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Table of contents

Original articles

Case report

Wolters Kluwer Health | Medknow

The Egyptian Journal of Surgery

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Neck dissection in papillary thyroid carcinoma: when and why?

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Background
Papillary thyroid carcinoma (PTC) is the most common histological subtype of thyroid cancer, occurring in about 80% of cases. Ongoing debates on the best treatment strategy for patients with PTC over the last decades have included the extent of lymphadenectomy, the value of radioactive iodine (RAI) ablation, and the impact of each therapy on the patient's life.

The aim
The aim of this study was to compare different surgical procedures with regard to their safety, efficacy, and impact on the patient's life, as well as compare surgery with other treatment modalities such as RAI ablation.

Patients and methods
This study was conducted on 142 patients with PTC. Patients were arranged into three groups according to their clinical presentations: Group I included 34 patients who presented with hidden PTC within multinodular goiter; they were treated with total thyroidectomy (TT). Group II included 52 patients with PTC without palpable lymph nodes; they were treated with TT + prophylactic central neck dissection (pCND). Group III included 56 patients with PTC with palpable lymph nodes; they were treated with TT + central neck dissection (CND) + lateral neck dissection. RAI ablation was given to those patients who showed residual disease in the RAI scan. Completion surgery was performed only in relapsed cases with palpable disease. We compared the results of the three groups regarding complications, recurrence, and impact on patients' life.

Results
There was a statistically significantly higher incidence of most postoperative complications in groups II and III than in group I, although the final outcome was the same in the three groups. RAI therapy showed a good success rate in ablation of residual impalpable disease. At the end of the follow-up period, all patients were tumor free.

Conclusion
pCND should be abandoned because of its considerable risks and limited benefit. RAI ablation is a very good treatment option for residual PTC. Completion surgery should be decided only for relapsed bulky disease.

Keywords:
neck dissection, papillary thyroid carcinoma, radioactive iodine ablation

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1110-1121

Introduction

Papillary thyroid cancer is the most common endocrine malignancy and accounts for the majority of cases of thyroid cancer in iodine-sufficient areas of the world [1].

Lymph node (LN) metastases are a common finding in papillary thyroid carcinoma (PTC), occurring in the central compartment of the neck (level VI) in 20–50% of patients and in the lateral compartment of the neck (levels II–V) in 10–30% [2]. The high rate of metastases to regional lymph nodes is clearly associated with a higher risk for persistent or recurrent disease, although effects on survival remain controversial [3].

The subject of management of the neck has been extensively debated as the prognostic implications of the presence of positive nodes, either in the central compartment or in the lateral neck, were found to be minimal [4]. When there is no suspicion of metastatic disease to lymph nodes on imaging or palpation, prophylactic or elective central neck dissection (pCND) is a matter of debate [5–16].

The combination of surgery, radioactive iodine (RAI) treatment, and thyroid hormone suppression is the mainstay of treatment for PTC. However, because of the overall excellent outcomes in patients with PTC and the lack of prospective randomized controlled trials, many of the current recommendations and guidelines for treatment of PTC are controversial, such as the extent of surgery, the role of RAI treatment in low-risk patients, and the extent and frequency of surveillance [17].

In this research, we aimed at evaluating each surgical procedure with regard to its safety, efficacy, and impact on the patient's life. In addition, we tried to compare

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surgery with other treatment modalities such as RAI ablation.

Patients and methods

This study was conducted on patients with PTC admitted to Zagazig University Hospitals from March 2008 to March 2011. Cases were followed up for at least 3 years up to April 2014.

Inclusion criteria

(1) Age above 10 years and below 80 years.
(2) Histopathologically proven presence of PTC.
(3) Being fit for and willing to undergo surgery.

All patients consented to undergo surgery and join this study. For patients below 18 years of age, consent was given by their parents.

Exclusion criteria

(1) Age below 10 years or above 80 years.
(2) Prior unilateral, subtotal, near-total, or complete thyroidectomy.
(3) Histopathological report of any type of malignancy other than PTC, even the mixed papillary and follicular type.
(4) Being unfit for or refusal to undergo surgery.
(5) Being lost to postoperative evaluation or follow-up.

The plan

Patients were arranged into three groups according to their clinical presentations.

Group I included patients who presented with multinodular goiter (MNG) with clinically impalpable cervical lymph nodes (cN0). After total thyroidectomy (TT), their histopathological specimens showed hidden PTC. Patients whose postoperative RAI scan showed deposits in the cervical LNs received RAI ablation. Only patients who showed relapse [enlarged cervical LNs with elevated serum thyroglobulin (TG)] underwent neck dissection followed by thyroid hormone suppression.

Group II included patients who presented with suspicious thyroid swellings that were proved by fine needle aspiration cytology (FNAC) to be PTC; however, their clinical, ultrasonography, and computed tomography (CT) neck examination showed no suspicious cervical LNs (cN0). They underwent TT + pCND. Patients with deposits in the lateral cervical LNs on postoperative RAI scan received RAI ablation and follow-up. Patients showing relapse underwent completion lateral neck dissection (LND) followed by thyroid hormone suppression.

Group III included patients who presented with thyroid swellings with multiple enlarged cervical LNs detected by clinical and/or CT neck examination. These were proved by FNAC to be PTC. They were treated with TT + CND + LND. Patients whose postoperative RAI scan showed active deposits on the contralateral LNs received RAI ablation. Again, only patients who showed relapse with palpable LNs underwent contralateral neck dissection. Finally, all patients received thyroid hormone suppression (Fig. 1).

Neck ultrasonography and CT were performed by an experienced trained radiologist (Figs 2 and 3).

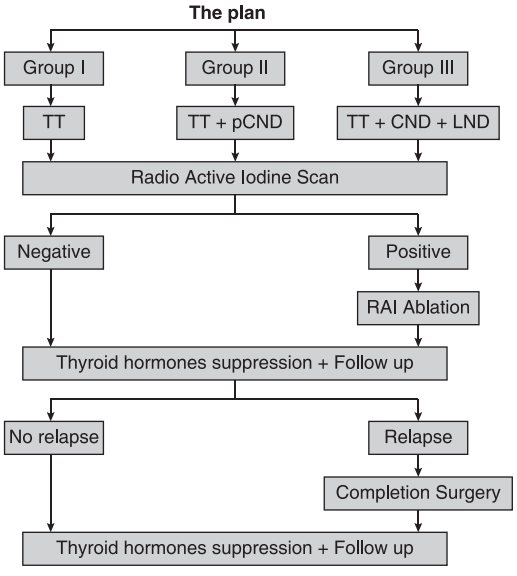
The ultrasound criteria by which LNs were recognized as malignant deposits are as follows:

(1) Size 1 cm or more.
(2) Presence of hyperechoic punctuations.
(3) Loss of corticomedullary differentiation.
(4) Cystic degeneration.
(5) Peripheral vascularization

These criteria were the inclusion criteria in group III.

