observed in the temporal and zygomatic branches (Table 6).

The incidence of postoperative functional outcomes — that is, parotid leak [*N* = 11 (27.5%)]: all cases were observed in superficial parotidectomy only as sialocele in 5 (12.5%) patients and as parotid fistula — glandular type in 4 (10%) patients and ductal type in 2 (5%) patients (Table 7).

Parotid leak (i.e. sialocele or fistula) was classified by the injury classification system into three regions: posterior to the masseter or intraglandular (site A), 7 (17.5%) patients; overlying the masseter 'site B', 3 (7.5%) patients; anterior to the masseter 'site C', 1 (2.5%) patient [25] (Table 8).

Table 3 Pathological data of excised specimens

Data	Findings
Site	
Lower pole	34 (65.3)
Middle of the gland	12 (23.2)
Upper pole	6 (11.5)
Size (cm)	
Diameter in its longest axis	3.6 ± 0.7
Histological types	
Pleomorphic adenoma	32 (61.5)
Mucoepidermoid carcinoma	6 (11.5)
Warthin's tumor	6 (11.5)
Acinic cell tumor	4 (7.7)
Epidermoid carcinoma	2 (3.9)
Chronic sialadenitis	2 (3.9)
Surgical margin invasion	
Yes	2 (3.9)
No	50 (96.1)
Perineural invasion	
Yes	3 (5.7)
No	49 (94.3)
Perivascular invasion	
Yes	6 (11.5)
No	46 (88.5)
Lymph node status	
Positive	7 (13.4)
Negative	45 (86.6)

Data are presented as mean+SD and number; ranges and percentages are in parentheses.

Table 4 Types of nerve injury, facial (*N* = 20) or auriculotemporal (*N* = 5)

Type of nerve injury	*n* (%)		*P*-value
	Superficial parotidectomy (*N* = 40)	Total conservative parotidectomy (*N* = 12)	
Temporary facial palsy	8 (20)	6 (50)	0.004
Permanent facial paralysis after 6 months (for grafting)	2 (5)	4 (33.3)	0.002
Symptomatic Frey's syndrome	4 (10)	1 (0.8)	0.125

Finally, patients with parotid leak were treated conservatively, except ductal parotid fistula in 2 (5%) patients, which was treated by surgical reconstruction.

Discussion

Parotidectomy has been classically performed through a bayonet-shaped incision without parotid bed

Table 5 Distribution of diseases with respect to facial nerve injury (*N* = 52)

Nature of the disease	Patients	Facial nerve injury
Pleomorphic adenoma	32 (61.5)	10 (31.2)
Mucoepidermoid carcinoma	6 (11.5)	4 (66.6)
Warthin's tumor	6 (11.5)	2 (33.3)
Acinic cell tumor	4 (7.7)	2 (50)
Epidermoid carcinoma	2 (3.9)	2 (100)
Chronic sialadenitis	2 (3.9)	0 (0)
Total	52 (100)	20 (38.4)

Data are presented as number; ranges and percentages are in parentheses.

Table 6 Different branches of facial nerve injury following surgery (*N* = 20)

Types	Branches	*N* (%)
Single branch	Temporal	0 (0)
	Zygomatic	0 (0)
	Buccal	2 (10)
	Mandibular	4 (20)
	Cervical	8 (40)
Multiple branches	Zygomatic and buccal	2 (10)
	Mandibular and cervical	2 (10)
Main trunk	All	2 (10)

Data are presented as number; ranges and percentages are in parentheses.

Table 7 Incidence of parotid leak (*N* = 11)

Parotid leak	Superficial parotidectomy (*N* = 40)	Total conservative parotidectomy (*N* = 12)
Sialocele	5 (12.5)	0 (0)
Parotid fistula		
Glandular	4 (10)	0 (0)
Ductal	2 (5)	0 (0)

Data are presented as number; ranges and percentages are in parentheses.

Table 8 Distribution of parotid leak by the injury classification system (*N* = 11)

Parotid leak	Superficial parotidectomy (*N* = 40)
Site A: posterior to masseter or intraglandular	7 (17.5)
Site B: overlying the masseter	3 (7.5)
Site C: anterior to the masseter	1 (2.5)

Data are presented as number; ranges and percentages are in parentheses.

reconstruction. This approach allows quick and wide access for dissection of the facial nerve and eases parotid gland removal [26].

To find the facial nerve in parotid surgery, we have used the anatomical landmarks, and in the case of any difficulty electrical intraoperative stimulation and monitoring the nerve function had to be used. There are cases in which such facilities are not advanced enough to find the main nerve trunk; therefore, a change in the method toward finding the peripheral branches and exploring the nerve backward to the mass has to be established. This technique and approach will bring about the condition to perform a satisfying oncologic surgery and a surgical field for preservation and/or repair of a traumatized facial nerve. In the cases of suspicious perineural invasion, the nerve has to be traced into the mastoid area to eradicate the malignant progression and find an intact proximal end for reconstruction and anastomosis [27].

Parotid malignancies are not common, consisting 3–4% of all head and neck malignancies [28]. However, two main conceptions have to be kept in mind for those who are involved in the surgery of the parotid gland. First of all, the best survival is in the hands of the first surgeon. He or she has to be quite aware of the possibility of perineural invasion [29,30], which has a serious impact on the type of surgery.

In this present series, 52 cases of parotid gland surgery were studied. Of these 52 cases, 20 patients developed facial nerve palsy immediately after operation, whereas five patients developed symptomatic Frey's syndrome. These patients were followed up for 6 months after surgery and re-evaluated the status of nerve palsy to detect whether it was temporary or permanent palsy. The results obtained in this series were compared with other national and international studies.

In our series, of the 52 cases studied, superficial parotidectomy was performed in 40 (76.9%) patients. Of them, facial nerve injury was noted in 10 (25%) patients. Of these 10 cases of facial nerve injury, eight (20%) patients had temporary palsy and two (5%) patients had permanent palsy even after follow-up of 6 months. This study is consistent with the study conducted by Rhman and colleagues who mentioned that, of the 30 cases studied, superficial parotidectomy was performed in 23 (76.67%) patients. Of them, facial nerve injury was noted in six (26.08%) patients. Of these six cases of facial nerve injury, five (21.73%) patients had temporary palsy and one (4.34%) patient had permanent palsy even after follow-up of 1 year [13].

Total conservative parotidectomy was performed in 12 (23.1%) patients. Of them, facial nerve injury was noted in 10 (83.3%) patients; of these 10 cases of facial nerve injury, six (50%) patients had temporary palsy and four (33.3%) patients had permanent palsy even after follow-up of 6 months. This study is consistent also with the study conducted by Rhman and colleagues who mentioned that, of the 30 cases studied, superficial parotidectomy was performed in 7 (23.3%) patients. Of them, facial nerve injury was noted in five (71.4%) patients. Of these five cases of facial nerve injury, three (60%) patients had temporary palsy and two (40%) patients had permanent palsy even after follow-up of 1 year [13]. The difference of facial nerve injury between superficial parotidectomy and total conservative parotidectomy is statistically significant ($P < 0.05$).

In a study, it is mentioned that temporary facial nerve palsy occurred in all (26.67%) and in one or two branches (18.88% of the facial nerve). The permanent total paralysis occurred in 10% of the patients and branches were injured in 3.3% of the patients [31]. Here, we found that the main trunk injury was observed in 2/20 (10%); however, no injury was observed in the temporal and zygomatic branches. Hence, the result is not similar to the above study.

The branch of the facial nerve that is most at risk for injury during parotidectomy is the marginal mandibular branch [32]. In our study, we found that cervical branch was the most common injured, 8/20 (40%). Hence, the result is not comparable with the above study.

In a series in case of parotid tumor, superficial lobe was involved in 63.7% of the patients, whereas the deep lobe was involved only in 10% of the patients [33]. In another series, 90.91% of the patients had pleomorphic adenoma in their superficial lobe [13]. In our study, 32 (61.5%) patients had pleomorphic adenoma. Hence, this study is consistent with the first study.

In a study, Tsai *et al.* [34] mentioned that, in case of parotid tumors, 85% are benign tumors and only 12% are the malignant ones. However, in our study, we found that 73% were benign and only 23.1% were malignant.

The incidence of Frey's syndrome after parotidectomy has been reported to be 10–15% [35]. In our study, 5 (9.6%) patients presented with Frey's syndrome; most of them were observed in superficial parotidectomy, 4/40 (10%) ($P = 0.125$). This result is not similar to the above study.

The incidence of postoperative functional outcomes – that is, parotid leak [$N = 11$ (27.5%)]: all cases were

observed in superficial parotidectomy only as sialocele in 5 (12.5%) patients and as parotid fistula — glandular type in 4 (10%) patients or ductal type in 2 (5%) patients. Only ductal parotid fistula was in need for surgical reconstruction. This result was mentioned by Srinidhi *et al.* [36].

Conclusion

Facial nerve injury is more common in total conservative parotidectomy than in superficial parotidectomy. Early detection of nerve injury is quite helpful to reduce the facial deformity by early reconstruction and other procedures. However, parotid leak is only observed in superficial parotidectomy; most of this leak can be managed conservatively except ductal fistula. Symptomatic Frey's syndrome is more common in superficial parotidectomy.

Acknowledgements

Conflicts of interest

None declared.

References

1 William BS: Norman SW, Christopher JKeds; Disorders of the salivary glands Bailey & Love's short practice of surgery 26th ed. Chapmen and Hail. London. 2010; 47:752–770.

2 Green JD, Shelton CT, Brackman DE: Surgical management of iatrogenic facial nerve injuries. Otolaryngol Head Neck Surg; 1998; 111:606–610.

3 Schwartz SI, Storer EH, Goldberg SM: Nivatrongs, Seds, Disorders of the head and neck, Schwartz's principles of surgery 9th ed. McGraw-Hill Book company, New York, 2010;640–669.

4 Frankenthaler RA, Luna MA, Lee SG: Prognostic variables in parotid gland cancer. Arch Otolaryngol Head Neck Surg; 1992; 117:1251–1256.

5 Webb, AJ, Eveson, JW: Pleomorphic adenomas of the major salivary glands: a study of the capsular form in relation to surgical management. Clin Otolaryngol, 2001, 26:134–142.

6 Zbaren, P, Schar, C, Hotz, M, Loosli, H: Value of fine-needle aspiration cytology of parotid gland masses. Laryngoscope, 2001, 111:19891992.

7 Futran ND, Parvathaneni UK, Martins RG, Laramore GE: In: Harrison LB, Sessions RB, Hong WK, eds Malignant salivary gland tumors. Head and neck cancer: a multidisciplinary approach. Philadelphia: Lippincott Williams and Wilkins; 2009; 589–610.

8 Sood SL, Quraishi MS, Jennings CR, Bradley PJ: Frey's syndrome following parotidectomy: prevention using rotation sternocleidomastoid muscles flap. Clin Otolaryngol Allied Sci 1999; 2:365–368.

9 Hui YP, Wong DS, Wong LY, Ho WK, Wei WI: A prospective controlled double-blind trial of great auricular nerve preservation at parotidectomy. Am J Surg 2003; 185:574–579.

10 Fee WE, Tran LE: Functional outcome after total parotidectomy reconstruction. Laryngoscope; 2004;114:223–226.

11 Meningaud JP: Parotidectomy: the facelift access route. EMC Stomatol 2005: 1:80–84.

12 O'Brien CJ: Current management of benign parotid tumors. The role of limited superficial parotidectomy. Head Neck; 2003; 946–952.

13 Roscic ZA: Conservative parotidectomy: a new surgical concept. J Maxillofac Surg. 1980; 8:234–240.

14 Rhman MA, Alam MM, Joarderb AH: Study of nerve injury in parotid gland surgery. Nepalese J ENT Head Neck Surg; 2011; 2:1–3.

15 Sinan KT, Nurettin ZD, Erkan TK: Does flap thickness affect the incidence of Frey's syndrome after superficial parotidectomy? KBB-Forum; 2003; 2:124–139.

16 Allison GR, Rappaport IP: Prevention of Frey's syndrome with superficial musculoaponeurotic system interposition. Am J Surg 1998; 166:407–410.

17 Sood SA, Quraishi CR, Bradley PJ: Frey's syndrome following parotidectomy: prevention using a rotation sternocleidomastoid muscle flap. Clin Otolaryngol 1999; 24:365–368.

18 Rubinstein RY, Rosen AM, Leeman DF: Frey syndrome: treatment with temporoparietal fascia flap interposition. Head Neck Surg. 1999; 125:808–811.

19 Dulguerow P, Quinodoz D, Cosendai G, Piletta P, Marchal F: Prevention of Frey syndrome during parotidectomy. Arch Otolaryngol Head Neck Surg 1999; 125:833–839.

20 Marchese-Ragona R, De Filippis C, Marioni G, Staffieri A: Treatment of complications of parotid gland surgery. Acta Otorhinolaryngol Ital 2005; 25:174–178.

21 Christiansen H, Wolff A, Knauth J, Hille A, Vorwerk H, Engelke C: Radiotherapy: an option for refractory salivary fistulas. HNO. 2009; 57:1325–1328.

22 Li J, Wang B, Nelson M: Salivary adenocarcinoma, not otherwise specified: a collection of orphans. Arch Pathol Lab Med 2004;128:1385–1394.

23 Spiro J, Spiro R: Cancer of the parotid gland: role of 7th nerve preservation. World J Surg 2003; 27:863–867.

24 Ronald HS: Parotid gland surgery in Mastery of surgery 5th ed. By Robert J.B. and Josef E.F. in Boston, Massachusetts 2007; 1:328–336.

25 Van Sickels JE: Management of parotid gland and duct injuries. Oral Maxillofac Surg Clin North Am 2009; 21:243–246.

26 Taylor SM, Yoo JK, Matthews WT, Lampe HB, Trites JR: Frey's syndrome and parotidectomy flaps: a retrospective cohort study. Otolaryngol Head Neck Surg 2000; 122:201–203.

27 Bonanno PC, Palia DK, Rosenberg MA, Casson PU: Prophylaxis against Frey's syndrome in parotid surgery. Ann Plast Surg 2000; 44:498–501.

28 Mokhtari N, Pourhamzeh M: Surgical dissection of the facial nerve in parotidectomy; our personal experience. Iran J Otorhinolaryngol 2010; 22, 60:102–106.

29 Scurry WC, Isaacson JE, Fedok FG: New-onset facial paralysis and undiagnosed recurrence of cutanous malignancy: evaluation and management. Am J Otolaryngol 2006; 27: 139–142.

30 Ginsberg LE, Eicher SA: Great auricular nerve: anatomy and imaging in a case of perineural tumor spread. Am J Neuroradiol 2000; 21: 568–571.

31 Staffieri A, Marioni G, Ragona R, Filippis C: Treatment of complications of parotid gland surgery. Acta Otorhinolaryngol Ital 2005; 25:174–178.

32 Gaillard C, Peries S, Susini B, Guily L: Facial nerve dysfunction after parotidectomy: the role of local factors. Laryngoscope 2005; 115:287–291.

33 Obaid MA, Yusuf AS: Surgical management of epithelial parotid tumurs. J Coll Physicians Surg Pak; 2004; 14:394–399.

34 Tsai HM, Lin CC, Huang CC, Huq CH, Tseng HC: Parotid tumors: a 10 years experience. Am J Otalaryngol Head Surg 2008; 29:94–100.

35 Rhee JS, Mylonas AL, Davis RE, Goodwin WJ: Minimizing deformity from parotid gland surgery, Curr Opin Otolaryngol Head Neck Surg 1999; 7:90–98.

36 Srinidhi D, Shruthi R, Madhumati S, Shouvik C: Parotid sialocele and fistulae: current treatment options. Int J Contemp Dent, 2011; 2:9–16.

Capsule endoscopy versus intraoperative enteroscopy in management of small bowel arteriovenous malformations

Wael E. Lotfy[a], Ramadan M. Ali[a], Sherif M. Galal[b]

Departments of [a]General Surgery and [b]Tropical Medicine, Faculty of Medicine, Zagazig University, Zagazig, Egypt

Correspondence to Wael E. Lotfy, MD, Department of General Surgery, Faculty of Medicine, Zagazig University, Zagazig, Egypt
Tel: +20 100 066 2264;
e-mail: waellotfy@hotmail.com

Received 23 April 2014
Accepted 13 May 2014

The Egyptian Journal of Surgery
2014, 33:171–177

Background
Small bowel arteriovenous malformations (AVMs) are the most common cause of obscure gastrointestinal bleeding, and they are problematic cases both in diagnosis and treatment.
Patients and methods
A total of 12 patients with small bowel AVMs admitted to Zagazig University hospitals were included in this study. Cases with previous bleeding (group I) and cases with moderate ongoing bleeding (group II) underwent both capsule endoscopy (CE) and intraoperative enteroscopy (IOE), whereas cases with massive ongoing bleeding (group III) underwent IOE only.
Results
CE picked up the diagnosis of AVMs only in 50% of cases. It underestimated the extent of the lesions in 40% of positive cases and wrongly localized the lesion in 20% of positive cases. IOE diagnosed all 12 cases of AVMs. Two cases were treated with plasma photocoagulation and 10 cases were treated with resection of the diseased segment. There was only one perioperative mortality.
Conclusion
CE has a limited diagnostic yield in cases of small bowel AVMs especially in absence of ongoing bleeding, and IOE remains the mainstay method for diagnosis and treatment of these cases.

Keywords:
arteriovenous malformations, capsule endoscopy, gastrointestinal bleeding, intraoperative endoscopy

Egyptian J Surgery 33:171–177

1110-1121

Introduction

Obscure gastrointestinal bleeding (OGIB) is defined as bleeding of unknown origin that persists or recurs after an initial negative panendoscopic evaluation, including oesophagogastroduodenoscopy and ileocolonoscopy [1]. It is estimated that OGIB comprises ~5% of all patients with gastrointestinal (GI) bleeding, with the majority of bleeding lesions found to be in the small bowel [2].

For decades, investigation of OGIB has often caused frustration in both patients and clinicians. Noninvasive tests, such as small-bowel follow-through, radioisotope-labeled red blood cell scan and push enteroscopy, have had suboptimal diagnostic yields in the range of 20–40% [3–5]. Capsule endoscopy (CE) approximately doubles the diagnostic yield of push enteroscopy in patients with OGIB and its yield is also far superior to that of small bowel radiography [6].

Invasive methods, such as laparotomy or intraoperative enteroscopy (IOE), may improve the yield up to 70% [7]. However, complications such as mucosal laceration, avulsion of mesenteric vessels, prolonged ileus and wound infection are not uncommon, and death has been reported in the literature [8].

Vascular lesions of the small bowel are the most frequent finding in patients with bleeding from the small bowel (~50–70% of findings). There seems to be a morphological heterogeneity of probably overlapping entities, such as arteriovenous malformation (AVM), venous or vascular ectasia, angiodysplasia, angiectasia, or even Dieulafoy's lesion. Thereby, terminology of these benign flat lesions depends somewhat on the person who describes it, being either an endoscopist or a histopathologist [9].

We focused in this research on this hidden killer, and we selected only the cases that have firm diagnoses of AVMs either by direct intraoperative finding and/or histological examination to evaluate the most accurate and appropriate method of diagnosis and the best approach to manage them.

Patients and methods

This research was conducted on patients with OGIB admitted to Zagazig University hospitals between October 2010 and September 2013.

According to their presentations, we classified our patients into three groups: group I, this group included patients presented with previous attacks

 DOI: 10.4103/1110-1121.141903

of GI bleeding and severe iron deficiency anaemia; group II, this group included patients presented with ongoing moderate GI bleeding (melena) on admission and group III, this group included patients presented with massive GI bleeding (haematochezia) with shock and collapse.