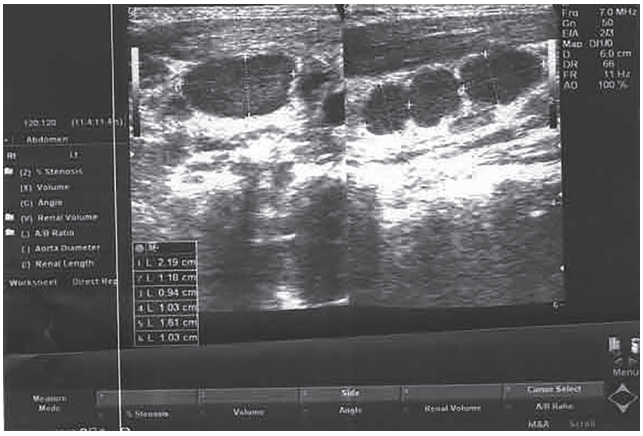
TT indicates removal of the whole thyroid gland aiming at leaving no thyroid tissue but making every effort to preserve the recurrent and external laryngeal nerves and the parathyroid glands (Figs 4 and 5). This cannot be achieved without adequate identification and careful dissection of these structures.

Figure 1



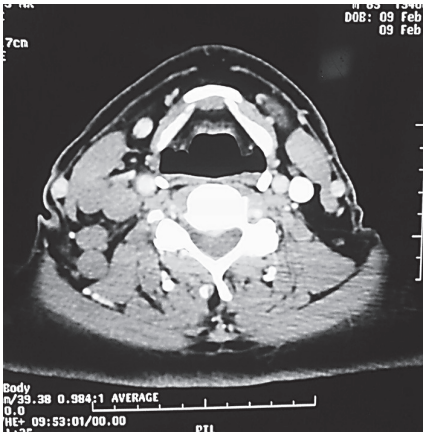
Plan of patients' management

Figure 2



Neck ultrasonography showing multiple enlarged cervical lymph nodes.

Figure 3

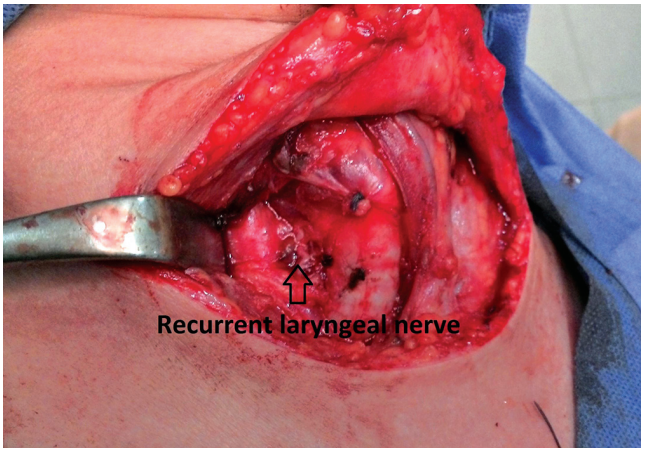


Neck computed tomography showing multiple enlarged cervical lymph nodes.

Figure 4

The neck after total thyroidectomy.

Figure 5



Preservation of the recurrent laryngeal nerve during total thyroidectomy.

CND entails removable of LNs at levels VI and VII – that is, the prelaryngeal, the perithyroid LNs including those around the recurrent and external laryngeal nerves, the pretracheal, bilateral paratracheal LNs, and the superior mediastinal LNs together with the whole fibrofatty tissues from the level of the hyoid bone above to the innominate veins below and from the medial side of the carotid artery on one side to the contralateral one – through a cervical incision.

LND entails removal of the whole LNs at levels II, III, and IV in the ipsilateral side sparing the sternomastoid muscle, accessory nerve, and internal jugular vein from the base of the skull above to the level of the clavicle below.

All patients were admitted to the department of general surgery in Zagazig university hospitals where they were fully investigated and prepared for surgery. Routine laboratory investigations were ordered and basal serum calcium (Ca) levels were ascertained. Indirect laryngoscopy was performed to evaluate vocal cord mobility before surgery. All operations were performed by the same surgical team and following the same surgical principles. Also, all FNAC and paraffin sections of the resected specimen were examined and diagnosed by the same pathologists in the pathology department in Zagazig University Hospitals (Figs 6 and 7). RAI ablation was decided and calculated by radiotherapists at our university hospitals.

Postoperatively, all patients were cared for in the high dependency care unit in our surgical department until they became stable and were discharged when they were surgically free.

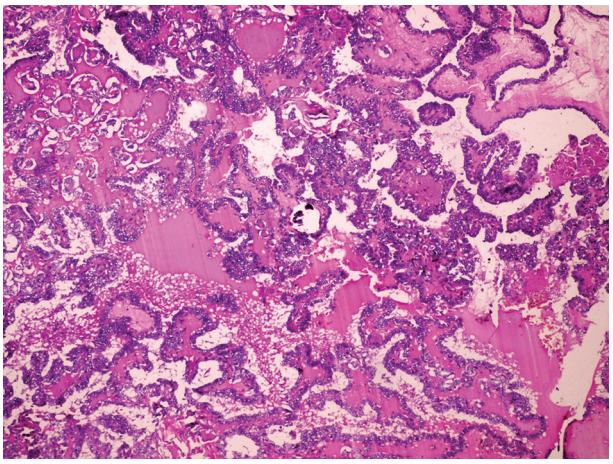
Total serum Ca was measured 24 h after surgery. Medications were started immediately if serum Ca

was less than 10 mg%. No patient developed tetany. Ca salts alone at 3 mg/day were given if total serum Ca was between 8–10 mg%, and calcitriol 1 mg/day was added when it was below 8 mg%. Further, PTH level in the serum was measured 1 month after surgery (normal level 10–65 ng/l); if it was low it was measured every 3 months. Transient hypoparathyroidism was defined as low serum Ca and low PTH that could be corrected within 1 year after surgery; if not corrected, it was defined as permanent hypoparathyroidism.

Indirect laryngoscopy was repeated on the second postoperative day to check for recurrent laryngeal nerve injury (RLNI), which was identified either unilaterally or bilaterally, and patients with RLNI were submitted to regular additional examinations every 3 months until vocal cord mobility was regained. If the mobility remained impaired for more than 1 year postoperatively it was regarded as permanent RLNI.

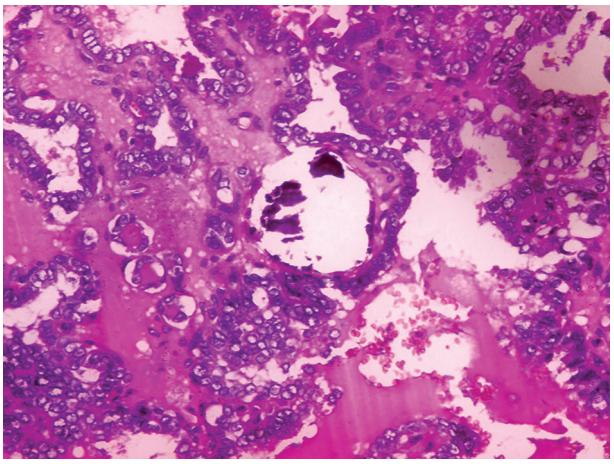
Patients were discharged from the hospital on scheduled follow-up visits every 3 months for the first year and then every 6 months for the next 2 years. At each visit, a full medical examination was carried out and routine laboratory investigations were ordered, including assessment of serum TG and anti-TG antibody. In addition, serum Ca and PTH levels were evaluated in patients with hypothyroidism, and indirect laryngoscopy was performed for patients with RLNI. An RAI scan was carried out 1 month postoperatively and at the end of each year's follow-up to check for any residual or recurrent tumor (Figs 8 and 9). All data were recorded. Immediately after surgery, all patients received the replacement levothyroxine for

Figure 6



Photomicrograph showing complex papillary architecture with vascularized connective tissue cores covered with malignant columnar epithelial cells. H and E, ×100.

Figure 7

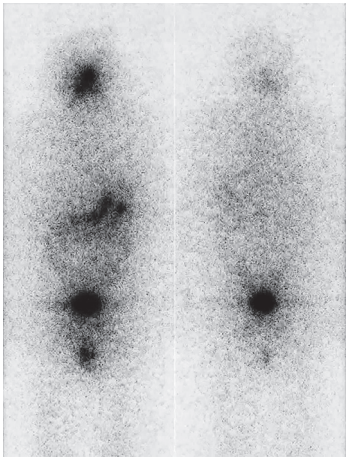


Photomicrograph showing crowded tall columnar epithelium with occasional grooving with large calcified psammoma body at the tip of papillae. H and E, ×400.

Figure 8

Total body scan shows residual tumor (arrow).

Figure 9



Total body scan shows complete ablation of the tumor.

2 weeks; levothyroxine was ceased to prepare the patients for RAI scans, which were taken at 1 month postoperatively. Patients with positive residual tissue were submitted to RAI ablation when their thyroid stimulating hormone level reached above 25 mu/l. Completion radical surgery was performed when there was relapse after RAI ablation in the form of palpable LNs and elevation of serum TG. In such cases, patients received suppressive levothyroxine to keep the thyroid stimulating hormone below 0.1 mu/l.

Statistical analysis

All data were recorded and collected for statistical analysis. The statistical program (SPSS, Chicago, Illinois, USA) for windows, version 13, was used for data entry and analysis. Qualitative data were presented by frequency distribution. The χ^2-test was used to compare between two or more proportions. The lowest accepted level of significance was 0.05.

Table 1 The incidence of postoperative complications among the three groups

Postoperative complications	*N*	Group I (*N* = 34) [*N* (%)]	Group II (*N* = 52) [*N* (%)]	Group III (*N* = 56)
		TT	TT + pCND	TT + CND + LND
Reactionary haemorrhage	5 (3.5)	2 (5.8)	2 (3.8)	1 (1.7)
RLNI				
Unilateral	18 (12.6)	1 (2.9)	7 (13.4)	10 (17.8)
Temporary	13 (9.1)	1 (2.9)	6 (11.5)	6 (10.7)
Permanent	5 (3.5)	0 (0)	1 (1.9)	4 (7.1)
Bilateral	6 (4.2)	0 (0)	3 (5.7)	3 (5.3)
Temporary	4 (2.8)	0 (0)	2 (3.8)	2 (3.5)
Permanent	2 (1.4)	0 (0)	1 (1.9)	1 (1.7)
Total	24 (16.9)	1 (2.9)	10 (19.2)	13 (23.2)
Hypoparathyroidism				
Temporary	26 (18.3)	1 (2.9)	14 (26.9)	11 (19.6)
Permanent	5 (3.5)	1 (2.9)	2 (3.8)	2 (3.5)
Total	31 (21.8)	2 (5.8)	16 (30.7)	13 (23.2)
Other complications				
Accessory nerve injury	7 (4.9)	0 (0)	0 (0)	7 (12.5)
Chyle leak	2 (1.4)	0 (0)	0 (0)	2 (3.5)
Neck stiffness	3 (2.1)	0 (0)	0 (0)	3 (5.3)
Torticollis	1 (0.7)	0 (0)	0 (0)	1 (1.7)
Persistent hypoesthesia	12 (8.4)	0 (0)	0 (0)	12 (21.4)
Total	25 (17.6)	0 (0)	0 (0)	25 (44.6)

LND, lateral neck dissection; pCND, prophylactic central neck dissection; TT, total thyroidectomy.

Results

Of 148 patients with PTC who fulfilled the inclusion criteria, six patients were excluded (one patient had mixed follicular and papillary carcinoma, two patients refused the second operation of completion neck dissection, and three patients were lost to follow-up) and only 142 patients completed this study. They were 56 male and 86 female patients (male : female = 2 : 3) and their ages ranged from 12 to 53 years, with average age at initial treatment of 32.5 ± 18.25 years.

Group I included 34 patients with hidden PTC in MNG. They underwent TT.

Group II included 52 patients of PTC diagnosed preoperatively with cN0. They underwent TT plus pCND.

Group III included 56 patients with PTC with cervical LN metastasis. They underwent TT + CND + LND.

Postoperative complications

Regarding the immediate postoperative complications, reactionary hemorrhage occurred in five patients (two in group I, two in group II, and one in group III). These patients were re-examined in the operating room and the bleeding sites were identified and managed. All five patients recovered well. There was no statistically significant difference among the three groups regarding hemorrhage (Tables 1 and 2).

RLNI occurred in 24 (16.9%) patients (18 unilateral and six bilateral): 17 were temporary (11.97%) and seven were permanent (4.92%). There was a statistically significantly higher risk of RLNI in groups II and III than in group I, but no statistically significant difference between groups II and III in the incidence of such injury (Table 2). The condition of 13 of the 18 patients with unilateral RLNI improved spontaneously within 3 months, whereas in the remaining five patients hoarseness of voice persisted. With respect

Table 2 The statistical analysis of the incidence of the postoperative complications among the three groups

Complications	Group I vs. group II [*N* (%)]			Group I vs. group III [*N* (%)]			Group II vs. group III [*N* (%)]		
	N = 34	*N* = 52	*P* value	*N* = 34	*N* = 62	*P* value	*N* = 52	*N* = 62	*P* value
Reactionary hage	2 (5.8)	2 (3.8)	0.66	2 (5.8)	1 (1.7)	0.29	2 (3.8)	1 (1.7)	0.51
RLNI	1 (2.9)	10 (19.2)	0.04	1 (2.9)	13 (23.2)	0.02	10 (19.2)	13 (23.2)	0.78
Hypoparathyroidism	2 (11.6)	16 (30.7)	0.01	2 (11.6)	13 (23.2)	0.03	16 (30.7)	13 (23.2)	0.50
Other complications	0	0	–	0	25 (44.6)	0.000	0 (0)	25 (44.6)	0.000

RLNI, recurrent laryngeal nerve injury.

to the bilateral injury four patients showed marked improvement with time but the remaining two cases showed permanent aphonia over the follow-up period.

There were 31 (21.8%) reported cases of hypoparathyroidism: 26 (18.3%) temporary and five (3.5%) permanent. There was a statistically significantly increased incidence of hypoparathyroidism in groups II and III over group I. There was no statistically significant difference between groups II and III regarding this complication (Table 2).

Other complications such as accessory nerve injury, chyle leak, neck stiffness, torticollis, and persistent hypoesthesia were reported only in group III.

Postoperative follow-up

Group I

Histopathology revealed hidden PTC in MNG. There were 18 patients (52.9%) with PTC microcarcinoma (<1 cm) and 16 patients (47.1%) with PTC macrocarcinoma (>1 cm). The postoperative RAI scan showed positive residual tumor in only three patients (8.8%). They were submitted to RAI ablation, which effectively eradicated the residual tumor in all three patients (100%), and RAI scan after 1 year showed full tumor ablation. None of the patients in group I underwent a second operation.