On admission, full history taking and thorough clinical examination of all cases were performed, and full laboratory investigations were ordered. Blood transfusion was initiated in patient with haemoglobin less than 8 g% and plasma transfusion was given to all patients with ongoing GI bleeding (group II and III). Resuscitation of shocked patients (group III) was initiated immediately with intravenous crystalloids and plasma expanders until blood transfusion became available. In addition, pelviabdominal ultrasonography (US) examination was performed for all cases. ECG and other needed preoperative investigations were conducted on request.

Inclusion criteria

(1) Patients above 18 years and below 80 years of age.
(2) Patients with OGIB with negative upper and lower GI endoscopies and irrelevant data by imaging studies such as abdominal US or computed tomography.
(3) All cases should be mentally oriented and consented to join our study.

Exclusion criteria

(1) Patients below 18 and above 80 years of age.
(2) Patients who refused to undergo CE or IOE.
(3) Patients whose GI bleeding was due to any cause other than small bowel AVMs.
(4) Patients whose IOE findings were negative, although their CE findings were positive for AVMs.
(5) Patients who were lost during the follow-up period.

After the initial management, all cases were prepared for upper and lower GI endoscopy, which if negative, cases of group I and II were prepared to undergo pelviabdominal US and triphasic computed tomography, and only negative cases were accepted to join the study and prepared for CE, which is usually performed on the next day. Waiting for the results, the patients were prepared for exploration and IOE. Anaemia, electrolytes imbalance and hypoalbuminaemia all were corrected then IOE was performed within 7 days of CE. Group III patients (emergency cases) with negative endoscopies were prepared for urgent exploration and IOE directly (no time for other investigations).

Capsule endoscopy

Wireless CE is a new technology that enables endoscopic visualization of the whole length of the small bowel. The capsule measures 26.4 mm in length and 11 mm in diameter. It is swallowed after 12 h of fasting and left to proceed in the gut by its peristalsis. The capsule is composed of a lens, a light source, a complementary semiconductor chip, a battery and a transmitter. Images are continuously taken two per second and immediately transmitted to a recorder that is fixed by a belt to the abdomen of the patient and then downloaded to a computer unit where they are visualized and recorded by special software. The records were revised by an expert gastroenterologist.

Intraoperative enteroscopy

Patients were prepared with oral 500 ml of mannitol 20%, 12 h before surgery. IOE was performed by two experienced endoscopists and surgery was performed by the same surgical team. First, the intestines were totally examined for obvious lesions or palpable masses then before enteroscopy, we divided any possible adhesions to make the small bowels move mobile and amenable to manipulation, but we did not perform excessive mobilization such as Kocher's technique or division of ligament of Treitz because such manoeuvres may damage major vessels while giving little advantage to the procedure. We think that completing the procedure with adding enterotomy is much less hazardous than these risky mobilizations.

Adult colonoscope of total length 2500 mm and a working length of 227 mm and loop diameter of 16 cm was used. Peroral route was tried in all cases, but if endoscopy failed to reach the terminal ileum, a small enterotomy was performed and the endoscope was completed through it after covering the shaft of endoscope with sterile plastic sheath used for the laparoscopic camera, which is temporarily sutured to the edge of the enterotomy to avoid spillage of intestinal contents. We advanced the endoscope manually through the bowel by telescoping the bowel over it gently trying not to harm the mucosa or the mesentery. Neither pressure nor tension was allowed throughout the procedure; otherwise, serious tears and lacerations of the mesentery would occur.

Minimal air insufflation was used during advancement, and desufflation of the bowel was carried out during withdrawal. The bowel was inspected during advancement of the endoscope; otherwise, petechial haemorrhage or even haematomas that would occur during manipulation might be mistaken for angioectasias on withdrawal. If a lesion was visualized during advancement of the endoscope, the segment of bowel was marked with silk sutures for later resection

and the advancement was completed to diagnose other possible lesions.

The light of the operating room was shut off to allow both internal and external examination of the transilluminated bowel by both the endoscopist and the surgeon simultaneously. Only patients with small bowel AVMs were included in this study. Other causes of bleeding were excluded to evaluate the results of CE in cases of small bowel AVMs only and to study the prognosis of these cases. Minor lesions were treated using argon laser beam through endoscopy, whereas large and wide-spread lesions were excised by resection anastomosis of the small bowel. The resected specimens were certainly sent for histopathological examination.

The operative time, amount of intraoperative blood transfusion, the site of AVMs and the method of management all were recorded.

Postoperative care

All patients were postoperatively cared in ICU with parenteral nutrition, antibiotic and other supportive measures until they became haemodynamically stable and haematologically accepted. Thereafter, they were transferred to their ordinary rooms in the hospital to complete their postoperative regimens and care. All surviving patients were discharged when surgically stable and they were followed up in the outpatient clinic for at least 2 months postoperatively and checked for overt or occult blood in stool.

Four cases were excluded from this study after joining it. The first refused to perform IOE after the CE had diagnosed jejunal AVMs; the second case was found to have bleeding jejunal diverticulitis on exploration and the third was found to bleed from an ileal lymphoma. The fourth case had CE diagnosed jejunal AVMs that did not show on IOE, and nothing was performed for this case and surprisingly this case did well during the postoperative period; bleeding did not recur through the 6 months of follow-up period and her anaemia was corrected gradually.

Results

This study included 12 patients with final diagnosis of small bowel AVMs, eight men and four women (male : female, 2 : 1). Their ages ranged between 32 and 79 years with mean age of 49.75±14.28 years. Three patients presented with previous OGIB (group I) and severe iron deficiency anaemia, seven patients presented with ongoing OGIB on admission (group II) and two patients presented with massive GI bleeding and shock (group III). Clinical examination and provisional investigations of the cases revealed diabetes mellitus in five patients, hypertension in six patients, ischaemic heart disease in three patients and previous cerebral stroke in two patients. All patients were anaemic with variable degree; their haemoglobin concentration ranged from 4 to 8.5% at presentation with average concentration 5.9±1.39 g% (Table 1).

Results of capsule endoscopy

CE diagnosed small bowel AVMs only in five (50%) patients of total 10 patients who underwent this investigation in the study. They were two jejunal and three ileal AVMs patients, including four of seven patients of group II with ongoing bleeding and only one of three patients of group I without active bleeding.

The capsule was retained only in one patient in the terminal ileum and was removed during the exploration for IOE. The cause of retention was not obvious. In addition, it failed to reach the colon during the recording time in one case mainly due to delayed gastric evacuation. CE did not have a place in cases with massive bleeding of group III due to lack of time and theoretically unsuitable field for it.

Results of intraoperative enteroscopy

The IOE picked up the diagnosis of small bowel AVMs in all 12 cases included in the study. There were five cases of jejunal AVMs, five cases of ileal AVMs and two cases of multiple jejunal and ileal AVMs (Photos 1–3).

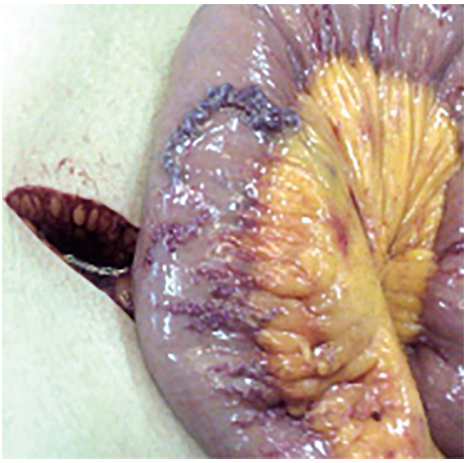
Eight (66.7%) patients were diagnosed by simple naked eye examination of small bowel at exploration and four (33.3%) patients were diagnosed by combined endoscopic examination and transillumination of the bowel (Photos 4–6).

Table 1 Patient's age, sex, group, haemoglobin% and associated medical diseases

Case numbers	Age (years)	Sex	Group	Hb (g%)	Associated medical diseases
1	63	Male	I	4	DM, HT
2	43	Male	II	6.5	–
3	46	Male	II	7	DM
4	38	Female	III	8	–
5	56	Male	II	5	DM, HT
6	42	Male	I	5.5	HT
7	68	Male	II	4.5	HT, CS
8	35	Female	II	6	DM
9	52	Male	I	4.5	HT, IHD
10	79	Female	III	5.5	HT, IHD, CS
11	32	Female	II	8.5	–
12	43	Male	II	6	DM

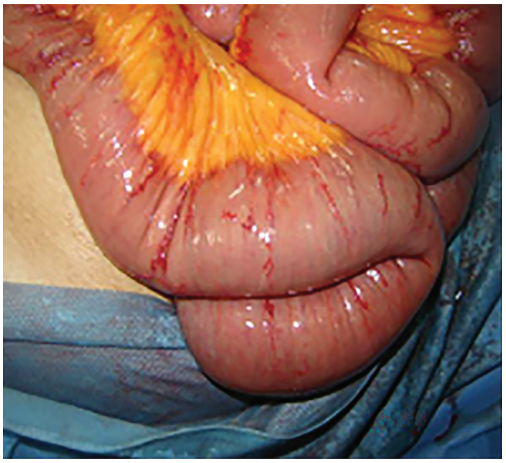
CS, cerebral stroke; DM, diabetes mellitus; Hb, haemoglobin; HT, hypertension; IHD, ischaemic heart disease.

Photo 1



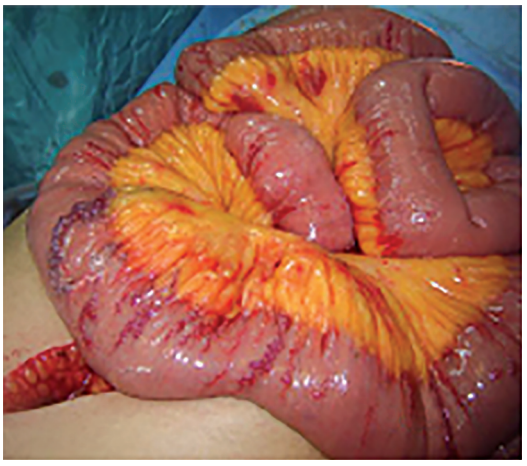
Large jejunal AVMs

Photo 2



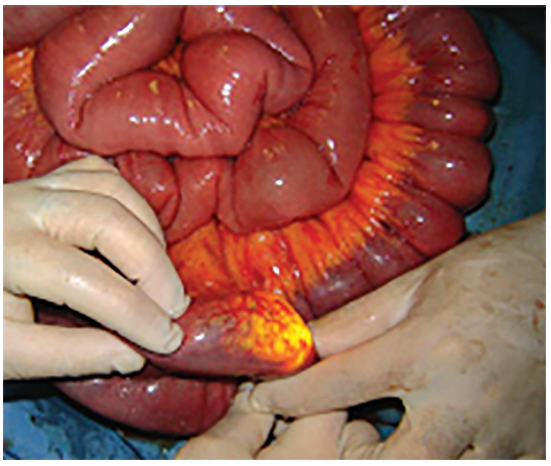
SmallIleal AVMs

Photo 3



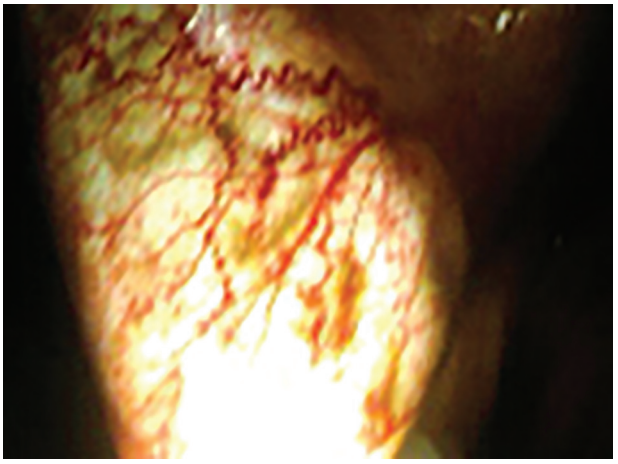
Multiple jejunal and ileal AVMs

Photo 4



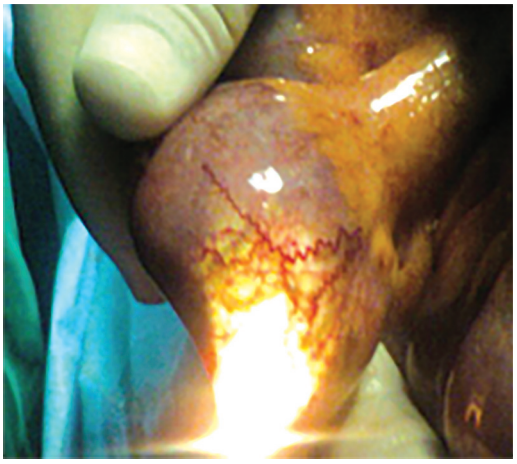
Trans-illumination of small jejunal AVMs

Photo 5



Trans-illumination of smallileal AVMs

Photo 6



Trans-illumination ofsmallileal AVMs

Transoral approach succeeded to reach the terminal ileum in seven (58.3%) patients, whereas in the remaining five (41.7%) patients endoscopy was completed through small enterotomies in the mid-length of the small bowel.

The mean operative time was 165 min. The intraoperative blood transfusion was 2.5 U on average. Argon plasma coagulation was used in two cases with small localized AVMs, whereas in the remaining 10 cases, resection of the diseased segment was performed. The mean length of the resected segment was 75 cm (Table 3). All sent specimens were histopathologically confirmed to have AVMs.

Evaluation of capsule endoscopy findings

We regarded the results of intraoperative endoscopy as the standard data against which the results of CE were compared. This is because the results of IOE are the most accurate criteria upon which the treatment options were chosen. In addition, most of the results of IOE were histopathologically confirmed.

The overall diagnostic yield of CE in small bowel AVMs was only 50% (five of 10 patients) and it was only 33.3% in cases with previous bleeding and 57.1% for those with ongoing bleeding (Table 2). In addition, there was underestimation of the extent of AVMs in two cases of wide-spread jejunal and ileal lesions (case nos 3 and 8). In addition, CE failed to diagnose the accurate site of AVMs in one case (case no. 11) when it diagnosed jejunal AVMs, whereas IOE revealed multiple ileal AVMs, which were resected (Table 3).

Regarding complications, CE had only two complications: retention in one case and battery failure in one case. IOE had numerous complications: mesenteric haematomas in eight cases, mesenteric tears in six cases, serosal tears in five cases and prolonged ileus more than 3 days in two cases (Table 4).

Postoperative results

We recorded postoperative complications in four cases: two cases showed prolonged ileus; one case developed postoperative heart failure and pulmonary oedema, which resolved on the ninth postoperative day and one case had a postoperative myocardial infarction superimposed on previous myocardial ischaemia and died on the third postoperative day (case no. 10). Otherwise, the remaining eight cases did well and recovered almost completely and were discharged surgically free. All surviving patients improved during the follow-up period and anaemias were corrected and bleeding did not recur during the follow-up period. It is worth to mention that one patient (case no. 2) presented with subacute intestinal obstruction 7 months after surgery. Conservative measures failed to bring improvement and he was re-explored where there was a stricture at the previous anastomosis, which was revised, and the patient recovered well postoperatively.

Table 2 Results of capsule endoscopy

CE results	[*n* (%)]		
	Group I (previous OGIB) (*N* = 3)	Group II (ongoing OGIB) (*N* = 7)	Total (*N* = 10)
Positive cases	1 (33)	4 (57)	5 (50)
Negative cases	2 (64)	3 (43)	5 (50)
Sensitivity (%)	33	57	50

CE, capsule endoscopy; OGIB, obscure gastrointestinal bleeding.

Discussion

Small bowel AVMs are the most common cause of OGIB. They may produce considerable and fatal bleeding that may end the patient's life before the traditional investigations can diagnose or localize the site of bleeding.

Although the CE acquired an excellent reputation in diagnosis, the cause of OGIB and its sensitivity reached

Table 3 Comparison between capsule endoscopy and intraoperative enteroscopy findings and methods of treatment

Case numbers	Group	CE finding	IOE finding	Action
1	I	Negative	Multiple jejunal AVM	Resection of 35 cm
2	II	Ileal AVM	Multiple ileal AVM	Resection of 28 cm
3	II	Ileal AVM	Multiple jejunal and ileal AVM	Resection 135 cm
4	III	Not done	Large ileal AVM	Resection of 17 cm
5	II	Negative	Small-sized jejunal AVM	Argon plasma coagualtion
6	I	Ileal AVM	Multiple ileal AVM	175 cm resection (right hemicolectomy)
7	II	Negative	Multiple jejunal AVM	Resection of 45 cm
8	II	Jejunal AVM	Multiple jejunal and ileal AVM	Resection of 145 cm
9	I	Negative	Small-sized jejunal AVM	Argon plasma coagulation
10	III	Not done	Large ileal AVM	Resection of 30 cm
11	II	Jejunal AVM	Multiple ileal AVM	Resection of 65 cm
12	II	Negative	Multiple jejunal AVM	Resection of 75 cm

AVM, arteriovenous malformation; CE, capsule endoscopy; IOE, intraoperative enteroscopy.

Table 4 Complications of capsule endoscopy and intraoperative enteroscopy

Complications of CE (total *n* = 10)	*N* (%)	Complications of IOE (total *n* = 12)	*N* (%)
Capsule retention	1 (10)	Mesenteric haematoma	8 (66.6)
Battery failure	1 (10)	Mesenteric tears	6 (50)
		Serosal tears	5 (41.6)
		Prolonged ileus	2 (16.6)

CE, capsule endoscopy; IOE, intraoperative enteroscopy.

more than 75% in many literatures [6,10,11]. However, its sensitivity in detection of small bowel AVMs seems to be lower than this figure; CE had only 50% sensitivity in this study. This may be explained by that CE lacks both air insufflation and suction of secretion during the whole technique. Air insufflation causes stretch of mucosal folds and allows better inspection of hidden lesions. In contrast, suction of intestinal secretion or possible food residues improves the view and unmasks small lesions. In addition, AVMs may be discovered better through the external surface of the intestines or by transillumination of the wall rather than through its mucosal surface.

CE underestimated the extent of the lesions in two (40%) cases of its positive cases (five cases) and wrongly localized the site of lesion in one (20%) case of its positive cases; this underestimation may be due to the fact that CE sometimes moves quickly through a long segment of the bowel with hyperperistalsis.

In addition, CE lacks the ability of immediate intervention or even obtaining biopsies for histological confirmation. Again, CE is a tedious investigation that wastes much time both in performance and interpretation of its results. This time may be very precious in case of moderate and massive GI bleeding.

Our CE had only 10% incidence of retention and 10% of failure due to finish of battery life before completion of the procedure, and these rates are comparable with other studies [10,12–14].

In our research, the transoral method of IOE failed to reach the terminal ileum in five (41.6%) cases, and this failure rate is higher than that reported by other studies [7,8]. This may be due to the fact that we used the adult colonoscope not the paediatric one, which is rather more flexible and more easily manipulated.

This study was not designed to evaluate the diagnostic yield of IOE because its results were used as the standard criterion against which findings of CE were blotted. However, IOE appears to be the most sensitive method in management of small bowel AVMs because it combines endoscopic inspection, naked eye visualization and transillumination of the small bowel in addition to its ability to provide histopathological confirmation of the findings and the feasibility of simultaneous immediate management of the lesions.

Being an invasive investigation, IOE had much higher incidence of complications than CE. However, this high rate of complications can be lowered with more experience of the operators and rising of the learning curve.

We have one perioperative mortality (8.3%), which lies within range of the published different studies [7,8,10–12,15–22]; they recorded mortality rate between 0 and 18%.