Group II

Histopathology confirmed the diagnosis of PTC and revealed LN deposits in 18 patients (34.6%). The number of cases of LN metastasis is shown in Table 3. RAI scan after 1 month showed only eight patients (15.3%) with lateral LN involvement. These patients were submitted to RAI ablation: six patients (75%) showed marked response with complete disappearance of the residual tumor at the RAI scan after 1 year; two patients (25%) showed relapse and LNs became palpable with elevated serum TG and they were candidates for completion LND performed at 1-year interval. The histopathology showed involvement of 5/18 and 3/21 of the LNs resected in the specimen, respectively. The RAI scan and neck CT 1 month later showed no residual tumor.

Table 3 Shows the number of lymph nodes involvement in group II and III

Number of LNs	Group II (%)	Group III (%)
First operation	*N* = 52	*N* = 56
Negative cases	34 (65.4)	0 (0.0)
Positive cases	18 (34.6)	56 (100)
1–3 + LNs	12	2
4–5 + LNs	6	15
6–7 + LNs	0	27
>7 + LNs	0	12
Second operation	*N* = 2	*N* = 3
Negative cases	0 (0)	0 (0)
Positive cases	2 (100)	3 (100)
1–3 + LNs	1	1
4–5 + LNs	1	1
6–7 + LNs	0	1
>7 + LNs	0	0

LN, lymph node.

Group III

In group II, histopathology revealed PTC with LN metastasis in all cases. The number and pattern of LN involvement are shown in Table 3. RAI scan after 1 month showed tumor metastasis to the contralateral LNs in 16 cases (28.5%). They received RAI ablation. Thirteen of them (81.2%) showed complete tumor ablation but the other three cases (18.7%) showed progressive disease that necessitated completion contralateral neck dissection. The histopathology reported metastasis in 3/19, 5/22, and 6/24 of the resected LNs in the specimen, respectively. RAI scan at 1 month postoperatively was tumor-free.

All patients were followed up for at least 3 years. The follow-up period ranged from 3 to 5.5 years with an average of 4.1 years. We had no perioperative mortality in the three groups and all patients at the end of the follow-up period were tumor-free – that is, the 3-year cure rate was 100%.

Discussion

There is a big debate around the best way to manage cases of PTC. Treatment should be individually tailored to each case, usually according to the patient's preference and/or surgeon's experience. Radical neck dissection is associated with complications, even with meticulous surgery in the best hands.

In this study, the overall incidence of postoperative complications such as RLNI and hypoparathyroidism were comparable to other studies [4,6,8,13,14,17].

It was not surprising that we found that the nodal recurrence was much higher in group III than in groups I and II, because patients of group III already had palpable LNs and certainly more LN involvement than those in groups I and II and consequently a higher incidence of nodal recurrence.

In cN0 patients, the addition of pCND to TT was associated with much higher incidence of postoperative complications such as RLNI and hypoparathyroidism compared with those with TT alone. These complications outweigh the benefits

of the surgical radicality because most of these complications are incurable and handicapping. The treatment appears to be more hazardous than the disease and this remind us of the dictum 'Let punishment fit the crime'.

RAI ablation gave very good results (100% in group I, 75% in group II, and 81% in group III), which are comparable to the surgical radicality; both groups I and II had cN0; patients of group I did not undergo neck dissection but only RAI ablation in patients with positive RAI scans; in contrast, patients of group II underwent pCND, and in most of them histopathology showed no LN metastasis. Both groups achieved the same final excellent results at the end of the follow-up period but many patients of group II paid the price of surgical radicality.

In our study, the addition of LDN to TT + CND did not increase the risk of RLNI or hypoparathyroidism. This disagrees with the Roh *et al*. [8] who stated that the extension of nodal dissection to the lateral cervical compartment in addition to the central compartment increases the vascular compromise in the dissected central neck and the parathyroid glands, which causes a high rate of hypoparathyroidism during the early postoperative weeks. However, we agree with many studies [18-20] that LND added many other complications not recorded in TT plus CND such as accessory nerve injury, chyle leak, neck stiffness and neck deformity.

Again, RAI ablation achieved a very good cure rate in patients with subclinical LN metastasis from PTC, which is supported by the results of many studies [1,21,22]. This should be taken into consideration before rushing into redo surgery.

Administration of RAI ablation before resorting to radical surgery achieved a highly accepted cure rate and eradication of residual tumor cells, and even in those who relapsed after RAI therapy delay of completion surgery did not disprove the prognosis or hinder cure.

Conclusion

The highly significant increase in the postoperative complications associated with pCND without significant improve in prognosis may preclude its use.

RAI ablation succeeds in eradicating residual subclinical tumor deposits in a good percentage of patients and should be attempted before resorting to completion radical surgery. Neck re-exploration for completion or redo surgery should be reserved only for patients who develop relapse with palpable disease and elevated TG.

Acknowledgements

Conflicts of interest

None declared.

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Topical tannic acid application decreases posthemorrhoidectomy pain: a novel idea

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Background
Posthemorrhoidectomy pain represents an annoying problem for the surgeon and the patient; although it can be controlled with an analgesic ladder, its management remains in question.

Purposes
The current study investigated the efficacy of topical tannic acid powder in reducing postoperative pain, in promoting wound healing after open diathermy hemorrhoidectomy, and in the prevention of secondary hemorrhage.

Patients and methods
A prospective, randomized trial was conducted on 97 patients suffering from grade 3 or 4 internal or external hemorrhoidal disease to compare posthemorrhoidectomy pain and wound healing with the use of topical tannic acid applied to the surgical site compared with placebo. Postoperative follow-up was for 3 months.

Results
Postoperative pain in patients given topical tannic acid improved during the first 2 days (VAS: 1.2 ± 0.4 vs. 8.2 ± 0.6; $P < 0.05$) and on day 7 (VAS: 3.6 ± 0.6 vs. 6.3 ± 0.5; $P < 0.05$); wound healing also improved significantly [mean postoperative edema score: 3.0 vs. 7.0, $P < 0.05$; and mean overall wound healing score: 4.0 vs. 6.0, $P < 0.05$)], although there was no difference as regards primary and secondary healing ($P > 0.05$). In addition, secondary hemorrhage in the topical tannic acid group was significantly less (mean score, 2.0 vs. 12.0; $P < 0.05$).

Conclusion
Topical tannic acid application plays an important role in diminishing postoperative pain, in improving wound healing after open diathermy hemorrhoidectomy, and in preventing secondary hemorrhage.

Keywords:
hemorrhoidectomy, pain control, tannic acid

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1110-1121

Introduction

Tannic acid (Fig. 1) is odorless but has a very astringent taste. Pure tannic acid is a light yellowish and amorphous powder. Tannic acid is a polymer comprising gallic acid molecules and glucose. It is distributed in tea, nettle, wood, berries, and Chinese galls [1,2].

Tannic acid has antibacterial, antienzymatic, and astringent properties. It has constringing action upon mucous tissues. It also has antioxidant and antimutagenic properties [3,4].

Tannic acid can be administered through more than one route: oral, in the form of solution, and topical, in the form of powder. It has many side effects: it causes extra heartbeats, hallucination, fits, allergy, and blood disorders [1].

The physiology of postoperative pain involves transmission of pain impulses through splanchnic (not vagal) afferent fibers to the central nervous system, where they initiate spinal, brain stem, and cortical reflexes. Spinal responses result from stimulation of neurons in the anterior horn, resulting in skeletal muscle spasm, vasospasm, and gastrointestinal ileus. Brain stem responses to pain include alterations in ventilation, blood pressure, and endocrine function. Cortical responses include voluntary movements and psychological changes, such as fear and apprehension. These emotional responses facilitate nociceptive spinal transmission, lower the threshold for pain perception, and perpetuate the pain experience [5–7].