In conclusion, CE has a limited diagnostic yield in cases of small bowel AVMs especially in absence of ongoing bleeding, and IOE remains the mainstay method for diagnosis and treatment of these hidden killers.

Because of the relative rarity of the small bowel AVMs, the number of cases in this study was too small to perform a statistical analysis; hence, we recommend performing a more extended multicentre study to re-evaluate the role of CE in these cases.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

References

1 American Gastroenterological Association medical position statement: evaluation and management of occult and obscure gastrointestinal bleeding. Gastroenterology 2000; 118:197–200.

2 Leighton JA, Goldstein J, Hirota W, Jacobson BC, Johanson JF, Mallery JS, *et al.* Obscure gastrointestinal bleeding. Gastrointest Endosc 2003; 58:650–655.

3 Rex DK, Lappas JC, Maglinte DD, Malczewski MC, Kopecky KA, Cockerill EM. Enteroclysis in the evaluation of suspected small intestinal bleeding. Gastroenterology 1989;97:58–60.

4 Olds GD, Cooper GS, Chak AA, Wong RC.The yield of bleeding scans in acute lower gastrointestinal hemorrhage. J Clin Gastroenterol 2005; 39:273–277.

5 Zaman A, Katon PM. Push enteroscopy for obscure gastrointestinal bleeding yields a high incidence of proximal lesions within reach of a stand endoscope. Gastrointest Endosc 1998; 47:372–376.

6 Triester SL, Leighton JA, Leontiadis GI, Gurudu SR, Fleischer DE, Hara AK, *et al.* A meta-analysis of the yield of capsule endoscopy compared to other diagnostic modalities in patients with obscure gastrointestinal bleeding. Am J Gastroenterol 2005;100:2407–2418.

7 Ress AM, Benacci JC, Sarr MG. Efficacy of intraoperative enteroscopy in diagnosis and prevention of recurrent, occult gastrointestinal bleeding. Am J Surg 1992; 163:94–99.

8 Desa LA, Ohri SK, Hutton KA, Lee H, Spencer J. Role of intraoperative enteroscopy in obscure gastrointestinal bleeding of small bowel origin. Br J Surg 1991; 78:192–195.

9 Handra-Luca A; Montgomery E. Vascular Malformations and Hemangiolymphangiomas of the Gastrointestinal Tract: Morphological Features and Clinical Impact Int J Clin Exp Pathol 2011; 4:430–443.

10 Hartmann D, Schmidt H, Bolz G, Schilling D, Kinzel F, Eickhoff A, *et al*. A prospective two-center study comparing wireless capsule endoscopy with intraoperative enteroscopy in patients with obscure GI bleeding. Gastrointestinal Endoscopy 2005; 61:826–832.

11 Lewis BS, Wenger JS, Waye JD. Small bowel enteroscopy and intraoperative enteroscopy for obscure gastrointestinal bleeding. American Journal of Gastroenterology 1991; 86:171–174.

12 Hartmann D, Schmidt H, Schilling D, Kinze F, Eickhoff A, Weickert U, *et al*. Follow-up of patients with obscure gastrointestinal bleeding after capsule endoscopy and intraoperative enteroscopy. Hepato-Gastroenterology 2007; 54:780–783.

13 Douard R, Wind P, Berger A, Maniere T, Landi B, Cellier C, Cugnenc PH. Role of intraoperative enteroscopy in the management of obscure gastointestinal bleeding at the time of video-capsule endoscopy. American Journal of Surgery 2009; 198:6–11.

14 Apostolopoulos P, Liatsos C, Gralnek IM, Kalantzis C, Giannakoulopoulou E, Alexandrakis G. Evaluation of Capsule Endoscopy In Active Mild To Moderate, Overt, Obscure GI Bleeding Gastrointestinal Endosc 2007; 66 1174–1181.

15 Kendrick ML, Buttar NS, Anderson MA, Lutzke LS, Peia D, Wang KK. *et al*. Contribution of intraoperative enteroscopy in the management of obscure gastrointestinal bleeding. Journal of Gastrointestinal Surgery 2001; 5:162–167.

16 Schulz HJ, Schmidt H. Intraoperative enteroscopy. Gastrointestinal Endoscopy Clinics of North America 2009; 19:371–379.

17 Kopácová M, Bures J, Vykouril L, Hladík P, Simkovic D, Jon B, *et al*. Intraoperative enteroscopy: ten years' experience at a single tertiary center. Surgical Endoscopy 2007; 21:1111–1116.

18 Flickinger EG, Stanforth AC, Sinar DR, MacDonald KG, Lannin DR, Gibson JH. Intraoperative video panendoscopy for diagnosing sites of chronic intestinal bleeding. American Journal of Surgery 1989; 157:137–144.

19 Jakobs R, Hartmann D, Benz C, Schilling D, Weickert U, Eickhoff A, *et al*. Diagnosis of obscure gastrointestinal bleeding by intra-operative enteroscopy in 81 consecutive patients. World Journal of Gastroenterology 2006; 12:313–316.

20 Lala AK, Sitaram V, Perakath B, Ramakrishna BS, Kurian G, Khanduri P. Intraoperative enteroscopy in obscure gastrointestinal hemorrhage. Hepato-Gastroenterology 1998; 45:597–602.

21 Lau WY. Intraoperative enteroscopy – indications and limitations. Gastrointestinal Endoscopy 1990; 36:268–271.

22 Lopez MJ, Cooley JS, Petros JG, Sullivan JG, Cave DR. Complete intraoperative small-bowel endoscopy in the evaluation of occult gastrointestinal bleeding using the sondeenteroscope. Archives of Surgery 1996; 131:272–277.

Closed versus open lateral internal anal sphincterotomy for chronic anal fissure in female patients

Jamila Al Sanabani, Saleh Al Salami, Azzan Al Saadi

Department of Surgery, Faculty of Medicine, Sana'a University, Sana'a, Yemen

Correspondence to Jamila Al Sanabani, MD, Department of Surgery, Sana'a University, 16851, Sana'a, Yemen
Tel: +967 142 7303;
e-mail: jsanabani@yahoo.com

Received 2 May 2014
Accepted 14 May 2014

The Egyptian Journal of Surgery
2014, 33:178–181

Objective
The aim of the study was to determine the best technique for surgical treatment of chronic anal fissure in female patients.
Study designs
The study was designed as a prospective randomized study.
Place and duration of study
The study was conducted in Surgical Unit, Al Kuwait University Hospital and Al Huribi Hospital (Sana'a, Yemen) from January 2007 to December 2010.
Patients and methods
A total of 205 female patients undergoing surgery were divided into two groups. In group A, there were 100 patients who were treated by closed lateral internal anal sphincterotomy, and in group B there were 105 patients who were managed by open lateral internal anal sphincterotomy method. Patients were followed up for 6 months following surgery to observe for pain, bleeding, infection, incontinence, and recurrence.
The exclusion criteria were patients who had in addition hemorrhoids or any other anorectal diseases.
Results
There was acceptable difference in postoperative acute complications between the two methods of internal anal sphincterotomy. However, in group A, six patients (6%) were complicated with very low anal fistula postoperatively, whereas the recurrence rate was 6 versus 1.9% in group A versus group B, respectively ($P = 0.015$).
Conclusion
Lateral internal sphincterotomy either with open or closed method is the treatment of choice for chronic anal fissure in female patients and can be performed effectively and safely with acceptable rate of complications; however, the open method is considered to have less morbidity and rate of recurrence.

Keywords:
anal fissure, postoperative complications, sphincterotomy

Egyptian J Surgery 33:178–181

1110-1121

Introduction

Anal fissure is a benign painful condition of the anoderm, characterized by raised resting internal anal sphincter pressure, which is important in the pathogenesis of anal fissure, possibly by impairing tissue perfusion and leading to ischemic ulcer [1,2].

Chronic fissures are characterized by a sentinel tag, hypertrophic anal papillae, anal spasm, and/or fibrosis of the internal sphincter muscle. With the patient in a recumbent position, chronic fissures are commonly seen posteriorly at 6 o'clock and occasionally anteriorly at 12 o'clock position. Fissures at any other position need further investigation of the underlying cause. Possible causes are Crohn's disease, anal intercourse, sexually transmitted disease, or anal carcinoma [3].

The usual presentation is severe pain at the initiation of defecation that lasts for few hours afterwards. The pain is usually tearing or burning in nature. Few patients may complain of bleeding per rectum along with pain. Bleeding is usually small in amount staining the stool surface or in the shape of drops after defecation; occasionally, it may be severe [4].

On clinical examination, the fissure can usually be seen by gently parting the buttocks and everting the anal verge. Digital rectal examination and proctosigmoidoscopy are not recommended except under proper anesthesia [4].

Most of the acute fissures can be treated conservatively with bulking agents, stool softeners, local anesthesia creams, and sits path. Chronic fissures are more difficult to treat conservatively [4].

Topical glycerol trinitrate 0.2% ointment applied twice a day for weeks is effective in alleviating the symptoms of chronic anal fissure, with a 69.9% success rate after 2 months of follow-up [5].

 DOI: 10.4103/1110-1121.141905

Most common surgical procedure performed for chronic anal fissure is lateral internal anal sphincterotomy, which may be performed by open or closed method. The main objective was to divide the lower third to half of the internal sphincter, thus reducing the internal sphincter spasm and increasing local anoderm blood flow [4].

Surgical sphincterotomy leads in most cases to quick healing of chronic fissure. In all, 94.7–96% of fissures heal at 6 weeks postoperative and has a low recurrence rate [5–7]; two large studies have demonstrated a 2.3–3% failure rate at 5 years [8].

Patients and methods

This was a prospective study on 205 female consecutive patients admitted for surgery to Kuwait University Hospital and Al Huraibi Hospital (Sana'a, Yemen) from January 2007 to December 2010. In our study, chronic anal fissure was defined on clinical examination when induration at the edge of the fissure was visible and horizontal fibers of the internal anal sphincter could be seen in the base of the lesion and when anal pain on defecation was for at least 2 months, which failed to resolve with medical treatment. Patients who had hemorrhoids or any other anorectal diseases were excluded.

Patients undergoing surgery (205) were divided into two groups. In group A, there were 100 patients who were treated by closed lateral sphincterotomy, and in group B there were 105 patients who were managed by open lateral sphincterotomy method. All patients were viral markers (HBsAg, HCAb, and HIV) free.

After a routine preoperative assessment, all patients were operated as a day case, under general anesthesia.

Both procedures were performed under general anesthesia, with the patient in the lithotomy position. In the closed method, the left index finger is inserted in the anal canal to palpate the internal sphincter and feel the intersphincteric groove. A 1-cm incision is made in the groove between the internal and external sphincter, and scalpel is used to divide the lower third of internal sphincter controlled by the left index finger. In the open method, park retractor is used to retract the anal canal and feel the intersphincteric groove. A small 1-cm incision is made in the intersphincteric groove, and a scissor is used to separate the muscle from the mucosa and the lower third is divided followed by pressure for 3 min to control bleeding; the wound is closed with Vicryl 4/0 suture. Small dressing is applied at the end of the procedure. Patients were followed up for 6 months following surgery to observe for pain, bleeding, infection, incontinence, and recurrence.

Statistical analysis

Data were analyzed using a computer SPSS program, version 18 (Developers: IBM Corporation, University of Chicago). The Fisher test and Student's test were used for statistical analysis.

Result

The patients included in this study presented to out-patients clinic of Kuwait university hospital and Al Huribi Hospital with history of pain especially during defecation, bleeding per rectum, pruritus ani, and swelling at the level of anal verge. The chief complaint of most of the patients was pain on defecation (Table 1). The mean age was 32.2 years with a range between 18 and 45 years (Fig. 1).

About 182 (88.8%) of the patients were married, among whom in 80% the pain initiated after normal delivery (Table 2).

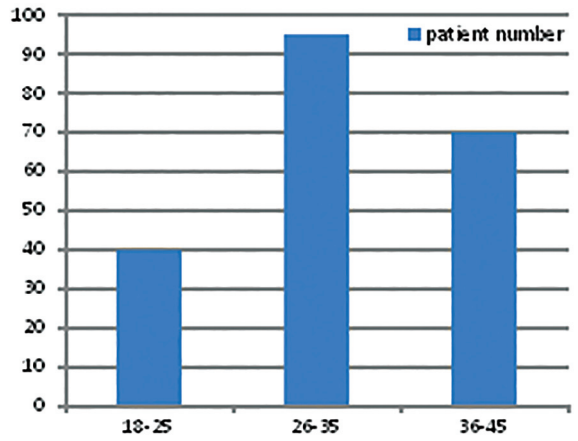
The position of the anal fissure was documented in 205 patients. In all, 175 patients were having posterior midline fissure, 20 patients were having anterior fissure, and 10 patients were having both (Table 3).

In patients undergoing open lateral internal anal sphincterotomy, 75 of 105 were free of symptoms on

Table 1 Mode of presentation

Symptoms	Number of patients (%)
Pain only	135 (65.85)
Pain and bleeding	70 (34.15)

Figure 1



Age distribution.

Table 2 Epidemiological data

Epidemiological data	All patients	Group A	Group B
Age (mean ± SD)	32.2 ± 8.19	32.4 ± 9.35	31.9 ± 6.94
Marital status [*n* (%)]			
Single	23 (11.2)	13 (13.0)	10 (9.5)
Married	182 (88.8)	87 (87)	95 (90.5)
Possible cause [*n* (%)]			
Postdelivery	160 (78.0)	80 (80.0)	80 (76.2)
Postconstipation	45 (22.0)	20 (20.0)	25 (23.8)

Table 3 Site of fissure

Site	Number of patients (%)
Posterior	175 (85.36)
Anterior	20 (9.75)
Both	10 (4.89)

Table 4 Postoperative complications

Complication	Number of patients	Group A [*n* (%)]	Group B [*n* (%)]
Pain	50	20 (20.0)	30 (28.5)
Bleeding	4	4 (4.0)	Nil (0.0)
Infection	2	1 (1.0)	1 (0.95)
Temporary incontinence	12	5 (5.0)	7 (6.7)
Fistula	6	6 (6.0)	0 (0.0)
Recurrence	8	6 (6.0)	2 (1.9)

Fisher's test; $P = 0.015$.

the next postoperative day, and, in patients undergoing closed lateral internal anal sphincterotomy, 80 of 100 were free of symptoms.

Postoperatively, only few patients showed complications. Twenty patients complained of postoperative pain in group A compared with 30 patients in group B; the pain improved within 2 weeks postoperatively. Bleeding after surgery was found in four patients in group A. Infection was found in two patients, one in each group. Mild incontinence to flatus, which was temporary, was found in five patients in group A compared with seven patients in group B. Recurrence was noticed in six patients in group A, whereas it was seen in only two patients in group B. Six patients were complicated by very low anal fistula postoperatively in group A (Table 4).

Regarding operative time, the operation took 2.6 (SD 0.78) min in group A compared with 6.6 (SD 1.03) min in group B ($P < 0.001$).

Discussion

In our study, of 205 patients, 105 patients were treated by open method and the rest were managed by the closed method of lateral internal anal sphincterotomy. The main aim of the study was to determine the best technique for the treatment of chronic anal fissure in female patients.

The majority of the fissures were found in the young age group. Ninety-five patients were between 26 and 35 years of age and the mean age in present study was 30.85 years. The mean age reported in different studies range from 30 to 45 years [9,10].

Patients suffering from anal fissure complain of pain, bleeding, discharge, and pruritus ani. A total of 135 (65.85%) patients presented with pain during or after defecation and 70 (34.15%) patients presented with bleeding with or without pain, which was not very close to 90.80 and 71.4% reported by Hanaanel and Gordon [10], respectively.

In our study, 175 patients (85.36%) presented with posterior midline fissures, 20 patients (9.75%) presented with anterior anal fissures, and 10 patients (4.89%) presented with anterior and posterior fissures. Samual [11] described that anal fissures are more common posteriorly. Giles [12] also described that most of the fissures are posteriorly midline. Nahas *et al*. [9] reported 86.1% posterior midline and 13.9% anterior fissures.

In patients undergoing open versus closed lateral internal anal sphincterotomy, 71.4 versus 80% were free of symptoms on the next postoperative day, respectively. Hiltunen and Matikainen [13] has described a similar result in case of closed lateral internal anal sphincterotomy, whereas Ullah and Nadeem [14] reported that 90 versus 88% were free of symptoms on the next day postoperative in patients undergoing open versus closed lateral internal sphincterotomy, respectively.

Our results of open and closed techniques regarding complications were as follows: pain (28.6 vs. 20%), bleeding (0 vs. 4%), infection (0.95 vs. 1%), incontinence (6.7 vs. 5%), fistula (0 vs. 6%), and recurrence (1.9 vs. 6%) ($P = 0.015$). It was noted that the complication rate is significantly higher in closed lateral internal sphincterotomy, whereas the time consumed during operation with closed versus open technique was 2.6 versus 6.6, respectively ($P < 0.001$).

Several other studies have also reported that there were no significant differences in the morbidity between open and closed method of sphincterotomy [15–17]. Pernikoff *et al*. [15] have reported that the complication rate is relatively higher in open lateral internal sphincterotomy.

In our study, it is clear that open and closed techniques are effective for treatment of chronic anal

fissure; however, the morbidity and recurrence rates are relatively less common in open lateral internal sphincterotomy.

Conclusion

Lateral internal sphincterotomy either with open or closed method is the treatment of choice for chronic anal fissure in female patients and can be performed effectively and safely with acceptable rate of complications; however, the open method is considered to have less morbidity and rate of recurrence.

Acknowledgements

Conflicts of interest

None declared.

References

1 Gibbons CP, Read NW. Anal hypertonic in fissure: cause or effect? Br J Surg. 1986; 73: 443–445.

2 Mc Namara MJ, Percy JP, Fielding IR. Amanometric study of anal fissure treated by subcutaneous lateral sphincterotomy. Ann Surg 1990; 211: 235–238.

3 Sajid M, Afzal M. Lateral internal sphincterotomy; outcome and complications. Professional Med J 2009; 16: 24–28.

4 Vila S, Garcia C, Piscoya A, De Los Rios R, Pinto J, Huerta Mercada J, Bussalleu A. Use of glycerol trinitrate in an ointment for the management of chronic anal fissure at the National Hospital 'Cayetano Heredia'. Rev Gastroenterol Peru 2009; 29: 33–39.

5 Wily M, Day P, Rieger N, Stephens J, Moore J. Open vs. closed lateral internal sphincterotomy for idiopathic fissure – in ano: a prospective, randomized, controlled trial. Dis Colon Rectum 2004; 47: 847–852.

6 Hyman N. Incontinence after lateral internal sphincterotomy: a prospective study and quality of life assessment. Dis Colon Rectum 2004; 47: 35–38.

7 Hasse C, Brune M, Bachmann S, Lorenz W, Rothmund M, Sitter H. Lateral, partial sphincter myotomy as therapy of chronic anal fissure. Long-term outcome of an epidemiological cohort study. Chirug 2004; 75: 160–167.

8 Mc Callion K, Gardner KR. Progress in the understanding and treatment of chronic anal fissure. Postgrad Med J 2001; 77: 753–768.

9 Nahas SC, Sobrado Junior CW, Araujo SE, Aisaka AA, Habar Gama A, Pinotti HW. Chronic anal fissure: results of the treatment of 220 patients. Rev Hosp Clin Fac Med Sao Paulo 1997; 52: 246–249.

10 Hanaanel N, Gordon PG. Lateral internal sphincterotomy for fissure in ano. Dis Colon Rectum 1997; 40: 597–602.

11 Samual S. Anal fissure. In: Mazier WP, Leien DH, Luchfeld MA, Senagore AG. Surgery of colon, rectum and anus. Philadelphia: W.B. Saunders; 1995; 255–268.