Hemorrhoidectomy remains a painful operation, but for most patients it is extremely successful as a means of controlling symptoms from third-degree piles. The single most important challenge after surgical hemorrhoidectomy is the management of postoperative pain. Postoperative pain likely has two major components: first, discomfort from the surgical incision in the uniquely sensitive anoderm and perianal skin and, second, discomfort from tissue inflammation resulting from bacterial infiltration of the wound. Decreasing pain from the surgical incision itself can be accomplished by minimizing surgical trauma [7,8].

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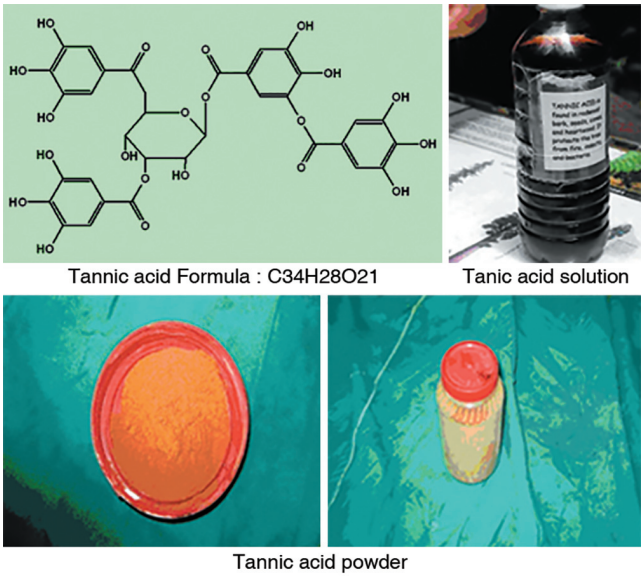
Figure 1



Tannic acid formula, solution and powder.

Optimal management of posthemorrhoidectomy pain requires planning. Effective postoperative pain control has numerous benefits: enhanced breathing, increased mobility, and prevention of gastrointestinal immotility [9–11].

Effective posthemorrhoidectomy pain control should be administered according to a protocol of increasing strength (analgesic ladder): paracetamol, nonsteroidal anti-inflammatory drugs, patient-controlled morphine analgesia [8,12].

Patients and methods

After obtaining approval from the local ethical committee of Benha University and fully informed written patient consent, this study was conducted by including 97 patients who were fit for surgery from Benha University and a private hospital during the period October 2012–May 2014. A prospective, randomized trial was conducted to compare posthemorrhoidectomy pain, wound healing, and prevention of secondary complications with the use of topical tannic acid powder applied to the surgical site in 50 patients (group A) compared with 47 patients administered placebo carrier (group B). The study population comprised 63 (64.9%) female and 34 (35.1%) male patients; 79 (81.4%) were between 21 and 43 years of age and 18 (18.6%) were above 43 years (Table 1).

Patients included in this study were suffering from primary hemorrhoids of grade 3 [73 cases (75.3%)] or grade 4 [24 cases (24.7%)], internal or external hemorrhoids; there were 89 (90.7%) noncomplicated cases and nine (9.3%) complicated cases (with massive bleeding, thrombosis, or gangrene). Sixteen (16.4%) patients in the tannic acid group and 19 (19.6%) patients in the control group had an associated fissure-in-ano and underwent fissurectomy and sphincterotomy in addition to hemorrhoidectomy (Table 1).

Table 1 Distribution of cases

Preoperative parameters	*N* (%)
Approach	
Group A: topical tannic acid application	50 (51.6)
Group B: placebo carrier application	47 (48.4)
Sex	
Female	63 (64.9)
Male	34 (35.1)
Age (years)	
Between 21 and 43 years	79 (81.4)
>43 years	18 (18.6)
Grades	
Grade 3	73 (75.3)
Grade 4	24 (24.7)
Types of primary origin	
Noncomplicated hemorrhoids	89 (90.7)
Complicated hemorrhoids	9 (9.3)
Associated anal fissure	
Group A	16 (16.4)
Group B	19 (19.6)

Patients suffering from kidney or liver disorder, skin allergy and heart problems, as well as pregnant and breast-feeding women were excluded.

All patients were submitted to full history, clinical examination, and laboratory tests as follows:

(1) History: patient history was taken to exclude pregnancy, lactation, and allergy or to diagnose the grades of hemorrhoids, usually present with bleeding or prolapse and with frequent complaints of discharge of mucus, pruritus, and some discomfort. Symptomatic hemorrhoids are often intermittent. Bleeding is commonly associated with constipation and straining. Hemorrhoids are often associated with skin tags, which may cause irritation and difficulty in maintaining anal hygiene. If hemorrhoids prolapse, they may spontaneously return to the anal canal after straining; large hemorrhoids may be irreducible. Thus, hemorrhoids may be classified as first degree (piles that never prolapse), second degree (piles that prolapse but spontaneously return), third degree (piles that prolapse and require digital replacement), and fourth degree (piles that are permanently prolapsed) [13].
(2) Clinical examination:
    (a) General examination: this was carried out in a meticulous way and included the airways, vital signs, and back, abdominal, and skeletal examination (body weight) to ascertain fitness.

(b) Local examination: it was carried out to detect severe skin allergy and to diagnose hemorrhoids; some hemorrhoids can be diagnosed solely by inspection. There may be skin tags and descent of the hemorrhoids during straining. When hemorrhoids become evident during straining they appear as two or three circumscribed swellings, as compared with the circumferential appearance of a full-thickness rectal prolapse. Furthermore, most patients with hemorrhoids do not have a patulous anus, as do patients with rectal prolapse. Digital examination is important to detect the presence of anal pathology and to assess anal tone [14].

(3) Preoperative investigations: preoperative examinations included analysis of complete blood count, blood sugar, and liver functions, renal function tests, ECG in patients above 40 years, and specific tests to confirm the presence of hemorrhoids — that is, proctoscopy at rest and during straining. Proctosigmoidoscopy is important to exclude any rectal pathology, particularly polyps, proctitis, or a neoplasm in patients above 50 years of age.

Operative procedures

There are two techniques for hemorrhoidectomy. The operation may be performed as an open procedure so that any discharge of blood, serum, or pus can drain easily, or a closed hemorrhoidectomy may be performed in which the mucosa and the skin defect are closed, which leaves an intact anal canal. The techniques used in this study were open diathermy hemorrhoidectomy after general (better), spinal anesthesia and lithotomy (better), or prone jackknife position. The patient was placed with the feet in stirrups and the anal canal was gently dilated. A proctoscope was inserted to identify the site of the three principal hemorrhoids. A weak adrenaline solution (1: 200 000) in saline was infiltrated around the skin adjacent to each primary hemorrhoid and further injection was made in the lower part of the intersphincteric space and in the submucosal plane under the hemorrhoid. Tissue forceps were then applied to each pile and to the skin adjacent to the hemorrhoid. The procedure started with the 7 o'clock hemorrhoid, followed by the 3 o'clock hemorrhoid, and finished with the 11 o'clock hemorrhoid, and hence the operation field was not obscured by bleeding. The tissue forceps held the hemorrhoid and its adjacent skin was grasped in the left hand. A V-shaped incision was made in the surrounding perianal skin with scissors. The cut was deepened toward the anal canal to reveal the lower fibers of the internal anal sphincter. The sphincter was gently swept away with tissue forceps from the hemorrhoid. The scissors were then used to excise the hemorrhoidal tissue within the anal canal, which left the apex of the hemorrhoid with its arterial supply and venous drainage intact for ligature. The pedicle of each hemorrhoid was then enclosed in an arterial clip, and the pedicle was transfixed using nonabsorbable suture material. Hemostasis was then secured from the bed of the hemorrhoid by use of cautery. Only then was the pedicle ligated. The ligature was left long so that in the event of any further bleeding the pedicle could be easily identified and delivered into the operative field. Each hemorrhoid was dealt within the same manner; however, well-established skin bridges between each V-shaped segment of excised skin must remain. At the end of the operation, an anal speculum was inserted to ensure complete hemostasis. Then topical tannic acid powder or placebo carrier was applied to the surgical site. Finally, gauze dressings containing mixed tannic acid and lignocaine cream 2% were applied to each hemorrhoidal area [15–20].