12 Giles GR. The colon, rectum and canal. In: Cuschieri A, Giles GR, Moosa AR. Essential surgical practice. 3rd ed. London: Butterworth Heinemann; 1995; 1362–1407.

13 Hiltunen KM, Matikainen M. Closed lateral subcutaneous sphincterotomy under local anesthesia in the treatment of chronic anal fissure. Ann Chir Gynaecol 1991; 180: 353–356.

14 Ullah S,Nadeem M. Closed versus open lateral internal sphincterotomy in chronic anal fissure: comparative study of prospective complications & results. Pakistan J Med Res 2004; 43:1–4.

15 Pernikoff BJ, Eisenstat TE, Rubin RJ, Oliver GC, Salvati EP. Reappraisal of partial lateral internal sphincterotomy. Dis Colon Rectum 1994; 37: 1291–1295.

16 Nelson R. Operative procedures for fissure in-ano. Cochrane Database syst Rev 2002:CD002199.

17 Orsayc C, Rakinic J, Perry WB, *et al.* Standards practice task force; American Society of colon and rectal surgeons Practice parameters for the management of anal fissures (revised). Dis Colon Rectum 2004; 47: 2003–2007.

Evaluation of delayed lipomodelling for breast reconstruction after different oncological surgical interventions for breast cancer patients

Yasser S. Ahmed, Mohamed H. Sultan, Samy E. Ibrahim, Khaled E. Soliman, Medhat M. Anwar, Rabie R. Abdelwahed, Ahmed Karmouty, Hamza Alaa

Experimental and Clinical Surgery Department, Medical Research Institute, University of Alexandria, Alexandria, Egypt

Correspondence to Yasser S. Ahmed, Experimental and Clinical Surgery Department, Medical Research Institute, Alexandria University, 165 Horia Street, El Hadra, Alexandria, Egypt
e-mail: yasserendo30@yahoo.com

Received 13 May 2014
Accepted 16 May 2014

The Egyptian Journal of Surgery
2014, 33:182–187

Background
Oncoplastic techniques, autologous flaps and implants are commonly used plastic surgery techniques in patients undergoing breast reconstruction. Lipomodelling is a currently used technique to correct soft-tissue defects.
Restoring an acceptable appearance after breast cancer surgery has become an integral part of the treatment process. Even though advances in autologous and implant-based surgical techniques have markedly improved breast reconstructions over the past decennia, they have ultimately raised the patients' expectations.

Patients and methods
The study included 30 female patients undergoing delayed lipomodelling after breast cancer surgery using the Coleman technique. Patients, after mastectomy and after breast conservative surgery with tissue defect and/or deformities, will undergo delayed lipomodelling at least 6 months after completion of radiotherapy.

Results
In our study, 43 lipofilling sessions were performed in 30 patients. Twenty-four patients had invasive ductal carcinoma and six patients had DCIS. The mean amount of fat injected ranged from 50 to 400 ml and sessions of lipofilling ranged from one session to three sessions according to the indication. The follow-up interval was 16 months. The most common complication was macrocalcification and oil cyst formation in three patients. No cases of local recurrence were detected. The satisfaction rate was excellent in 36.6% and good in 43.3% of the patients.

Conclusion
Fat grafting can be used as an alternative method of breast reconstruction in selected cases as it is an easy and cheap method with a very high rate of acceptance from the patient because it is an easy day surgery technique, with minimal complications to the recipient and the donor site. An excellent aesthetic result as well as longevity can also be achieved.

Keywords:
breast reconstruction, cancer breast surgery, lipofilling

Egyptian J Surgery 33:182–187

1110-1121

Introduction

The psychological impact of surgery in breast cancer patients is multifactorial, the cosmetic result and body image being important factors as also the fear of recurrence of cancer. A better cosmetic result usually leads to a better psychological outcome [1].

Oncoplastic techniques, autologous flaps and implants are commonly used plastic surgery techniques in patients undergoing breast reconstruction [2,3].

Coleman [4] introduced a new refined technique of fat aspiration, purification and injection that considerably improved graft survival and reduced the rate of complications. The Coleman technique was soon adopted by most plastic surgeons worldwide and became used widely for both cosmetic and reconstructive indications [5–10].

The recent re-emerging popularity of breast fat transplantation is based on recent reports and work by a number of surgeons including Coleman and Delay, who have introduced the term 'lipomodelling', and used the technique alone or in combination with other reconstructive procedures [11].

Lipomodelling is the process of relocating autologous fat to alter the shape, volume, consistency and profile of tissues, with the aim of reconstructing, rejuvenating and regenerating body features. The terms in current use to describe the technique are micro fat grafting, fat transfer, fat injection and lipofilling [12,13].

Success depends on careful harvesting, refining and grafting of the fat. As techniques have improved, lipomodelling has become more widely applied in reconstruction following breast cancer surgery, treatment of secondary defects after breast-cancer

 DOI: 10.4103/1110-1121.141906

reconstruction or tissue damages and deformities after radiotherapy, treatment of congenital and acquired breast deformities and recently, for cosmetic augmentation [12,13].

In this study, we aimed to evaluate delayed lipomodelling after different techniques of Surgery for Breast Cancer in terms of patient satisfaction, aesthetic results, complications, number of sessions needed and the amount of fat harvested, injected and reabsorbed.

Patients and methods

The study included 30 female patients scheduled to undergo delayed lipomodelling using the Coleman technique after surgery for breast cancer including just mastectomy, mastectomy with autologous flaps, mastectomy with implants and breast conservative surgery (BCS) with tissue defects and/or deformities [3]. The patients included had undergone delayed lipomodelling at least 12 months after the completion of radiotherapy. Lipomodelling was staged (from two to three sessions after modified radical mastectomy and one to two sessions after BCS).

Exclusion criteria

(1) General medical comorbidities that are a contraindication to repeated procedures requiring general anaesthesia such as bleeding disorders and vasospastic conditions that increase the risk of postoperative complications. The use of local anaesthesia with or without sedation may be a suitable alternative.
(2) Heavy smoker.
(3) Current use of medications such as aspirin, NSAIDs, cytotoxic and immunosuppressant drugs because of associated risks of bleeding and infection.
(4) Inadequate donor sites.
(5) Unsuitability of the recipient site.
(6) Patients actively dieting around the time of fat grafting.

Preoperative evaluation

Thirty patients admitted and operated for cancer breast in the Department of Surgery, Medical Research Institute Hospital, Alexandria University, were evaluated by clinical and radiological breast examinations (mammography and breast ultrasonography) before the lipofilling operation. All individuals agreed to participate after the objectives of the study were explaining to them and they signed an informed consent. Moreover, the study was approved by the local Institutional Ethical Committee. Preoperative photographs were taken in all cases, and all the breast defects were measured by a ruler on its two major axis, and, finally, the depth was measured by an approximate and empirical measurement.

Surgical technique

The procedure was performed under general anaesthesia. The selected donor site was infiltrated with Klein's solution [14]. It consists of 1 mm of epinephrine diluted in 500 ml of 0.001% lactate ringer solution. The amount of solution injected was double the volume of pre-estimated fat tissue requirement (Fig. 1a).

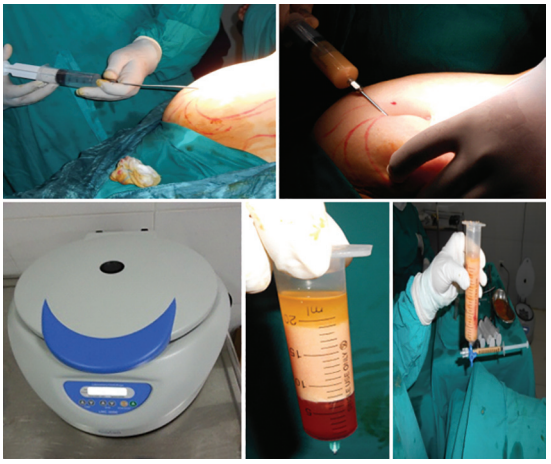
The entire procedure of fat harvesting and 'lipofilling' was performed according to Coleman's technique [3], with minimal modifications (Fig. 1).

After the injection of the diluted solution, a two-hole, 3-mm diameter Coleman's cannula with a blunt tip attached to a 50-ml Luer-Lock syringe was inserted through the small incision. A combination of a slight negative pressure and the curetting action of the cannula through the tissues allows fat harvesting. The fat was harvested until we reached the pre-estimated defect volume. Then, we obtained the fat for centrifugation at 3000 rpm for 3 min until the serum and oily components were separated from the adipose tissue.

The cellular component was immediately transferred to a 1 or a 3-ml Luer-Lock syringe and prepared for injection.

The prepared cellular component was then injected into the defect area through a blunt Coleman's cannula. A retrograde injection with a thin-layer and multiple-

Figure 1



Coleman's Technique: (a) Infiltration of donor site with Klein's solution. (b) Liposuction (abdomen) using 3 mm Coleman's cannula and 50cc Luer Lock syringe. (c) Centrifugation at 3000 rpm for 3 minutes for fat separation. (d) Products of centrifugation.Centrifugation of the lipoaspirate yields three layers, with the purified fat forming the central layer. (e) Pure fat collected and transferred to 1 mm syringes.

tunnel technique was administered. We avoided placing fat as an excessive depot, which may result in liponecrosis and graft loss.

Local factors can influence our technique approach for individual cases, especially in scarred and irradiated tissues. We broke the fibrotic scar with a sharp cannula to create the space for grafting. However, this group is more likely to have a second session for lipofilling and the second procedure in this group is usually easier as the tissue quality is improved by the first lipofilling procedure.

Clinical examination

Immediately postoperatively for the detection of haematoma, bruises and cellulite in donor site or recipient site.

At 6 and 9 months' follow-up for each patient clinically for detection of any area of palpable traumatic fat necrosis.

Radiological follow-up

Ultrasound and mammogram were performed for assessment of breast to detect any complication such as fat cyst and macrocalcifications at 6 and 12 months.

Patient satisfaction

Patient satisfaction was assessed by a questionnaire given to the patient to assess the result (symmetry with other site, softness, shape of breast, donor and recipient site complications and level of acceptance of the intervention and impact on sexual and social life).

Results

The mean age of the patients at the time of fat grafting was 39 years (range 31–48 years).

Discussion

Surgery for cancer breast can result in physical and psychological trauma to a patient; thus, preservation of good aesthetic shape after surgery is an integral part of management in these patients.

Different plastic reconstructive techniques such as prosthesis and autologous flap reconstruction are used for this purpose; however, these techniques may lead to complications in the donor or the recipient site and may require more interventions for correction of shape. Thus, the introduction of fat-free injections provided an excellent solution for correction of these deformities after different breast surgical interventions.

Fat injections were initiated in the 1980s for correction of small defects after maxillofacial surgery [4].

Coleman started the use of lipofilling by providing a description of the perfect technique for harvesting and separation of fat with minimal trauma to fat cells to preserve mature adipocyte and stem cells viable for correction of defect after conservative breast surgery (CBS).

Delaporte *et al*. [15] used Coleman's technique for complete breast reconstruction after mastectomy, with a perfect result, with injection of a larger amount of fat.

In our study, we used the Coleman technique for lipofilling as an alternative technique for autologous flap for reconstruction of defects that result from primary breast surgery of cancer breast.

After modified radical mastectomy

Complete reconstruction of the breast after mastecomy only by lipofilling started in France as a new technique by Delay. Five patients were included in our study; between two and three sessions were needed for complete reconstruction, with a moderate amount of fat injected, around 200 ml, in each setting. We performed an intervention 12 months after radiotherapy.

At the follow-up 3 months after each setting, we found that the reduction in the volume of fat was 30–37%, facilitated by the BTTC programme. We performed tattooing and nipple reconstruction after the optimal shape of the breast was achieved.

All sessions were performed as day surgery procedures.

After conservative breast surgery

One of the important applications of lipomodelling is correction of defects after CBS resulting from postoperative radiotherapy or surgery [16]. Ten cases after CBS needed one session of fat grafting that was sufficient with a median amount of fat injected of 90 ml. We performed dissection of fibrosis by a sharp needle to improve the shape of the breast.

The main problem in CBS is the fear of increased incidence of local recurrence [16,17], but in our follow-up, there was no increase in local recurrence.

After autologous flap

For correction of symmetry with other sites instead of reduction mammoplasty of the normal breast [17], we used this technique for correction of discrepancy in the size of the other breast in nine patients; this was

easier as injection into the tissue flap and correction of symmetry were satisfactory for cases with a median amount of fat (160 ml).

Our result was similar to that of Sinna *et al.*, who injected an average of 176 ml of fat and found a satisfactory result in 94% of patients [18].

After skin-sparing mastectomy with prosthesis

Six patients with implant had irregularities in the surface and thin skin over the implant; we changed the implant, with injection of fat into the layer between the capsule of the implant and the skin. The texture of the skin improved and sensation of an implant under the skin decreased.

Table 1 Clinicopathalogical data and type of primary oncological surgery

Type of primary oncological surgery	Number (%)
Mastectomy	4 (13.3)
Mastectomy with TRAM	5 (16.6)
Mastectomy with LD flap	4 (13.3)
Skin-sparing mastectomy with implant	6 (20)
Conservative breast surgery	3 (10)
	8 (26.6)
Stage of breast cancer	
Stage I	12 (40)
Stage II	17 (42.6)
Stage III	1 (3.4)
Stage VI	0 (0)
Pathology of the tumour	
IDC	22 (83.4)
DCIS	8 (26.6)

TRAM, transverse abdomens myocutaneous.

Cigna *et al.* [19] injected a skin envelope overlying implant for correction of complications of radiation and to decrease the extent of complications of implant reconstruction after irradiation [19,20].

Follow-up

Two of our patients had cellulite at the donor site and they were treated with antibiotics and dressing.

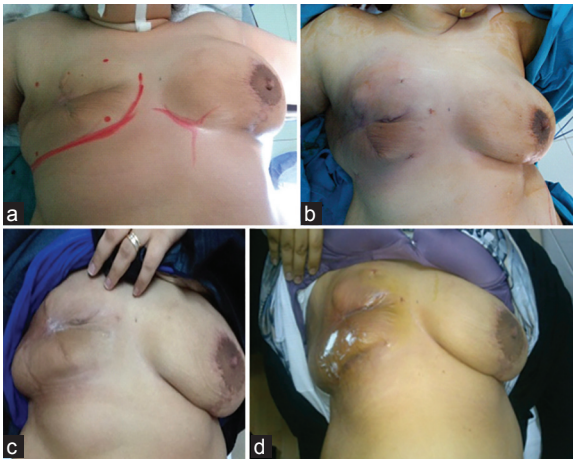
On mammogram follow-up, there were microcalcifications and oil cyst in four patients.

On oncological follow-up, no cases of local recurrence were found at a median follow-up of 16 months, similar to the result of the study carried out by Petit *et al.* [21].

Table 2 Volume of fat and type of surgery

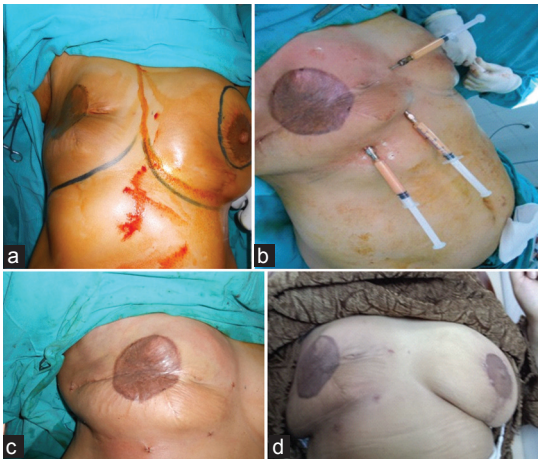
Surgical techniques	*N* (%)
Anaesthesia	
General	23 (76.6)
Local	7 (23.4)
Donor site	
Abdomen	25 (83.3)
thigh	4 (13.3)
buttock	1 (3.3)
Average amount of fat injected (ml)	
<100	8 (26.7)
From 100 to 200	12 (40)
From 200 to 300	6 (20)
>300	4 (13.3)

Figure 2



(a) 42 years old patient operated since 1.5 years by skin sparing mastectomy and immediate reconstruction with silicone implant inserted subpectorally (removed 2 weeks later after being infected) and contralateral reduction mammoplasty (Preoperative photo). (b) Immediately postoperative after injection of 200 cc of purified fat. (c) 1 week postoperative. (d) 1 month postoperative.

Figure 3



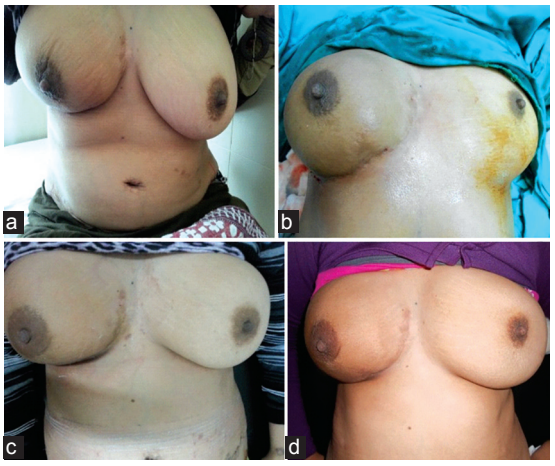
(a) After 3 months amount of fat grafted was reduced by 40% and the areola was made by skin tattooing (Preoperative photo). (b) Fat grating using 1,5 mm cannula and 3 cc Luer Lock syringes (injection is multidirectional at different levels on withdrawal of the cannula). (c) Immediately postoperative after injection of 410 cc of purified fat. (d) 1week postoperative.

Table 3 Patient satisfaction

Type of surgery	Satisfaction				
	Poor	Fair	Good	Excellent	No
MRM	0	1	2	2	5
SSM + autologus flap	1	1	3	4	9
SSM + flap	1	0	5	0	6
CBS	0	2	3	5	10
Precentage	6.6	13.3	43.3	36.6	

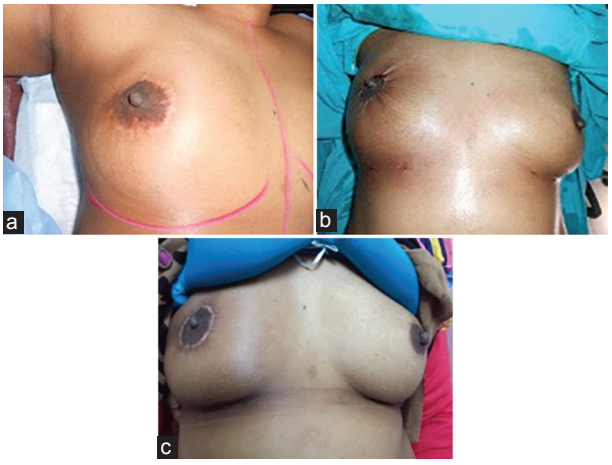
MRM, modified radical mastectomy; SSM, skin-sparing mastectomy.

Figure 4



(a) 34 years old patient with NSM and TRAM Flap undergoing lipofilling for asymmetry (Preoperative photo).(b) Immediatelypostoperative after injection of 200 cc of purified fat. (c) 1 week postoperative. (d) 1 month postoperative

Figure 6



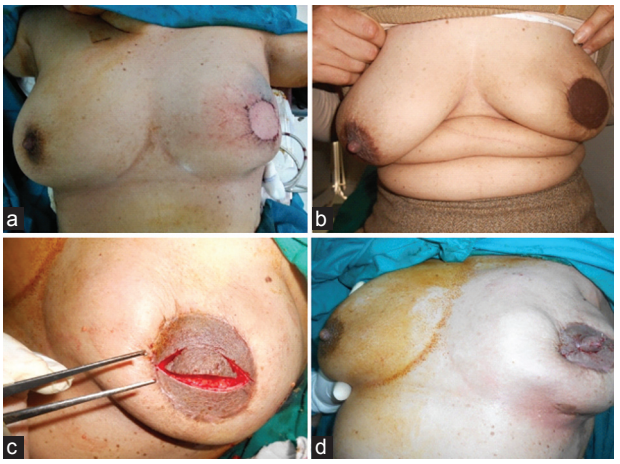
(a) 37 years old patient after BCS using oncoplastic technique (round block mammoplasty) for delayed lipofilling for correction of defect at upper outer quadrant (marked by a circle) and asymmetry (Preoperative photo). (b) Immediately postoperative after injection of 130 cc of purified fat. (c) 1 month postoperative.

Patient satisfaction

36.3% of our patients achieved an excellent result, whereas 43.6% achieved a good result in terms of the shape of the breast and ease of the procedure as it was a day surgery and there were minimal complications to the donor and recipient site.

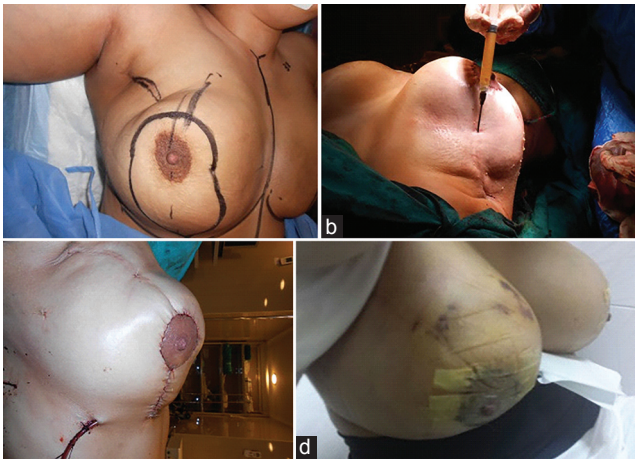
The BCS and skin-sparing mastectomy group that received an autologous flap reported greater satisfaction as they achieved the perfect shape in one session, with minimal to moderate amount of fat injection and fewer complications to the donor or recipient site. However, the mastectomy group reported the least satisfaction as more sessions and a large amount of fat injection were required, and they did not achieve the expected result.

Figure 5



(a) 53 years old patient with retroareolar breast cancer operated with skin sparing mastectomy with immediate LD flap reconstruction. (b-d) 6 months later nipple and areola reconstruction after tattooing and lipofilling by 230 cc fat for augmentation.

Figure 7



(a) 32 years old patient with quadrantectomy, after 28 months of adjuvant chemotherapy and radiotherapy. (b,c) correction of deformity by injection of 210 cc of fat. (d) one week postoperative.

Conclusion

Fat injection is a new promising modality among reconstructive techniques for breast reconstruction after different types of oncological surgical management of cancer breast, involving scarless day surgery procedure and minimal complications to the donor and recipient site, with excellent patient satisfaction.

It is a perfect solution in cases of CBS or skin-sparing mastectomy with an autologous flap, but in the cases of mastectomy, it can be considered a preparatory step for correction of the quality of skin after radiotherapy, followed by insertion of a small-size implant (Tables 1–3 and Figs. 2–7).

Acknowledgements

Conflicts of interest

None declared.

References

1 Nicholsona RM, Leinsterb S, Sassoona EM. A comparison of the cosmetic and psychological outcome of breast reconstruction, breast conserving surgery and mastectomy without reconstruction. Breast 2007; 16: 396-410.

2 Coleman SR. Structural fat grafting: more than permanent filler. Plast Reconstr Surg 2006; 118(3 Suppl): 108S-120SS.

3 Coleman SR. *Structural fat grafting. Chapter 47*. Lippincott Williams & Wilkins, St Louis. 2007; 480-485.

4 Coleman SR. Facial recontouring with lipostructure. Ann Plast Surg 1997; 24:347–367.

5 Elfadl D, Garimella V, Mahapatra TK, *et al.* Lipomodelling of the breast: a review. Breast. 2010; 19:202–209.

6 Chan CW, McCulley SJ, Macmillan RD. Autologous fat transfer a review of the literature with a focus on breast cancer surgery. J Plast Reconstr Aesthet Surg. 2008; 61:1438–1448.

7 Parrish JN, Metzinger SE. Autogenous fat grafting and breast augmentation: a review of the literature. Aesthet Surg J 2010; 30:549–556.

8 Coleman SR, Saboeiro AP. Fat grafting to the breast revisited: safety and efficacy. Plast Reconstr Surg. 2007; 119:775–785.

9 Zocchi ML, Zuliani F. Bicompartmental breast lipostructuring. Aesthetic Plast Surg 2008; 32:313–328.

10 Illouz YG, Sterodimas A. Autologous fat transplantation to the breast: a personal technique with 25 years of experience. Aesthetic Plast Surg 2009; 33:706–715.

11 Del Vecchio DA, Bucky LP. Breast augmentation using preexpansion and autologous fat transplantation: a clinical radiographic study. Plast Reconstr Surg. 2011; 127:2441–2450.

12 Rohrich RJ, Sorokin ES, Brown SA. Search of improved fat transfer viability: a quantitative analysis of the role of centrifugation and harvest site. Plast Reconstr Surg 2004; 113:391e7.

13 Chan CW, McCulley SJ, Mcmillan RD. Autologous fat transfer – a review of the literature with a focus on breast cancer surgery. J Plast Reconstr Aesthet Surg 2008; 61:1438-1448.

14 Klein JA. In: Klein JA, editor. Subcutaneous fat: anatomy and histology. Tumescent technique. St Louis: Mosby; 2000. 213–221.

15 Delaporte T, Delay E, Toussoun G, Delbaere M, Sinna R. Breastvolumereconstruction by lipomodelingtechnique: about 15 consecutivecases. Ann Chir Plast Esthet. 2009; 54:303-316.

16 Delay E, Garson S, Tousson G, *et al.* Fat injection to the breast: technique, results, and indications based on 880 procedures over 10 years. Aesthet Surg J 2009; 29:360–376.

17 Delay E, Gosset J, Toussoun G, Delaporte T, Delbaere M. Efficacy of lipomodelling for the management of sequelae of breast cancer conservative treatment. Ann Chir Plast Esthet 2008; 53:153-168.

18 Sinna R, Delay E, Garson S, Delaporte T, Toussoun G. Breast fat grafting (lipomodelling) after extended latissimusdorsi flap breast reconstruction: a preliminary report of 200 consecutive cases. J Plast Reconstr Aesthet Surg 2010; 63:1769-1777.

19 Cigna E, Ribuffo D, Sorvillo V, Atzeni M, Piperno A, Calò PG, Scuderi N. Secondary lipofilling after breast reconstruction with implants. Eur Rev Med Pharmacol Sci. 2012;16:1729-1734.

20 Irani Y, Casanova D, Amar E. Autologous fat grafting in radiated tissue prior to breast prosthetic reconstruction: is the technique reliable? Ann Chir Plast Esthet. 2012; 57:59-66.

21 Petit JY, Rietjens M, Botteri E. Evaluation of fat grafting safety in patients with intraepithelial neoplasia: a matched-cohort study. Ann Oncol. 2013; 24:1479-1484.

Evaluation of intracorporeal knotting and metallic clipping of the appendicular stump in laparoscopic appendicectomy

Hady S. Abou Ashour

General Surgery Department, Faculty of Medicine, Minoufiya University, Shibin Al Kom, Egypt

Correspondence to Hady Saleh Abou Ashour, MD, MRCS. (Eng.), Faculty of Medicine, Minoufiya University, Shibin Al Kom, Egypt
Tel: +201000630111;
e-mail: aboashour_hady@yahoo.com

Received 3 May 2014
Accepted 28 May 2014

The Egyptian Journal of Surgery
2014, 33:188–193

Background
Laparoscopic appendicectomy has gained popularity, especially among laparoscopic surgeons, due to the advantages of minimal-access surgery and the simplicity of the technique. Together with endoloop, various techniques have been tried to secure the base of the appendix. Some laparoscopic surgeons apply ligature or clips owing to its lower cost and feasibility. In this study, we applied intracorporeal ligature (knotting) or metallic clips for secure closure of the base of the appendix during laparoscopic appendicectomy.

Aim
The aim of this work was to evaluate the application of both techniques, together with recording of any specific complications related to each.

Patients and methods
During the period from February 2010 to November 2013, in Minoufiya University Hospital and other private hospitals, 200 laparoscopic appendicectomy patients were included in this prospective study. In total, 117 patients were female and the overall average age was 27.4 years. Patients were divided into two equal groups (group A and group B): group A underwent intracorporeal knotting of the base and the metallic clip closure technique was the alternative in group B.

Results
The mean operative time was 45 min in group A and 37 min in group B ($P < 0.05$). The mean hospital stay was 2.07 days in group A and 2 days in group B, and this was not significant ($P > 0.05$). Complications varied between port-site wound infection and delayed intestinal sounds, and there were no significant differences or major complications.

Conclusion
In our study, both intracorporeal knotting and the metallic clip closure technique were successful, feasible, and economic in securing the appendicular stump, except for a wide, severely edematous, or gangrenous base, wherein the metallic clip closure technique was not appropriate.

Keywords:
clipping of appendicular stump, knotting, knotting and metallic clipping of the appendicular stump

Egyptian J Surgery 33:188–193

1110-1121

Introduction

Historically, the right lower quadrant incision of open appendicectomy (OA) has persisted essentially unchanged since it was pioneered by McBurney in the 19th century [1,2].

Laparoscopic appendicectomy (LA) has become a frequently used alternative in the treatment of acute appendicitis. In 1983, LA was first described by Semm, a German surgeon, and in 1987, Schreiber carried out the first LA for acute appendicitis. For long time, LA has not gained the same widespread popularity and enthusiasm as has laparoscopic cholecystectomy [3], but reports [3,4] have documented the feasibility and the safety of LA, suggesting that it is the new 'gold standard'.

Several studies have compared LA with the conventional open procedure, regarding the surgical time, the hospital stay, return of the patient to normal life, and complications [3,5].

Various techniques have been used for the ligation of the appendicular stump, such as preformed suture loops (endoloops) and endoscopic linear cutting staplers (endo-GIA), and sealing of appendiceal vessels was performed by the Liga-Sure System, the Harmonic scalpel [6,7], bipolar coagulation [8], and base control was further tried by polymeric clips [9,10], ligature by polyglactin suture [11], and endorings [12]. In this study, the evaluation of both techniques was performed regarding their safety and cost, and any expected specific complications were reported.

Patients and methods

During the period from February 2010 to November 2013, in Minoufiya University Hospital and other

 DOI: 10.4103/1110-1121.141908

private hospitals, 200 LA patients were included in this prospective study. The study was approved by the local ethics and research committee of the Minoufiya Faculty of Medicine and its university hospitals. In total, 117 patients were female and 83 were male. Patients were divided into two equal groups (group A and group B). Group A included patients who underwent intracorporeal knotting (ICK) of the appendicular stump and the metal clip closure technique (MCC) was the alternative option in group B.

The primary objective of this study was to evaluate both techniques regarding their safety and to report any complications specific to each technique.

Other secondary objectives included the following:

(1) The cost effectiveness of both techniques.
(2) The simplicity of the techniques for trainees.

Difficulty or insecure knotting or clipping of the appendicular stump due to any cause was reported as failure of the technique and no cross-over plan was decided. All patients were subjected to full history taking, clinical evaluation, abdominal ultrasound, and routine laboratory investigations. Informed consent was taken and patients with any criteria that interfere with laparoscopic surgery were excluded from the study, for example, pregnancy, previous lower abdominal surgery and hostile abdomen, age less than 5 years or more than 65 years, and concomitant morbidities that interfere with laparoscopic surgery, for example, patients with ASA III physical status.

Before surgery, all the patients received standard intravenous antibiotics (1.2 g of amoxicillin and clavulanic acid and 500 mg of metronidazole); the criteria of discharge were absence of fever, audible intestinal sounds, oral fluid tolerance, and the ability to walk around. The appendix was sent for histopathological evaluation, and the postoperative analgesia and antibiotic was continued for 5–7 days.

Patients were followed up for 6 months to report any early or late postoperative complications.

Surgical procedure

The surgeon stood to the left side of the patient, looking toward his/her caudal direction. Then, three ports were used: the first one was located in the periumbilical region to introduce a 0–30° Karl Storz optic telescope, two more working ports (5 mm) were inserted in the right lower quadrant at the McBurney point, and a 10 mm port in the left lower quadrant just above the pubic hair line lateral to the border of the rectus sheath; this port can also be used for the telescope, using the periumbilical port as a working port for the right hand and the right one as a working port for the left hand (this was an alternative option for standard port uses).

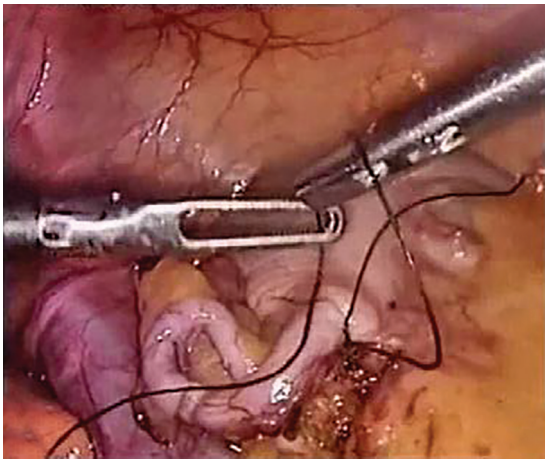
The patient was then positioned in the Trendelenburg with a mild-left tilt, to facilitate the exposure of the appendix. Any pus collection was aspirated, and then, dissection of the appendix and control of the appendicular artery by clips or ligation was performed. The appendiceal stump closure was secured by applying an ICK by polyglactin suture 2-0 or 3-0 in group A (Figs. 1–3). In group B, the stump was secured by two or three large titanium endoclips on the healthy firm tissue next to the cecum wall. A distal clip (spaced 10 mm from the proximal one) was applied to permit a cut in between (Figs. 4 and 5). It was noticed that the appendix base becomes wider in its attachment to the cecum, and the clip cannot secure 100% of the stump diameter (Fig. 6), and so it was better to clip 0.75 cm away from the cecum to achieve proper occlusion. After sectioning of the appendix, the extraverted appendiceal mucosa was coagulated and the abdominal cavity was reassessed for any local or remote fluid collection or bleeding, and irrigation with warm saline solution and suction under visualization was performed.

This was followed by routine histopathology of the removed appendix. A non suction drain was inserted in 15 patients with complicated appendix or infected collection.

The overall average cost was calculated for each technique after each operation.

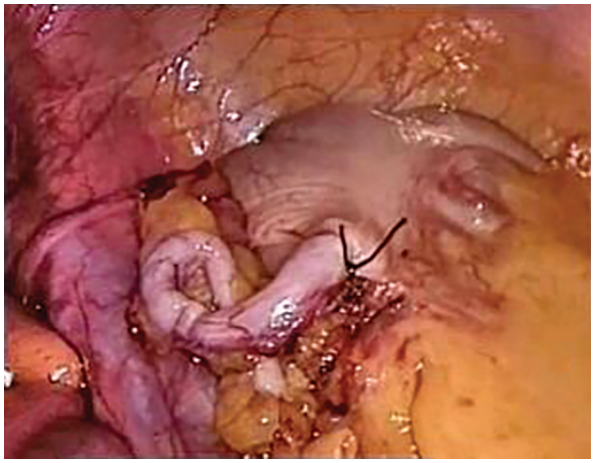
Diagnoses of operative complications were defined and reported as bleeding, iatrogenic injury, endoclip escape or blow out, small-bowel obstruction, or enteric leak.

Figure 1



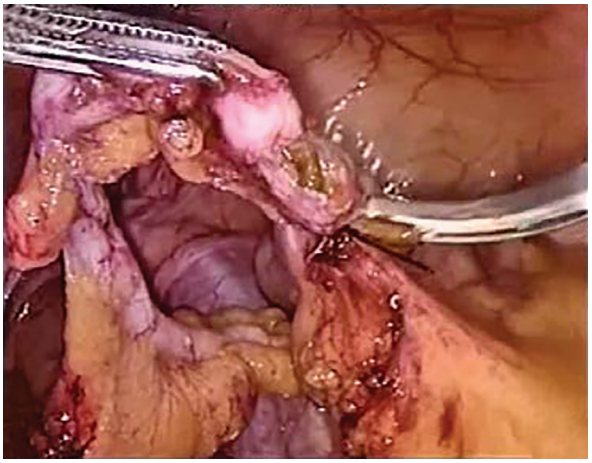
Intracorporeal knotting.

Figure 2



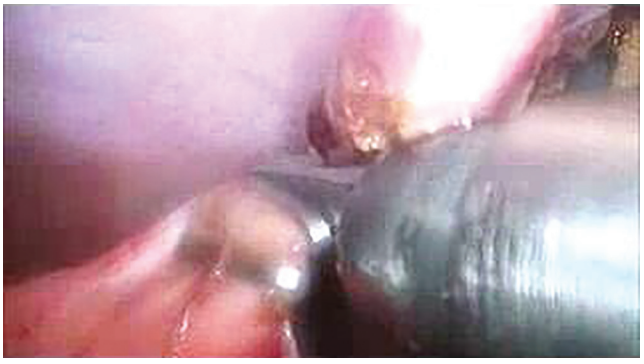
Secure knote.

Figure 3



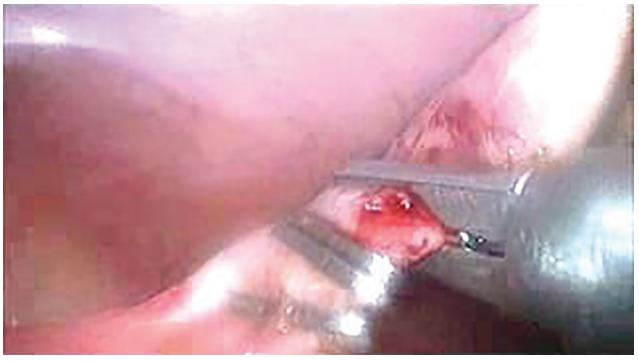
Cutting distal to the knote.

Figure 4



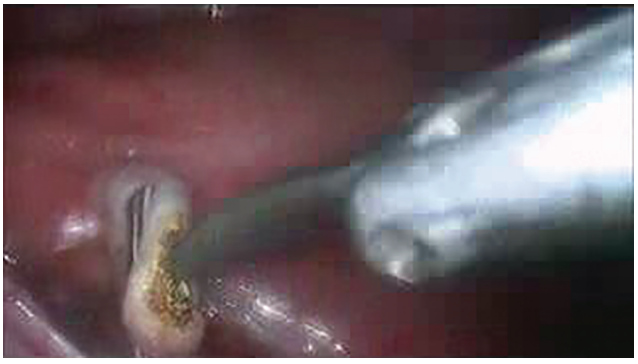
Metal clip closure technique.

Figure 5



Metal clip closure technique, distal clip.

Figure 6



Metal clip closure technique, mucosal coagulation.