Outcome items

Pain and wound healing were assessed on postoperative days 2, 7, and 14. But secondary hemorrhage was assessed on postoperative day 7.

Pain was evaluated using a visual analog score (VAS). Patients in both groups ranked the level of pain from 0 (no pain) to 10 (very severe pain). Narcotic analgesic (morphine; 10 mg) requirement was also recorded.

Wound healing and secondary hemorrhage were evaluated at 2–8 and 2 weeks, respectively, by taking high-quality color digital photographs of the surgical site. Photographs were independently ranked according to three categories: category A, postoperative edema; category B, primary versus secondary healing; and category C, overall wound healing.

These data are shown in Figs. 2–4.

Results

Ninety-seven patients were prospectively enrolled in this study. Fifty patients received topical tannic acid and 47 patients received the inert carrier. None of the patients were lost to follow-up, and data collection was complete.

Patients in the topical tannic acid group experienced significantly less postoperative pain during the first 2 days (VAS: 1.2 ± 0.4 vs. 8.2 ± 0.6; $P < 0.05$) and on day 7 (VAS: 3.6 ± 0.6 vs. 6.3 ± 0.5; $P < 0.05$). However, on day 14 (2.9 ± 0.3 vs. 3.2 ± 0.7; $P > 0.05$) there was no significant difference between groups (Table 2 and Graph 1). This was confirmed from significant difference in narcotic requirements between the topical tannic acid and control groups ($P < 0.05$). There was significantly

lower narcotic analgesic requirements in the topical tannic acid group during the first 2 days and on day 7.

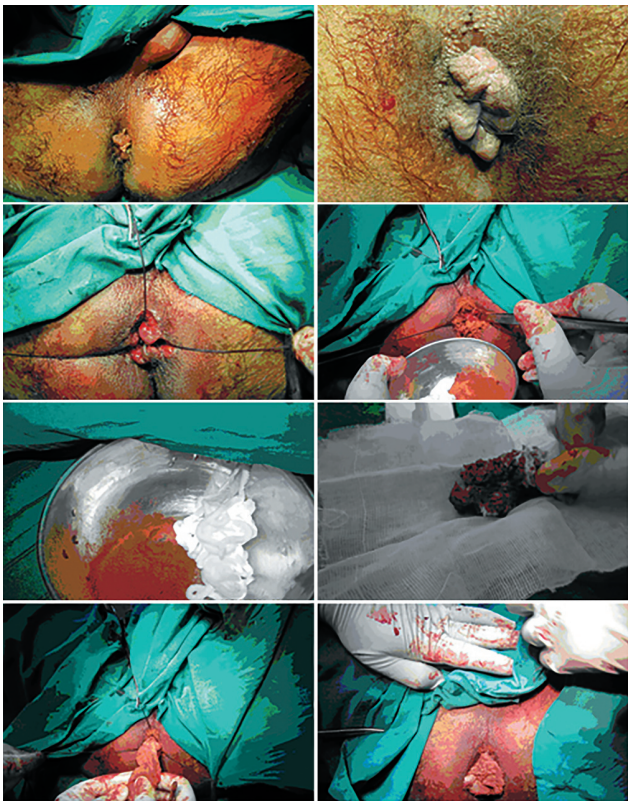
Wound healing in the topical tannic acid group was significantly better than in controls when ranked according to category A (postoperative edema) (mean score, 3.0 vs. 74.4; $P < 0.05$) (Table 3 and Graph 2).

There was no difference between the two groups when incisions were ranked according to category B (primary vs. secondary healing) ($P > 0.05$) (Table 4 and Graph 3).

In addition, category C (overall wound healing) was ranked significantly better in the topical tannic acid group (mean score, 4.0 vs. 63.8; $P < 0.05$) than in controls (Table 5 and Graph 2).

As regards secondary hemorrhage, patients in the topical tannic acid group experienced significantly less postoperative secondary hemorrhage on day 7 (mean score, 2.0 vs. 12.0; $P < 0.05$) (Graph 4 and Table 6).

Figure 2



Steps of posthemorrhoidectomy with topical application of tannic acid.

Figure 4

Group B (control).

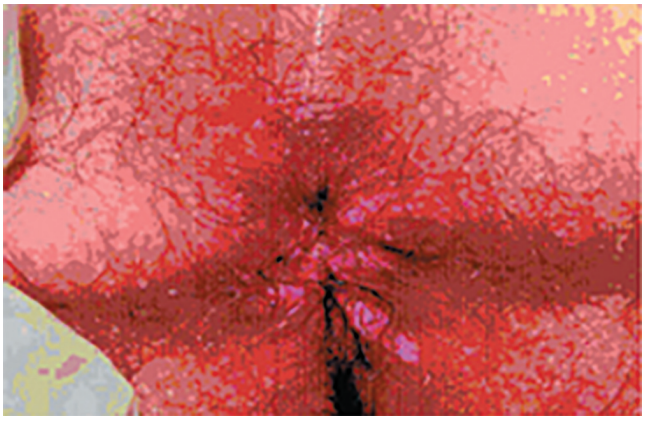
Table 2 Pain assessment using a visual analog score

Timing of pain	Group A	Group B	*P*-value
First 2 days	1.2 ± 0.4	8.2 ± 0.6	>0.05 (significant)
7 days	3.6 ± 0.6	6.3 ± 0.5	>0.05 (significant)
14 days	2.9 ± 0.3	3.2 ± 0.7	>0.05 (NS)

Table 3 Wound healing assessment at 2 weeks according to category A

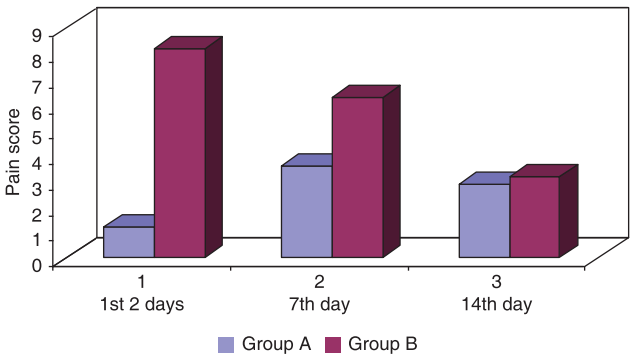
Category A	Postoperative edema [*N* (%)]	Total number of cases	*P*-value
Group A	15 (30)	50	>0.05 (significant)
Group B	35 (74.4)	47	

Figure 3



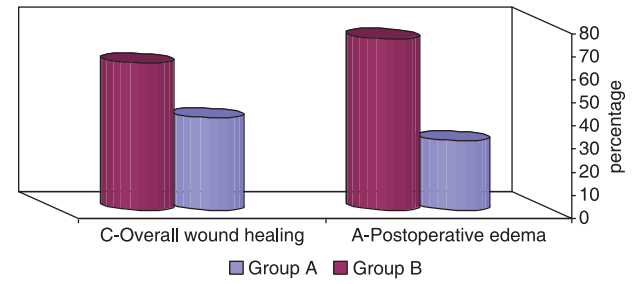
Group A (topical tannic acid).

Graph 1



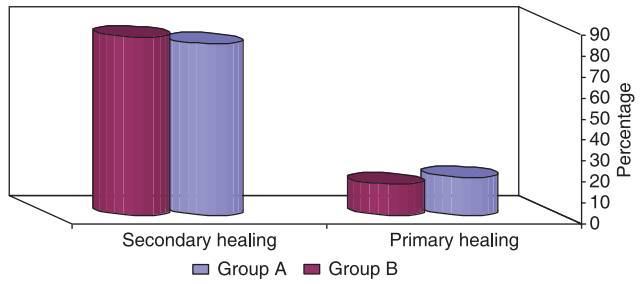
Pain assessment using a visual analog score.

Graph 2



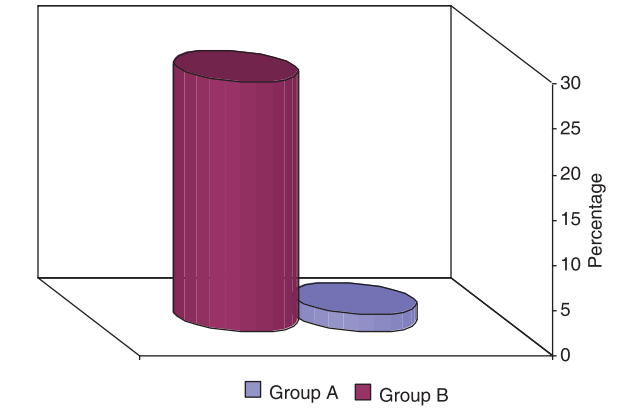
Wound healing assessment at 2 weeks, according to category A and C.

Graph 3



Wound healing assessment at 2 weeks, according to category B.

Graph 4



Secondary hemorrhage assessment on day 7.

Patients with secondary hemorrhage in group A were treated only with conservative measures but patients in group B were treated either by conservative measures [4 (30.7%)] or by surgical intervention, such as stitch ligature or diathermy [9 (69.3%)] (Table 7).

Discussion

Hemorrhoids usually present with bleeding or prolapse. Patients also frequently complain of discharge of mucus, pruritus, and some discomfort. Symptomatic hemorrhoids are often intermittent.

Table 4 Wound healing assessment at 6–8 weeks according to category B

Category B	Primary healing [*N* (%)]	Secondary healing [*N* (%)]	Total cases	*P*-value
Group A	9 (18)	41 (82)	50	>0.05 (NS)
Group B	7 (14.8)	40 (85.2)	47	

Table 5 Wound healing assessment at week 8 according to category C

Category C	Overall wound healing [*N* (%)]	Total number of cases	*P*-value
Group A	20 (40)	50	>0.05 (significant)
Group B	30 (63.8)	47	

Table 6 Secondary hemorrhage assessment on days 7–10

Postoperative	Secondary hemorrhage [*N* (%)]	Total number of cases	*P*-value
Group A	1 (2)	50	>0.05 (significant)
Group B	13 (27.6)	47	

Table 7 Secondary hemorrhage assessment on days 7–10

Secondary hemorrhage management	Group A [*N* (%)]	Group B [*N* (%)]
Conservative	1 (100)	4 (30.7)
Surgical	0 (0)	9 (69.3)

Bleeding is commonly associated with constipation and straining [13].

Hemorrhoidectomy remains a painful operation, but in most patients it is extremely successful as a means of controlling symptoms of third-degree piles, and in the majority of patients the operation is successful at controlling prolapse and bleeding [7].

The objective of treatment is to alleviate symptoms, not necessarily to improve the appearance of the anal canal. Asymptomatic patients with hemorrhoids do not justify treatment, because the therapy could cause more trouble than the underlying disease pathology [21,22].

The current study revealed the importance of topical tannic acid application after open diathermy hemorrhoidectomy in diminishing postoperative pain, directly by its astringent effect and indirectly by its antibacterial property [3].

Tannic acid improves wound healing by its direct antienzymatic effect and indirectly by reducing postoperative wound infection, directly through its antibacterial property and indirectly by adequate postoperative hemostasis through its constringing action upon mucous tissues [1].

Finally, topical tannic acid significantly decreases postoperative secondary hemorrhage through its vasoconstrictive effect directly on the mucous membrane and indirectly through its antibacterial property [3,4].

Conclusion

From the above-mentioned data, the following points can be concluded: Use of topical tannic acid is inexpensive, entails no allergic reaction, is easily available, has no systemic effects, and is easy to apply in open diathermy hemorrhoidectomy. It successfully reduces postoperative pain, improves wound healing, and reduces the incidence of postoperative secondary hemorrhage ($P > 0.05$). However, there is no significant difference in the type of healing — that is, primary and secondary healing ($P > 0.05$).

Acknowledgements

Conflicts of interest

None declared.

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Surgical site infections after breast surgery: Alexandria medical research institute hospital experience

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Background
Surgical site infections (SSIs) are major sources of adverse operation-related events in patients undergoing surgery and include increased morbidity, psychological trauma, additional cost, and delay of postoperative adjuvant therapies. This study aimed to identify the rate, degree, treatment, and causative organisms of SSIs after breast surgery in the hospital of Medical Research Institute, University of Alexandria.

Patients and methods
The study prospectively included all patients admitted during the period from February 2013 to July 2013 who were selected for breast surgery. Patients were followed up for 30 days after surgery if they had no implant and for up to 1 year if they had an implant placed during the operation. The rate, degree, treatment, and causative organisms of SSIs after breast surgery were registered.

Results
The study included 146 patients; SSIs were diagnosed after 17 (11.6%) operations. All patients who had SSIs after breast surgery were identified during the outpatient follow-up. Six (35.2%) of the 17 patients who had SSIs after breast surgery needed to be readmitted for management of SSIs. *Staphylococcus aureus* was the most common pathogen (isolated from 41.2% of patients).

Conclusion
SSIs are important and common complications after breast surgery. They can occur after any type of breast surgery. Microbiological diagnosis is an essential tool for proper management.