Results

The mean age was 29.3 years in group A and 25.5 years in group B. The mean operative time was 45 min in group A and 37 min in group B ($P < 0.05$). The mean hospital stay was 2.07 days in group A and 2 days in group B ($P > 0.05$). The ICK technique was successful to close the appendix base safely in 94% of the patients in group A and in 83% of the patients in group B ($P < 0.05$). There were no statistically significant differences detected between the two groups in terms of the distribution of age, sex, the appendix location, and the histopathologic diagnosis ($P > 0.05$). There were no intraoperative complications such as bleeding or intestinal injury. No statistically significant differences were detected between the groups in terms of the hospital stay, the follow-up time, and operative or postoperative complications ($P > 0.05$). The average overall cost of patients in groups A and B were \$465.5 and \$473.6, respectively.

Postoperative complications in group A were as follows: two (2%) patients had port-site skin infection; one (1%) patient showed delayed intestinal sounds for 72 h and improved by medications. In group B, one (1%) patient had port-site skin infection and one patient was readmitted after 4 days due to fever (38.1°) and lower abdominal pain and tenderness; the patient was admitted for 24 h; there was mild leukocytosis, and an abdominopelvic ultrasound denoted no collection,

and so blow out and leak were excluded; antibiotic and antipyretic were given to this patient with rapid improvement and discharge. There were no specific early or late complications related to both techniques, and the conversion to open technique was not needed in either of them.

It was noticed in this study that the condition of the base of the appendix, and not the distal part of the appendix, affected the applicability of both techniques, as gangrene of the tip only did not affect clipping or ligation, but severe friability or necrosis of the base made the application of both techniques impossible and risky. The quality of the base of the appendix varied as follows:

(1) Normal.
(2) Hyperemic.
(3) Severely edematous.
(4) Edematous and friable.
(5) Gangrenous necrotic.

The outcomes are shown in Table 1 and complications in Table 2.

Discussion

The acceptance of LA among surgeons is increasing [13]. LA has been shown to be advantageous compared with OA with regard to early postoperative parameters such as postoperative pain and recovery of bowel function. LA is also associated with a lower wound infection rate [14,15].

Despite the lack of a clear outcome of the cost benefit of LA, most cost studies have confirmed a substantially higher cost of LA compared with OA, due to the expensive disposable equipment used during the procedure [16,17]. The appendiceal stump has been secured by different ways during LA, including the use of mechanical endostapler, [18] endoligature (Endoloop) [19–21], metal endoclips [22–24], polymeric endoclips [25], and intracorporeal suture [26].

The previous alternatives have advantages and disadvantages for the different clinical stages of acute appendicitis, but endoloops and endostaplers are used most frequently [15,18–28].

Sahm *et al.* [13] and Billingham and Basterield [17] in their studies reported that intracorporeal suturing is a safe alternative to the expensive linear stapler or to the less expensive endoloop and showed no significant difference in efficacy and safety [13].

Kiudelis *et al.* [29] and Billingham and Basterield [17] reported that intracorporeal ligation is lower in cost and €80 cheaper than the endoloop technique. Compared with laparoscopic staplers, endolpoops have an advantage as they are 6–12 times cheaper than stapling devices [30], and intracorporeal suture is even cheaper than endoloops [29].

As commercially available titanium and absorbable clips can sustain a high degree of intraluminal pressure and cannot be displaced by a pressure of 300 mgHg [31] and are low cost, their use is acceptable for secure closure of the appendiceal stump similar to that of cystic duct closure. Rickert *et al.* [27] used a titanium double-shanked clip in their study. It has the ability to secure appendix stumps with a diameter of up to 20 mm safely. Despite being an easy and safe technique, the disadvantage is the need for a 12.5-mm trocar for introducing the clip applicator.

Table 1 Characteristics and outcomes of both techniques

	Group A (ICK)	Group B (MCC)	*P* value
Age (years)	29.3 (range 18–41)	25.5 (range 13–44)	
Sex (female)	52	65	
Condition of the stump			
Normal	6	7	
Hyperemia and mild edema	75	77	
Severe edema and thickening of the stump	15	11 (1 wide)	
Friability of the stump	3 (2 wide)	2 (1 wide)	
Base necrosis	1	3 (1 wide)	
Total no.	100	100	
Wide base>10 mm	9	7	
Intraoperative complications	0	0	
Operation time (min)	45 (range 40–65)	37 (range 32–50)	
Simplicity of the technique for the trainee	+++	+++++	
Hospital stay (days)	2.07 (range 1.3–2.4)	2	>0.05
Mean appendix diameter (mm)	10 (range 5–15)	10 (range 5–15)	

ICK, intracorporeal knotting; MCC, metal clip closure technique; +, increasing numbers of +, mean more simple.

Table 2 Complications of both techniques in the early period and over 6 months

	Group A (ICK)	Group B (MCC)	*P* value
Bleeding	0	0	
Iatrogenic intestinal injury	0	0	
Small-bowel obstruction	0	0	
Conversion rate	0	0	
Stump blow out or enteric leak	0	0	
Abdominal abscess	0	0	
Postoperative delay of intestinal sounds	0	1	
Wound infection	2	1	
Failure of the technique	6	17	<0.01
Readmission	0	1	
Reoperation	0	0	
Average overall cost	$465.5	$473.6	>0.05

ICK, intracorporeal knotting; MCC, metal clip closure technique.

We agreed with some authors' study results [11,22,23] that using a titanium endoclip for appendiceal stump closure is safe and associated with a shorter operation time in LA. It also simplifies the procedure and provides a useful alternative to ICK for appendiceal stump closure.

The only disadvantage of the titanium clip closure technique is the presence of appendiceal base necrosis, which was the most important factor responsible for procedure failure during the treatment of complicated appendicitis; one more reason for failure is an appendix with a wide base of more than 10 mm during MCC as clips do not close all diameters of the appendix. The use of mechanical stapler can circumvent the problem; however, it was not used in our study and management was performed successfully by ICK and base invagination by burse string sutures. In this study, the metal clip closure success rate was 83%, and the 17% failure was due to either a wide caliber base or the presence of advanced cecum–appendiceal inflammatory edema or proximal third necrosis or gangrene. ICK succeeded to securing 94% of the appendiceal stump, and the failure was due to friability, base necrosis or tissue break down in cases of severe stump edema. In our study, severely inflamed or more than 10-mm wide appendiceal base could not be secured by the MCC technique (group B), but it was successful in only 83 (83%) patients; the other 16 patients had wide and friable bases. Some bases with severe edema and thickening needed more care during securing because forcible firing of clips or tight ligation led to tissue break down.

In both techniques, failure of securing the stump was managed by gentle ligation at the most firm viable point close to the cecum, and then reinforced by burse string sutures and base invagination.

Rakić *et al.* [32] reported that the cost of the endostapler was set at €378.50 (Endopath-Endocutter ATG45; Ethicon Endo-Surgery Inc., Cincinnati, Ohio, USA) and the cost of the endoloop was set at €32.80 (Vicryl-Endoloop 0; Ethicon Endo-Surgery Inc.). In our study, the overall cost of the procedure in group A (ICK) was $465.5 and in group B (MCC) was $473.5 ($P$>0.05). The cost of titanium clips was $6.7 (about €5.2) and that of the polygalactin suture was $4.8 (about €4), which is very low compared with endoloops or endostaplers. From our study, the application of both techniques was found to be safe and cost effective, and there were no significant differences regarding complications: only one case in group B had a delay in bowel sounds, which was not related to the technique used; also, the incidence of port-site skin infection was low in both techniques (P > 0.05). There were no reported specific complications related to either techniques such as intestinal leak, blow out, or intestinal obstruction. There was no significant difference of cost or hospital stay for both techniques, but both were noticeably cheaper than those performed by staplers or endoloops.

Both techniques were feasible and cost effective, especially in developing countries, and MCC was much easier for trainees than the ICK technique and could be considered a preliminary step in teaching hospitals for closure of small-caliber noncomplicated appendix.

Conclusion

Both ICK and metallic clip closure techniques were safe and economic in securing the appendiceal stump, except for wide, severely edematous or gangrenous base, wherein the metallic clip closure technique was not appropriate and was inferior to knotting.

Acknowledgements

Conflicts of interest

None declared.

References

1 Sauerland S, Lefering R, Neugebauer EA. Laparoscopic versus open surgery for suspected appendicitis. Cochrane Database Syst Rev 2004;4:CD001546.

2 McBurney C II. The ındications for early laparotomy in appendicitis. Ann Surg 1891;13:233–254.

3 Minne L, Varner D, Burnell A, Ratzer E, Clark J, Haun W. Laparoscopic vs open appendectomy. Prospective randomized study of outcomes. Arch Surg 1997;132:708–711.

4 Heinzelmann M, Simmen HP, Cummins AS, Largiader F. Is laparoscopic appendectomy the new 'gold standard'? Arch Surg 1995;130:782–785.

5 Tarnoff M, Atabek U, Goodman M, Alexander JB, Chrzanowski F, Mortman K, *et al.* A comparison of laparoscopic and open appendectomy. JSLS 1998;2:153–158.

6 Daniell JF, Gurley LD, Kurtz BR, Chambers JF. The use of an automatic stapling device for laparoscopic appendectomy. Obstet Gynecol 1991;78:721–723.

7 Perko Z, Mimica Z, Druzijanic N, Kraljević D, Petricević A, Depolo A, *et al.* Harmonic scalpel in laparoscopic surgery. Lijec Vjesn 2004;126:246–250.

8 Khanna S, Khurana S, Vij S. No clip, no ligature laparoscopic appendectomy. Surg Laparosc Endosc Percutan Tech 2004;14:201–203.

9 Klein RD, Jessup G, Ahari F, Connolly RJ, Schwaitzberg SD. Comparison of titanium and absorbable polymeric surgical clips for use in laparoscopic cholecystectomy. Surg Endosc 1994;8:753–758.

10 Akkoyun I, İbrahim A, Fatih A, *et al.* Closing the appendicular stump with a polymeric clip in laparoscopic appendectomy: analysis of 121 pediatric patients. Eur J Pediatr Surg 2012;22:133–135.

11 Ates M, Dirican A, Ince V, Ara C, Isik B, Yilmaz S. Comparison of intracorporeal knot-tying suture (polyglactin) and titanium endoclips in laparoscopic appendiceal stump closure: a prospective randomized study Surg Laparosc Endosc Percutan Tech 2012;22:226–231.

12 Ali IV, Maliekkal JI. Laparoscopic appendicectomy using endo-ring applicator and fallope rings. Saudi J Gastroenterol 2009;15:39–41.

13 Sahm M, Kube R, Schmidt S, Ritter C, Pross M, Lippert H. Current analysis of endoloops in appendiceal stump closure. Surg Endosc 2011;25:124–129.

14 Yaghoubian A, Kaji AH, Lee SL. Laparoscopic versus open appendectomy: outcomes analysis. Am Surg 2012;78:1083–1086.

15 Beldi G, Muggli K, Helbling C, Schlumpf R. Laparoscopic appendectomy using endoloops: a prospective, randomized clinical trial. Surg Endosc 2004;18:749–750.

16 Safavi A, Langer M, Skarsgard ED. Endoloop versus endostapler closure of the appendiceal stump in pediatric laparoscopic appendectomy. Can J Surg 2012;55:37–40.

17 Billingham MJ, Basterield SJ. Pediatric surgical technique: laparoscopic or open approach? A systematic review and metaanalysis. Eur J Pediatr Surg 2010;20:73–77

18 Beldi G, Vorburger SA, Bruegger LE, Kocher T, Inderbitzin D, Candinas D. Analysis of stapling versus endoloops in appendiceal stump closure. Br J Surg 2006;93:1390–1393.

19 Brosseuk DT, Bathe OF. Day care laparoscopic appendectomies. Can J Surg 1999; 42:138–142.

20 Roviaro GC, Vergani C, Varoli F, Francese M, Caminiti R, Maciocco M. Videolaparoscopic appendectomy: the current outlook. Surg Endosc 2006;20:1526–1530.

21 McAnena OJ, Austin O, O'Connell PR, Hederman WP, Gorey TF, Fitzpatrick J. Laparoscopic versus open appendicectomy: a prospective evaluation. Br J Surg 1992;79:818–820.

22 Cristalli BG, Izard V, Jacob D, Levardon M. Laparoscopic appendectomy using a clip applier. Surg Endosc 1991;5:176–178.

23 Gonenc M, Gemici E, Kalayci MU, Karabulut M, Turhan AN, Alis H. Intracorporeal knotting versus metal endoclip application for the closure of the appendiceal stump during laparoscopic appendectomy in uncomplicated appendicitis. J Laparoendosc Adv Surg Tech A 2012; 22:231–235.

24 Alis H, Gonenc M, Deniztas C, Kapan S, Turhan NA. Metal endoclips for the closure of the appendiceal stump in laparoscopic appendectomy. Tech Coloproctol 2012;16:139–141.

25 Hanssen A, Plotnikov S, Dubois R. Laparoscopic appendectomy using a polymeric clip to close the appendiceal stump. JSLS 2007;11:59–62.

26 Semm K. Endoscopic appendectomy. Endoscopy 1983;15:59–64.

27 Rickert A, Bönninghoff R, Post S, Walz M, Runkel N, Kienle P. Appendix stump closure with titanium clips in laparoscopic appendectomy. Langenbecks Arch Surg 2012;397:327–331.

28 Gomes CA, Nunes TA, Soares C Jr, Gomes CC. The appendiceal stump closure during laparoscopy: historical, surgical, and future perspectives. Surg Laparosc Endosc Percutan Tech 2012;22:1–4.

29 Kiudelis M, Ignatavicius P, Zviniene K, Grizas S. Analysis of intracorporeal knotting with invaginating suture versus endoloops in appendiceal stump closure. Wideochir Inne Tech Malo Inwazyjne 2013;8:69–73.

30 Wherman WE, Tangren CM, Ing TH. Cost analysis of ligature versus stapling techniques of laparoscopic appendicectomy in children. J Laparoendosc Surg Tech A 2007;17:371–374.

31 Deans GT, Wilson MS, Brough WA. The ability of laparoscopic clips to withstand high intraluminal pressure. Arch Surg 1995;130:439–441.

32 Rakić M, Jukić M, Pogorelić Z, Mrklić I, Kliček R, Družijanić N, *et al.* Analysis of endoloops and endostaples for closing the appendiceal stump during laparoscopic. Surg Today 2013;43.

Retrospective study of different methods for managing Egyptian patients with pseudomyxoma peritonei: feasibility and overall outcome

Galal Abouelnagah[a], Mohamed Kasem[a], Sherif Anis[b], Sherif ElZawawy[c]

Departments of [a]Surgery [b]Gynaecology, [c]Clinical Oncology, Alexandria Faculty of Medicine, Alexandria, Egypt

Correspondence to Galal Abouelnagah, MD, FRCS, 63 ElTawnyat Buildings, Smouha, 21615 Alexandria, Egypt
Tel: +2035848088; Fax: +2034287179
e-mail: galalmma@hotmail.com

Received 24 May 2014
Accepted 10 June 2014

The Egyptian Journal of Surgery
2014, 33:194–200

Introduction
Pseudomyxoma peritonei (PMP) is a rare disease with poor outcome when not treated properly and is characterized by mucinous ascites and peritoneal implants. Treatment for PMP is variable, both because of the rarity of the disease and because of its often slow-growing nature. There is no consensus regarding the proper management of aggressive cases. Our study was designed to analyze the symptoms and signs of PMP, as well as the diagnostic tools, and evaluate the effect of treatment and factors influencing postoperative recurrence of and survival from PMP in Egyptian patients.

Patients and Methods
We reviewed consecutive cases of PMP that presented at the surgical department of the Main Alexandria University Hospital from January 1990 to December 2012.

Results
This study included 62 patients with PMP: 43 were women (69%) and 19 were men (31%). Their mean age at the time of diagnosis was 47.3 ± 11.6 years (median 49, range 29–67). The predominance of women was statistically significant ($P = 0.08$). A total of 69 surgical procedures had been performed in 46 cases, including 46 primary operations, 10 secondary operations, one tertiary cytoreduction and peritonectomy, and 12 debulking procedures for recurrence.

Conclusion
Surgical debulking is the standard treatment for PMP in primary and recurrent tumors. Intraperitoneal chemotherapy either intraoperative or postoperative is accompanied by better disease-free survival and overall survival. Referring of patients to specialized centers that treat these patients on a regular basis is essential to prevent high morbidity and mortality. Recurrence is common and requires reoperation with or without adjuvant chemotherapy.

Keywords:
aggressive peritoneal tumors, intraperitoneal chemotherapy, surgical treatment

Egyptian J Surgery 33:194–200

1110-1121

Introduction

Pseudomyxoma peritonei (PMP) is an uncommon locoregional surgical entity with an estimated incidence of one or two per million per year or two per 10 000 laparotomy cases. It is characterized by the presence of a mucinous tumor on peritoneal surfaces producing a progressive amount of mucinous ascites. The primary tumor is thought to be predominately a mucinous epithelial neoplasm of the appendix [1].

The term PMP was first introduced by Werth in 1884 [2] describing it in association with a mucinous tumor of the ovary. In 1901, Frankel [3] described a case associated with a cyst of the appendix. If PMP is left untreated, mucin will eventually build up to the point where it compresses vital structures, such as the colon, the liver, kidneys, stomach, spleen, and pancreas [4]. Many cases present unexpectedly at laparoscopy or laparotomy, or may be suspected at cross-sectional imaging, or staging, of another pathological entity. PMP is a disease more commonly seen in women (male : female ratio = 6 : 11); the mean age at presentation is 58 years [5].

Regarding its classification, PMP is a broad descriptive term embracing a wide spectrum of biological behaviors of the neoplasm, from the benign to the frankly malignant lesion. Ronnett *et al.* [6] proposed a classification distinguishing 'disseminated peritoneal adenomucinosis' from 'peritoneal mucinous carcinomatosis'.

A definitive diagnosis of PMP requires the presence of (a) mucinous neoplastic cells/epithelium and (b) mucinous ascites with diffuse intra-abdominal mucin. Some authors also consider the presence of diffuse mucinous implants for a diagnosis [7]. Viable epithelial glandular cells must be identified within the mucin pools by histological analysis to diagnose PMP.

PMP is a heterogeneous lesion, which may develop from mucinous metaplasia of the peritoneum or from appendiceal or ovarian lesions. Careful examination

 DOI: 10.4103/1110-1121.141912

of the ovary and appendix with appendectomy is advised in every case of PMP. Immunohistochemical examination of the peritoneal, ovarian, or appendiceal lesions using antibodies, in particular, that for CK7, would help in defining the origin of mucin production.

Recently, MUC 2 overexpression was suggested as a molecular marker for PMP of intestinal rather than of ovarian origin [8]. PMP has been reported as originating from the colon and rectum, stomach, gallbladder and bile ducts, small intestine, urinary bladder, lung, breast, fallopian tube, and pancreas.

Abdominal pain is the most common complaint of PMP with an incidence of 23% in the initial evaluation, whereas a newly onset hernia is seen in 12% of cases [9]. The usual clinical features of this tumor are increasing abdominal girth, ovarian tumors, hernia sac tumors, appendicitis-like syndrome, and infertility [10]. Primary PMP rarely causes complications even in the presence of large-volume disease. Rarely, ureteric obstruction and lower limb edema secondary to venous obstruction have been reported. Recurrent disease, however, may occur on bowel surfaces and can cause fibrosis and intestinal adhesions. This often leads to intestinal obstruction or obstructive jaundice, which may prove fatal [11].

Narrowing, but rarely complete obstruction, of the gastrointestinal tract frequently occurs at three well-defined anatomic sites: the pyloric antrum, the ileocecal valve, and the cul-de-sac of Douglas [9]. These are three portions of the gastrointestinal tract that are attached to the retroperitoneum and are relatively motionless. As mentioned above, PMP has multiple clinical manifestations that lead to difficulties in definitive diagnosis and timely treatment [12]. As symptoms remain nonspecific, the disease presents a great diagnostic challenge to clinicians. PMP can present with unspecific symptoms that mislead diagnosis. Patients usually experience a long period of deterioration in health before an accurate diagnosis is made [13].

The prognosis of PMP is poor. The 5-year survival rate is less than 50% [14]. Recently, heated intraperitoneal chemotherapy (HIPEC) was reported to provide 62.5–100% survival rates for low-grade and 0–65% rates for high-grade disease [1]. Ten percent of patients die of PMP within 5.5 years of their initial presentation. Overall survival (OS) of patients is about 75 and 68 for 5 and 10 years, respectively, as revealed by Ronnett *et al.*[6].

Treatment for PMP is variable, both because of the rarity of the disease and because of its often slow-growing nature [9]. Current treatment strategies range from follow-up with palliative supportive care to cytoreductive surgery with HIPEC or early postoperative intraperitoneal chemotherapy [15]. Palliative care includes monitoring with computed tomography (CT) scans, tumor marker tests, and physical symptoms, to determine when, and if, surgery is warranted.

There is no consensus regarding the proper management of aggressive cases. Recent studies support that cytoreduction with peritonectomy plus HIPEC is a safe procedure that suggests an improvement in survival rates, even in aggressive cases [9]. Our study was designed to analyze the symptoms and signs of PMP, as well as the diagnostic tools, and evaluate the effect of treatment and factors influencing postoperative recurrence and survival in PMP in Egyptian patients.

Patients and methods

We reviewed consecutive cases of PMP that presented to the surgical department of the Main Alexandria University Hospital from January 1990 to December 2012. We analyzed patient characteristics, clinical manifestations, surgical indications, preoperative radiological investigations, and patient management.

All analyses were performed using SPSS for Windows 16.0.1 software [16]. The sex preponderance was analyzed with the χ^2 method. The data were presented in proportions (percentages) for categorical variables and as means ± SEs (medians) for continuous variables.

Results

This study included 62 patients with PMP: 43 were women (69%) and 19 were men (31%). Their mean age at the time of diagnosis was 47.3 ± 11.6 years (median 49, range 29–67). The predominance of women was statistically significant (P = 0.08). There were five clinical presentations among our patients (Table 1).

Table 1 Different clinical presentations among patients with PMP

Chief complaint	*N* (%)		
	Females	Males	Total
Abdominal pain	13 (21)	6 (9)	19 (31)
Acute abdomen	4 (6)	5 (8)	9 (15)
Increasing abdominal girth	11 (18)	4 (6)	15 (24)
Newly onset hernia	4 (6)	4 (6)	8 (13)
Coincidental diagnosis	10 (16)	1 (1)	11 (17)
Total	43 (69)	19 (31)	62 (100)

PMP, pseudomyxoma peritonei.

The chief complaint was abdominal pain [28 patients (46%)], either chronic [19 cases (31%)] or acute [nine cases (15%)]. This was followed by increase in abdominal girth (abdominal distension) [15 cases (24%)] (Fig. 1), development of a new hernia [eight cases (13%), and finally coincidental diagnosis [11 cases (17%)]. During gynecological examination the condition was seen to be present in six women. Individual reasons for four women were cystocele, fever, mucoid feces, and palpable tumor; one man presented with a hydrocoele.

Seven patients (11%) had only a definitive preoperative histopathological diagnosis of PMP, which had been done by ultrasonography-assisted Tru-cut needle biopsy. The diagnosis was confirmed by open surgical biopsy taken at the initial surgery in 44 cases (71%), at the second exploratory operation in 10 cases (16%), and at the third exploratory operation in one case.

The time interval between symptoms and definitive diagnosis ranged from 2 to 8 months, with a mean of 4 months. Various methods had been used for radiological investigation of our patients, some of them had undergone more than one technique. All patients had been investigated with abdominal ultrasonography. Of the 62 patients, 35 (57%) had undergone CT before initial surgery, three patients (5%) had undergone MRI, and another three patients (5%) had undergone gastrointestinal contrast film. PMP had been diagnosed from 18 (51%) of the 35 CT scans, and hence CT had a sensitivity of 51% in recognizing PMP (Fig. 2).

For the 46 patients who had undergone initial surgery with a suspicion or diagnosis of PMP, diagnosis had been made in several ways using different tools, and some of them had more than one proven diagnosis. The diagnosis had been made using CT in 14 patients (30%), with ultrasonography in 16 patients (35%), by MRI in two patients (4%), by a combination of ultrasonography-assisted fine needle biopsy and gastrointestinal contrast film in one patient (2%), and with ultrasonography-assisted fine needle biopsy in six patients (13%). Suspected ovarian tumor was the most common cause for PMP, comprising 26 of 46 initial surgeries (56%).

During operations, synchronous ovarian lesions were detected in nine cases, appendiceal mass in four cases, metastatic adenocarcinoma in nine cases, adenocarcinoma of the pancreas in two patients, and gastric carcinoma in one patient. The origin of mucin production was not detected in most of the cases [21 cases (46%)].

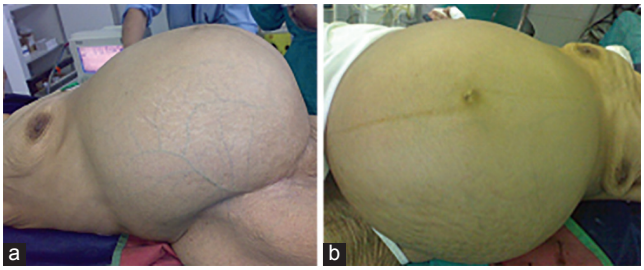
Normal preoperative CA125, carcinoembryonic antigen (CEA), and CA19.9 levels were detected in 29 patients (47%). On the other hand, high levels of CA125 were correlated with ovarian neoplasm in 12 cases, high CA19.9 was correlated with the two cases of pancreatic carcinoma, and CEA levels were high in seven cases of appendicular neoplasm.

Surgical debulking has been the traditional protocol at Alexandria Main University Hospital for managing patients with PMP. However, since 2007, an aggressive cytoreductive surgery (CRS) using peritonectomy has also been used in selected patients.

Treatment methods

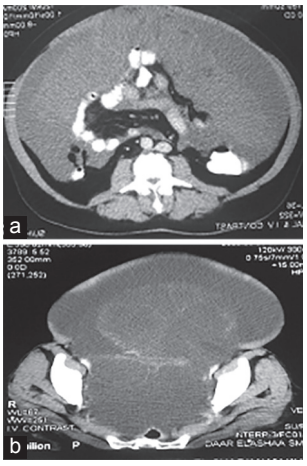
(a) Watch and wait: This approach was adopted in four patients (11%) whose general health condition and age were not suitable for surgical or adjuvant therapy.
(b) Surgery: The traditional surgical approach was debulking to remove as much of the tumor as possible, which had been applied in 46 cases (74%) with additional removal of one or more organs,

Figure 1



A female patient who presented with a huge distended abdomen. (a, b) The patient was diagnosed preoperatively as having PMP and received chemotherapy without response. PMP, pseudomyxoma peritonei.

Figure 2



(a) CT of the abdomen and pelvis showing a huge abdominal mass (omental cake). (b) Tense abdominal ascites (jelly belly). CT, computed tomography.

including removal of the uterus and ovaries in 25 cases, appendix or right colon in 39 cases, and the greater omentum in all 46 cases. Disease recurrence had occurred in all cases with an average disease-free period of 9 months (range: 6–18 months) (Figs. 3 and 4).

Repeat debulking surgery for recurrence had been performed for 12 cases with a higher rate of postoperative respiratory, cardiac, small bowel fistula, and wound complications. Complications were seen in 11 patients (91%).

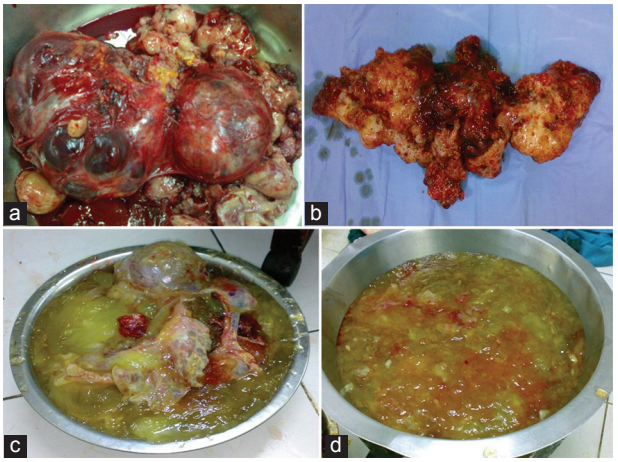
A 65-year-old man presented with a huge abdominal mass (Fig. 4). On exploration, a large omental cake was found with multiple tumor deposits at the mesentery of the intestine. Complete excision of the mass and debulking of the abdominal deposits was done. No apparent primary cause was found, and the postoperative pathology was PMP. This patient came back after 2 years with a recurrent abdominal mass. On second exploration, debulking of the mass with appendectomy was performed.

(c) CRS as in (b) combined with total parietal peritonectomy had been performed as a primary operation in only 12 cases and as a second operation in 10 cases: a total of 22 out of 62 cases of PMP (35%). Peritonectomy procedures involved stripping of the parietal peritoneum and resecting structures at fixed sites that contained adenomucinosis tumor tissue (Fig. 5).

The CRS, consisting of five procedures: omentectomy, splenectomy, left subdiaphragmatic peritonectomy, right subdiaphragmatic peritonectomy, pelvic peritonectomy — sleeve resection of sigmoid colon and cholecystectomy — lesser omentectomy three of our cases had been followed by postoperative intraperitoneal chemotherapy with mitomycin C, heated to 44°C, followed by intraperitoneal 5-FU for 5 days through abdominal drains.

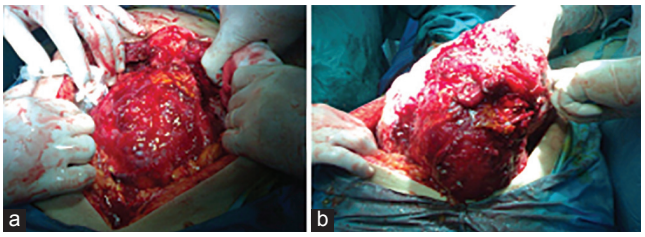
(d) Systemic chemotherapy: First indication included nine patients with large tumors or with inoperable or recurrent PMP in our series (15%) had been offered a combination of primary chemotherapeutic agents as a primary method of treatment. The patients were given six cycles of adjuvant chemotherapy. For inoperable or recurrent cases, the response was assessed after three cycles. These patients were then reconsidered for surgery or for continuation of palliative treatment. Three patients (33%) had partial benefit from this treatment with partial response.

Figure 3



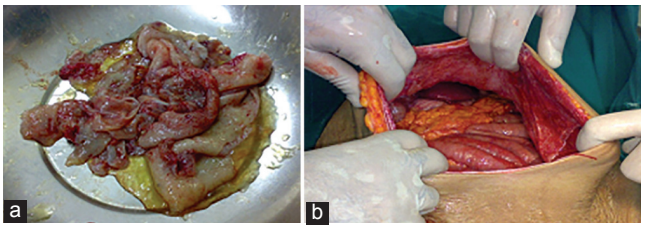
(a) Total abdominal hysterectomy. (b) Omentectomy of omental cake. (c) Total evacuation of the abdomen. (d) Large amount of gelatinous ascites (jelly like).

Figure 4



65 years old male patient presented with huge abdominal mass, on exploration, large omental cake was found with multiple tumor deposits at mesentery of the intestine, complete excision of the mass, debulking of the abdominal deposits was done. No apparent primary cause was found, the pathology postoperative was PMP. This patient came back after 2 year with recurrent abdominal mass, on second exploration, debulking of the mass with appendectomy was done.

Figure 5



(a) Total omentectomy and parietal peritonectomy. (b) Abdomen ready for closure.

Another 18 patients (30%) had undergone chemotherapy as adjuvant treatment: after surgery in 10 cases that had undergone primary reduction surgery or after excision of recurrence in eight cases. It was generally well tolerated with little side effects. The most commonly used agents include cisplatin, carboplatin, paclitaxel, 5-flourouracil, capcitapine, and mitomycin C given either intravenously or

intraperitoneally (using a postoperative intraperitoneal catheter). The intraperitoneal drain catheter had been used for injection of local intraperitoneal chemotherapy comprising three cycles in only three cases. Patients had good tolerance to local peritoneal chemotherapy with no major complications. For PMP of ovarian origin, a combination of cisplatin or carboplatin and paclitaxel was administered to 25 patients, 5-flourouracil or capcitapine, mitomycin C with or without cisplatin for gastrointestinal origin cases, and gemcitabine for pancreatic tumors (two cases).

A total of 69 surgical procedures had been performed in 46 cases, including 46 primary operations, 10 secondary operations, one tertiary cytoreduction and peritonectomy, and 12 second debulking procedures for recurrence. Postoperative mortality and morbidity results are shown in Table 2.

The 1-, 3-, and 5-year survival rates for all patients with PMP were 25.5, 9.3, and 0%, respectively. The median OS was 21 months. Details of disease-free survival and OS for all cases are shown in Table 3. Also disease-free survival and OS of cases of recurrence are shown in Table 4.

Discussion

PMP is a rare condition, which is known for its high mortality when not treated properly. The first step toward improving the prognosis of these patients is to recognize this clinical syndrome at an early stage. The main symptoms of our patient were nonspecific and misleading, and led to delayed diagnosis.

The most important symptom cited in the literature is increasing abdominal girth (50%), whereas in our patients abdominal pain was the chief complaint (46%), which characterizes the progressive stage of disease with peritoneal dissemination. Patients present late with a typical 'jelly belly' and complain of intestinal obstruction caused by the progressive amount of mucinous tumor and ascites.

The mean interval between the existence of a primary tumor and established PMP is described to be ~21 months [17]. The time interval between onset of symptoms and definitive diagnosis in our series ranged from 2 to 8 months with a mean of 4 months.

Histopathological examination of the appendix usually reveals a mucinous epithelial neoplasm. In 30% of female patients, the first symptom is an ovarian mass. Often these patients first consult the gynecologist with a pelvic mass. The correct diagnosis is then awaited for until after surgery, when examination of the mucinous ovarian tumor and the appendix reveals PMP metastases from an appendiceal primary or less frequently from an ovarian primary. In some cases, during laparoscopy or laparotomy for whatever reason, or during hernia repair, the surgeon or gynecologist unexpectedly encounters mucus [18].

In our patients, various methods for investigations were used, including abdominal ultrasound, CT, MRI, and gastrointestinal contrast film. PMP was diagnosed in 18 of the afore-mentioned 35 CT scans. CT had a sensitivity of 51% in recognizing PMP. Suspected ovarian tumor was the most common cause of PMP, comprising 57% of initial surgeries.

The origin of mucin production was not detected in most of the cases [21 cases (46%)]. Immunoreactivity for CK20 and CK7 is a good method for defining the original tumor. Unfortunately, these methods had not been applied to most of our cases.

Table 2 Different complication rates according to type of surgical interference

Type of operation	Debulking	Peritonectomy	Cytoreduction, pertonectomy	Recurrence debulking	Total [*n* (%)]
Number	46	10	1	12	69
Operative mortality	2	1	0	4	7 (10)
Cardio-respiratory complications	6	2	1	6	15 (22)
Deep vein thrombosis	10	1	0	4	15 (22)
Intestinal leak	2	2	0	5	9 (13)
Wound dehiscence	8	2	0	4	14 (20)
Wound infection	14	2	1	4	21 (30)
Total					69 (100)

Table 3 DFS and OS of all cases according to method of treatment

Type of operation	Primary debulking	Cytoreduction and pretoneictomy	Systemic chemotherapy	Palliative supports	*P* value
Number	35	11	2	4	
Disease-free survival	10	18	0	0	NA
Overall survival	27	34	10	5	0.03

DFS, disease-free survival; NA, not applicable; OS, overall survival.

Table 4 DFS and OS of recurrent cases after recurrence

Type of operation	Debulking of recurrence	Chemotherapy for recurrence	Palliative for recurrence	*P* value
Number	12	14	20	
Disease-free survival	8	0	0	NA
Overall survival	10	4	2	0.09

DFS, disease-free survival; NA, not applicable; OS, overall survival.

There has recently been a global interest in the management of PMP, particularly in the removal of the tumor through complex surgical techniques combined with total parietal peritoneal excision with or without HIPEC [19].

CRS with intraoperative HIPEC is a treatment strategy with encouraging survival results for selected PMP patients. The efficacy and superiority of this treatment compared with serial debulking have been established by many studies across the world. The outcome of this treatment has shown survival rates of 85% in 20 years, according to the latest follow-up studies. At least two randomized trials and many multicentric studies support this claim [20,21].

After treatment, patients should be monitored for recurrent or progressive disease. A CT scan is a very important tool for detecting progressive disease and can be performed 3 months after treatment as the basis for further follow-up. After that, a CT scan should be performed every 6 months in the first year and once a year or when progression is suspected in subsequent years. Other useful tools for detecting disease in the postsurgical period are the tumor markers CEA and CA 19.9, which also act as prognostic factors for survival [17].

Surgical excision of the tumor without rupture is important because rupture of the lesion causes PMP. Even in case of benign disease such as cystadenoma, dissemination of mucin-producing cells into the peritoneal cavity can cause PMP [22].

On the basis of the Sugarbaker peritonectomy procedure, a study by Deraco and colleagues showed that CRS with intraperitoneal hyperthermic perfusion permitted complete tumor removal, and this study confirmed the efficacy of this combined treatment in terms of improved long-term survival and better local control of the disease [23,24]. A recent study by Faris and Ryan concludes that the treatment of the low-grade variants of PMP includes serial cytoreduction surgery, with data indicating possible, but unproven, benefit from HIPEC, whereas there is no consensus so far on the role of cytoreduction and HIPEC in the management of the more aggressive histological variants and peritoneal carcinomatosis [25].

As a result, they support that systemic chemotherapy should be the standard of care for patients with high-grade variants and peritoneal carcinomatosis, as in our cases. Recent studies with promising results have shown that fluorouracil-based adjuvant chemotherapy can be used for PMP of appendiceal origin [9]. However, one must know that most of these studies do not focus on cases of aggressive PMP. Finally, PMP may recur following CRS, as seen in our case, especially when the disease is diagnosed at an advanced stage.

In recent times the laparoscopic approach has enabled avoidance of a large incision for exploration of the peritoneal cavity, conferring the advantage of minimally invasive surgery. Laparoscopic access and visualization may be compromised by disease extent, in particular a large omental 'cake', rendering accurate laparoscopic assessment impossible.

There are no randomized data on the role of adjuvant chemotherapy. Results from phase II trials and retrospective reviews are conflicting. The most widely used chemotherapeutic agents are 5-FU, cyclophosphamide, mitomycin C, and cisplatinum. The retrospective analysis from the Mayo Clinic series showed that survival rates were significantly better in patients treated with intraperitoneal infusions than in those treated with systemic chemotherapy.

The use of heated intraoperative intraperitoneal chemotherapy after complete dissection of adhesions and before anastomoses are completed allows optimal perfusion of the chemotherapy to the peritoneal surfaces and organs. There has recently been a global interest in the management of PMP, particularly in removal of the tumor by complex surgical techniques combined with total parietal peritoneal excision with or without HIPEC [19]. We hope that by introducing this technique at our institute we can improve local and overall outcomes.

Conclusion

PMP is a rare disease with poor prognosis when not treated properly and is characterized by mucinous ascites and peritoneal implants. The first step in improving the prognosis is to recognize the clinical syndrome at an early stage. CT imaging should be the choice for radiological assistance in the diagnosis of PMP.

Surgical debulking is the standard treatment for PMP in primary and recurrent tumors. Combined modality treatment, consisting of CRS in combination with total parietal peritonectomy, could be appropriate for

aggressive peritoneal mucinous carcinomatosis. Adding intraoperative HIPEC is the standard approach for improving survival after surgical debulking of tumors with favorable histology.

Referring of patients to specialized centers that treat these patients on a regular basis is essential to prevent high morbidity and mortality. Improvement of survival can be achieved by a combination of surgical experience and adequate patient selection. Recurrence is common and requires reoperation with or without adjuvant chemotherapy.

Acknowledgements

Conflicts of interest

None declared.

References

1 Bevan KE, Mohamed F, Moran BJ. Pseudomyxoma peritonei. World J Gastrointest Oncol. 2010; 2: 44–50.

2 Werth R, Pseudomyxoma peritonei Arch Gynecol Obstet, 24, 100–118, 1884.

3 Frankel E Uber das sogenannte pseudomyxoma peritonei. Med Wochenschr. 1901;48:965–970.

4 Buell-Gutbrod R, Gwin K, Pathologic diagnosis, origin, and natural history of pseudomyxoma peritonei. Proceedings of the ASCO Annual Meeting, May 31 - June 4, 2013; Chicago, Illinois.

5 Winder T, Lenz HJ Mucinous adenocarcinomas with intra-abdominal dissemination: a review of current therapy. Oncologist 2010;15:836–844.

6 Ronnett BM, Yan H, Kurman RJ, Shmookler BM, Wu L, Sugarbaker PH Patients with pseudomyxoma peritonei associated with disseminated peritoneal adenomucinosis have a significantly more favorable prognosis than patients with peritoneal mucinous carcinomatosis. Cancer. 2001;92:85–91.

7 Li C, Kanthan R, Kanthan SC. Pseudomyxoma peritonei – a revisit: report of 2 cases and literature review. World J Surg Oncol 2006; 4:60.

8 Ferreira CR, Carvalho JP, Soares FA, Siqueira SA, Carvalho FM Mucinous ovarian tumors associated with pseudomyxoma peritonei of adenomucinosis type: immunohistochemical evidence that they are secondary tumors. Int J Gynecol Cancer. 2008;18:59–65.

9 Touloumis Z, Galyfos G, Kavouras N, Menis M, Lavant L Aggressive pseudomyxoma peritonei: a case report with an unusual clinical presentation. Case Rep Oncol Med; 2013 (2013), 926963.

10 De Abreu Filho JG; EF De Lira Mucocele of the appendix: appendectomy or colectomy? J Coloproctol. (Rio J.) 2011;31. Available on http://www.scielo.br/scielo.php?pid=S2237-93632011000300008&script=sci_arttext.

11 Harshen R, Jyothirmayi R, N Mithal Pseudomyxoma Peritonei. Clin Oncol (2003) 15: 73–77.

12 de Oliveira AM, Rodrigues CG, Borges A. Pseudomyxoma peritonei: a clinical case of this poorly understood condition. Int J Gen Med. 2014; 7: 137–141.

13 Renehan AG, Stern PL, O'Dwyer ST, Oliveira AM, Rodrigues CG, Reis Borges A, *et al.* Pseudomyxoma peritonei. Encyclopedia Cancer; 2003; 27:1089–1103.

14 Misdraji J, Yantiss RK, Graeme-Cook FM, Balis UJ, Young RH, Appendiceal mucinous neoplasms: a clinicopathologic analysis of 107 cases Am J Surg Pathol 2003; 27: 8:1089–1103.

15 Losa F, Barrios P, Salazar R, Torres-Melero J, Benavides M, Massuti T, *et al.* Cytoreductive surgery and intraperitoneal chemotherapy for treatment of peritoneal carcinomatosis from colorectal origin. Clin Transl Oncol 2014;16:128–140.

16 Levesque, R SPSS programming and data management: a guide for SPSS and SAS users, 4th ed. (2007), SPSS Inc., Chicago IL.

17 Yalcin S, Ergül E, Korukluoglu B, Yalcin B Pseudomyxoma peritonei: what do we have?. Int J Surg. 2007;15. Available on http://ispub.com/IJS/15/1/8098#.

18 Smeenk RM, Verwaal VJ, Zoetmulder FAN Pseudomyxoma peritonei. Cancer Treat Rev 2007; 33:138–145.

19 Mohamed F, Cecil T, Moran B, Sugarbaker P A new standard of care for the management of peritoneal surface malignancy. Curr Oncol 2011;18.

20 Hayes-Jordan A, Anderson P, Curley S, Herzog C, Lally KP, Green HL, *et al.* Cancer Treatment Reviews 2007;33:138–145.

21 Blackham AU, Levine EA Cytoreductive surgery with hyperthermic intraperitoneal chemotherapy for malignant peritoneal mesothelioma. Available at: http://www.science.gov/topicpages/c/continuous+hyperthermic+peritoneal.html. [Accessed 1 January 2013].

22 Idjuski S, Turkalj I, Petrovic K, *et al.* Pseudomyxoma peritonei due to mucinous adenocarcinoma of the appendix. JBR-BTR 2013; 96:184.

23 Sugarbaker PH Pseudomyxoma peritonei: a cancer whose biology is characterized by a redistribution phenomenon. Ann Surg 1994; 219:109–111.

24 Deraco M, Baratti D, Inglese MG, Idjuski S, Turkalj I, Petrovic K, Vanhoenacker FM. Peritonectomy and intraperitoneal hyperthermic perfusion (IPHP): a strategy that has confirmed its efficacy in patients with pseudomyxoma peritonei. Ann Surg Oncol 2004; 11:393–398.

25 Faris JE, Ryan DP, Marcello D, Dario B, Maria G, Biagino A, *et al.* Controversy and consensus on the management of patients with pseudomyxoma peritonei Curr Treat Options Oncol 2013;14:365–373.

Carcinoma of the stomach presenting as a case of the left rectus abdominus muscle metastasis after curative resection

Showket Jeelani, Javeed Shafi, Raiees Ahmad, Ubaid Ali, Manzoor Dhoobi, Alfar Nafai

Department of General Surgery, SMHS Hospital GMC, Srinagar, India

Correspondence to Raiees Ahmad, MBBS, MS (Gen Surgery)
Department of General Surgery,
SMHS Hospital GMC, 190018 Srinagar, India
Tel: 8803012651;
e-mail: mallahraiees@gmail.com

Received 20 January 2014
Accepted 2 February 2014

The Egyptian Journal of Surgery
2014, 33:201–203

Recurrence after surgery and chemoradiation in gastric adenocarcinoma is not an unusual phenomenon, but recurrence after intended curative resection and chemoradiation as metastasis to the skeletal muscle is very rare. We came across an unusual case of recurrence from an operated case of gastric adenocarcinoma about 14 months after surgery and chemoradiation. Our case presented as isolated metastasis to the left rectus abdominus muscle from operated case of carcinoma of the stomach 14 months after surgery. This case report of isolated metastasis to the skeletal muscle as recurrence from carcinoma of the stomach is among the very few reported cases of the skeletal muscle metastasis of its kind.

Keywords:
curative resection, metastasis, rectus abdominus, recurrence

Egyptian J Surgery 33:201–203

1110-1121

Background

Gastric cancers remain the second leading cause of cancer-related deaths globally [1]. Among these gastric cancers, gastric adenocarcinoma represents 90% cases of gastric cancers. Despite the improvement in surgical resections for gastric adenocarcinoma, the recurrence rate remains high in patients with advanced stage of disease. Although several studies have clarified the prognostic indicators in gastric carcinoma, the timing of recurrence and pattern of postoperative recurrence are still not clear. Common sites of metastasis from gastric carcinoma are the liver, the lungs, the lymph nodes and the peritoneum. Metastasis to any type of skeletal muscle is rare and most of these are detected at autopsy. Metastasis to the skeletal muscles from gastric carcinoma is very uncommon, possibly because of high tissue pressure, accumulation of lactic acid, local changes in pH and oxygenation [2]. Commonly neoplasms metastasizing to the muscle are from the breast and the lungs and most common muscles involved are the psoas and the paravertebral muscles [3].

Case report

A 72-year-old woman was admitted to the Department Of General Surgery, SMHS Hospital, on 5 May 2012 with the chief complaint of recurrent vomiting and weight loss since 1 month. The patient also had decreased appetite since the same duration. On examination, patient was found to be anaemic. Rest of the examination was grossly normal. Complete blood count showed haemoglobin of 8 g/dl. Upper gastrointestinal endoscopy showed ulceroproliferative growth at the antrum with gastric outlet obstruction, and contrast enhanced computerized tomography (CECT) of the abdomen showed circumferential thickening of the pyloric antrum with perigastric nodes. The patient was operated, and distal gastrectomy with D_2 lymphadenectomy with gastrojejunostomy was performed on May 2012. Histopathology showed well-differentiated adenocarcinoma and stage IIB disease. The patient did well during the postoperative period and was totally symptom free on follow-up. The patient received adjuvant chemoradiation after surgery.

The patient again presented to the surgical outpatient department (OPD) with a complaint of abdominal swelling since 1.5 months, ~14 months after the surgery. The swelling gradually increased in size in the last 1.5 months. On examination, the patient was pale and the respiratory system/cardiovascular system/central nervous system was clinically normal. On abdominal examination, there was a visible bulge on the left central abdomen, a swelling about 3 cm ×4 cm arising from the abdominal wall occupying the left umbilical area and extending into the left iliac fossa (Fig. 1), which was nontender, firm-to-hard in consistency, overlying the skin free from swelling. Ultrasonography of the abdominal swelling showed globular mass in the left rectus muscle. Fine needle aspiration cytology (FNAC) of the swelling showed metastatic deposits of moderately differentiated adenocarcinoma. CECT of the abdomen showed nodular thickening with enhancement in the left rectus muscle (metastatic deposits) (Figs. 2 and 3) and anastomotic site was unremarkable. Upper gastrointestinal endoscopy showed patent gastrojejunostomy without any gross remarkable lesion. The patient was operated on 28

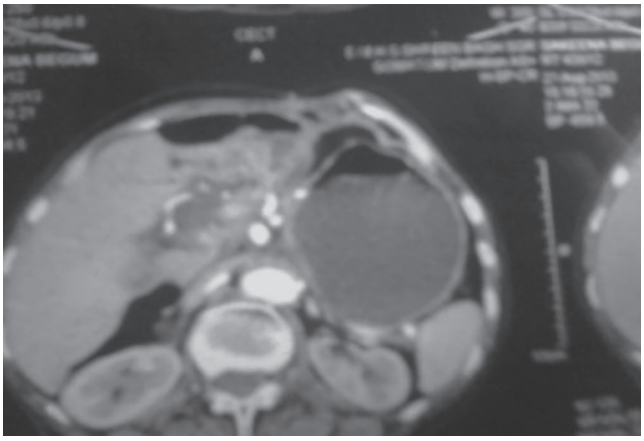
 DOI: 10.4103/1110-1121.141914

September 2013 and operative findings were: A large well-defined 5 cm × 5 cm mass in the left rectus abdominus muscle. Bowel loops were adherent to the abdominal wall and gentle blunt dissection was performed to free the loops of the gut from the abdominal wall; enlarged rectus abdominus muscle was not involved with adhesions of the bowel. The peritoneal cavity was opened to release the adhesions in order to remove the specimen of rectus abdominus *en bloc*. In addition, thorough inspection of the peritoneal cavity was performed to look for any residual disease or concomitant malignancy. All of the viscera were grossly normal; anastomotic site was grossly normal and liver was free, no ascites. Excision of the left rectus abdominus muscle (Fig. 4) was performed with placement of polypropylene mesh over the abdominal wall defect. Postoperative period was uneventful and patient was discharged on third postoperative day with an advice to visit the surgery OPD and the radiation oncology OPD for follow-up.

Discussion

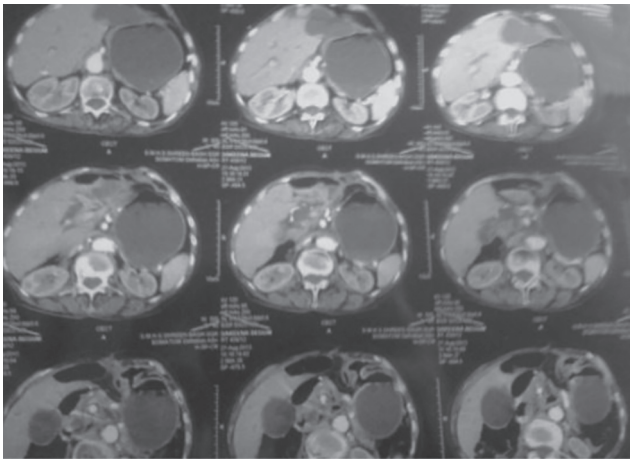
Metastasis to any type of skeletal muscle is rare and most of these cases are detected at autopsy. Most common neoplasms metastasizing to the muscle are from the breast and the lungs, and the most common muscles involved are the psoas and the paravertebral muscle. Low incidence of metastasis to skeletal muscles is related to anatomical characteristics and biochemical environment of the skeletal muscle. Inflammatory oncotaxis has been offered as the most likely explanation for this phenomenon [4] of the skeletal muscle metastasis. The most common sites of metastasis from gastric carcinoma are the liver, the lungs, the lymph nodes and the peritoneum. Metastasis to the skeletal muscles from gastric carcinoma is uncommon and recurrence as skeletal muscle metastasis from operated case of cancer of the stomach is extremely rare. During surgery, if adequate precautions are not taken and

Figure 1



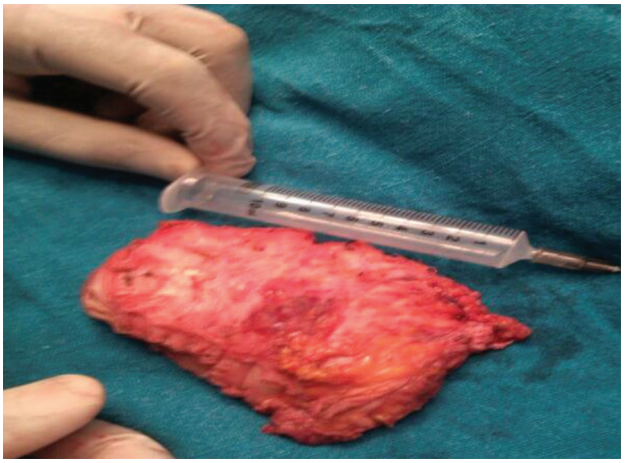
Multiple CECT sections of the same patient.

Figure 2



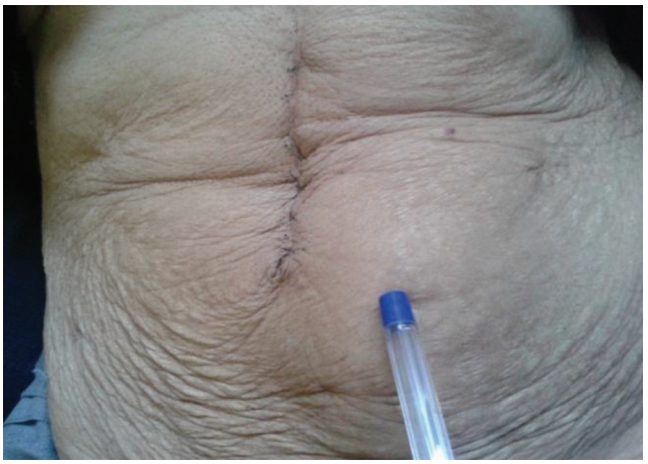
Specimen of the left rectus abdominus containing metastatic deposits.

Figure 3



Visible swelling on the left side of the abdomen.

Figure 4



CECT of abdomen showing metastasis to the left rectus abdominus.

oncological principles are not followed, implantation of tumour cells to wound can occur leading to metastatic deposits at the wound site. In our patient, while doing curative resection, all required precautions were taken to prevent spillage of tumour cells to wound, but still the possibility of implantation of tumour cells in the wound leading to metastatic deposits to the left rectus abdominus cannot be ruled out. Beşe *et al.* [5] reported a case of unusual skeletal muscle metastasis that occurred during follow-up of a patient after gastrectomy and adjuvant chemoradiation. Pestalozzi *et al*. [6] reported a case of skeletal muscle (calf) metastasis as initial manifestation of adenocarcinoma of the stomach. Amano and Kumazaki [7] reported a case of gastric carcinoma with metastasis to the calf muscles. Del Cimmuto *et al*. [8] reported a rare case of the abdominal wall metastasis from gastric carcinoma. Narváez *et al*. [9] reported an unusual case of the bone and skeletal muscle metastasis from gastric adenocarcinoma.

Our patient presented swelling in the left rectus abdominus muscle after radical surgery and chemoradiation for carcinoma of the stomach, which on investigation was found to be metastatic deposits of moderately differentiated adenocarcinoma of the stomach. Patient was operated upon and excision of the left rectus abdominus muscle was performed with placement of mesh over the abdominal wall defect. This case of operated carcinoma of the stomach presenting as recurrence to the left rectus abdominus is among very rare cases of recurrence of carcinoma of the stomach to the skeletal muscle.

Conclusion

Patterns of recurrence after complete resection of gastric adenocarcinoma are variable because of the difference in tumour biology, primary treatment as well as mode and timing of recurrence detection. There are very few case reports of recurrence of carcinoma of the stomach presenting as skeletal muscle metastasis, and among them recurrence to the rectus abdominus muscle is very rare. Our case of operated carcinoma of the stomach presenting as the left rectus abdominus metastasis is among the very few reported cases of metastasis to the skeletal muscle as recurrence of carcinoma of the stomach and was managed by excision of the left rectus abdominus muscle with placement of polypropylene mesh over the defect.

Acknowledgements

Conflicts of interest
None declared.

References

1 Crew KD, Neugut AL. Epidemiology of gastric cancer. World J Gastroenterol 2006; 12:467–477.

2 Kondo S, Onodera H, Kan S, Uchida S, Toguchida J, Imamura M. Intramuscular metastasis from gastric cancer. Gastric Cancer 2002; 5:107–111.

3 Pons Serra M, Moreno Solorzano I, Vila Plana J, Arevalo Navarrete D, Grau Amoros J. Muscular metastasis in a patient with adenocarcinoma of the colon. An infrequent complication [in Spanish]. An Med Interna 1997; 4:412–414.

4 Palazzo FF, New NE, Cullen PT. An unusual cause of thigh pain in colonic cancer. Inflammatory oncotaxis? Acta Chir Belg 2000; 100:28–30.

5 NŞ Beşe, M Özgüroğlu, A Ober. Skeletal muscle: an unusual site of distant metastasis in gastric carcinoma. Radiat Med 2006; 24:150–1537.

6 Pestalozzi BC, von Hochstetter AR. Muscle metastasis as initial manifestation of adenocarcinoma of the stomach Schweiz Med Wochenschr 1998; 128:1414–1417.

7 Amano Y, Kumazaki T. Gastric carcinoma metastasis to calf muscles: MR findings. Radiat Med 1996; 14:35–36.

8 Del Cimmuto P, Del Papa U, Faccia M, Astolfi A, Capanna A, Cellini G. Atypical metastases from gastric carcinoma. A primary and isolated case localized in the abdominal wall. Minerva Chir 1992; 47:1381–1385.

9 Narváez A, Narváez J, Clavaguera MT, Juanola X. Bone and skeletal muscle metastases from gastric adenocarcinoma: unusual radiographic, CT and scintigraphic features. Eur Radiol 1998; 8:1366–1369.