Keywords:
breast cancer, breast surgery, Southampton wound scoring system, surgical site infection

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Introduction

Breast cancer is the most common site-specific cancer in women and is the leading cause of death from cancer among women. It accounts for 33% of all female cancers and is responsible for 20% of the cancer-related death in women [1,2]. In Egypt, breast cancer is a significant public health problem, accounting for ~29% of newly diagnosed cancers [3,4]. Sixteen percent of all cancer-related death among women is attributed to breast cancer, making it the second leading cause of cancer-related death [3,4]. The standard definition of surgical site infection (SSI), developed by the Centers for Disease Control and Prevention (CDC), which is used by most hospital epidemiologists and infection control practitioners worldwide, specifies surveillance for SSIs for 30 days after operation in procedures without implants and for 1 year after operation when an implant is placed [5]. The rate of breast SSIs ranges from 1 to 30%, depending on the definition of SSIs, the type of operation, comorbidities of the patient, time of follow-up, perioperative therapy, and reporting institution. The incidence of SSIs in breast surgery is higher than that in other clean operations in which the infection rate is less than 5% [6–9]. The development of SSI can lead to prolonged hospital stay with increased costs, poor cosmetic results, psychological trauma, and, occasionally, a delay in postoperative adjuvant therapies [10]. A variety of risk factors for SSI after breast surgery have been reported, [11–14] including older age, obesity, heavy alcohol use [13], smoking, diabetes, malignant tumor, previous open biopsy [15,16], previous chemotherapy or radiation therapy [14,17–21], trainee surgeon responsible for the operation [22], seroma development, prolonged duration of drainage after operation [14,21], immediate reconstruction, and lack of antibiotic prophylaxis at the time of operation [23–25]. This study aimed to identify the rate, degree, treatment, and causative organisms of SSI after breast surgery in the hospital of Medical Research Institute, University of Alexandria.

Patients and methods

The study prospectively included all patients admitted to the Department of Surgery, the hospital of Medical Research Institute, University of Alexandria, from

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February 2013 to July 2013 who had been selected for different types of breast surgeries. Prospective detection of SSI was used to identify patients with SSIs. The type of operation submitted was registered and patients were followed up for 30 days after surgery if there was no implant and for 1 year when an implant was placed during the operation. The grade of SSI was identified using the Southampton wound scoring system [26]. Diagnosis was based on information from patients' medical records, including clinical data (symptoms and signs), investigations (laboratory, histopathology, radiological, etc.), microbiological culture and sensitivity results, and medication charts, in addition to the medical records of the infection control team in the hospital. Infections were identified either during the original surgical admission, at readmission to the hospital, or during outpatient follow-up of the surgical wound. All patients who were submitted for any procedure received third-generation cephalosporin antibiotic immediately before the procedure. Causative organisms were recorded from the microbiological reports. The method of management of these infections was also recorded.

Results

The study included 146 patients who were admitted to the Department of Surgery, hospital of Medical Research Institute, University of Alexandria, from February 2013 to July 2013 who were selected for breast surgery; the distribution of these cases according to the type of surgery is shown in Table 1.

SSIs were diagnosed in 17 (11.6%) surgical cases. The distribution of patients who had SSIs after breast surgery according to the type of surgery submitted is shown in Table 2.

All patients who had SSIs after breast surgery were diagnosed during the outpatient follow-up within the first 3 weeks after surgery, except two: one patient with an implant who was diagnosed 3 months after surgery and another patient with an expander who was identified 9 months after surgery. Regarding the age of patients who had SSIs after breast surgery; it ranged from 36 to 67 years and in those patients who had severe Southampton score (grade IV and V); the age was greater than 60 years. Six (35.2%) of the 17 patients who had SSIs after breast surgery were diabetic and they developed SSIs of Southampton score grade III or more and two of them needed to be readmitted for management of SSIs. Five (29.4%) of the 17 patients who had SSIs after breast surgery received neoadjuvant chemotherapy and they also developed SSIs of Southampton score grade III or more. The distribution of patients who had SSIs after breast surgery on the basis of the degree of infection according to the Southampton wound scoring system is shown in Table 3. Six (35.2%) of the 17 patients who had SSIs after breast surgery needed to be readmitted for management of SSIs: two patients for secondary suture after debridement and four patients for incision and drainage. Seven (41.2%) of the 17 patients who had SSIs after breast surgery needed aspiration to drain seroma; two of them needed insertion of a second tube.

Staphylococcus aureus was the most common pathogen (isolated from 41.2% of patients). Gram-negative bacteria were collectively isolated from 29.4% of patients. The distribution of patients who had SSI after breast surgery according to the type of isolated bacteria is shown in Table 4. All patients received antibiotics according to culture and sensitivity results.

Discussion

SSIs are major sources of adverse operation-related events in patients undergoing surgery, and include increased morbidity, psychological trauma,

Table 1 Distribution of breast surgery patients admitted during the period from February 2013 to July 2013 according to the type of surgery submitted

Type of surgical procedures	Number of cases (%)
Excisional biopsy	48 (32.9)
MDE	14 (9.6)
Nipple reconstruction	5 (3.4)
Lipofilling	11 (7.5)
Mastectomy	42 (28.8)
Reduction mammaplasty	8 (5.5)
TRAM	2 (1.4)
LD	6 (4.1)
Implant	6 (4.1)
Expander	4 (2.7)
Total	146 (100)

LD, latissimus dorsi myocutaneous flap; MDE, major duct excision; TRAM, transverse rectus abdominis myocutaneous flap.

Table 2 Distribution of patients who had surgical site infection after breast surgery according to the type of surgery submitted

Type of surgical procedures	Number of cases (%)
Excisional biopsy	1 (6)
MDE	2 (12
Mastectomy	8 (46)
Reduction mammaplasty	2 (12)
TRAM	1 (6)
Implant	2 (12)
Expander	1 (6)
Total	17 (100)

MDE, major duct excision; TRAM, transverse rectus abdominis myocutaneous flap.

Table 3 Distribution of patients who had surgical site infection after breast surgery according to the degree of infection as per the Southampton wound scoring system [26]

Degrees of infection	Number of cases (%)
Southampton score	
IIB	2 (11.8)
IIC	3 (17.6)
IIIB	2 (11.8)
IIIC	2 (11.8)
IIID	2 (11.8)
IVA	3 (17.6)
IVB	1 (5.8)
V	2 (11.8)
Total	17 (100)

Table 4 Distribution of patients who had surgical site infection after breast surgery according to the type of isolated bacteria

Isolated bacteria	Number of cases (%)
Staphylococcus aureus	7 (41.2)
Streptococcus pyogenes	3 (17.6)
Pseudomonas aeruginosa	3 (17.6)
Morganella morganii	2 (11.8)
No pathogen isolated	2 (11.8)
Total	17 (100)

additional cost, and delay of postoperative adjuvant therapies [27,28]. We reported a higher incidence of SSIs (11.6%) compared with that reported by Degnim *et al.* [29] (2.7%), Leinung *et al.* [30] (4.5%), and Olsen *et al.* [31] (4.7%), but lower than that reported by Vilar-Compte *et al.* [32] (18.9%). Further, our rate of SSIs is higher than that reported by Omar *et al.* [33] (2.3%), who believed that the rate of SSI in their study may be higher than reported. As the postoperative length of stay is decreasing, the follow-up of the patient is mainly carried out on an outpatient basis. During outpatient visits, when the SSI develops and requires no readmission, surgeons may not document the infection in the patient's records and may not request microbiological sampling of the wound. This is primarily because of fear of medical malpractice claims or negligence especially in a surgery classified as a clean one like breast surgery [33]. However, we believe that this bias is not present in our study because all of the authors are surgeons and we follow up all cases of breast surgery after the operation in the breast clinic, which is conducted every week in our department. In our study, six (35.2%) of the 17 patients who had SSI after breast surgery needed to be readmitted for management of SSI: two patients for secondary suture after debridement and four patients for incision and drainage. In other study, 62.5% were readmitted for management of SSI [13]. This is because in our study only six (35.2%) patients out of the 17 who had SSI after breast surgery had severe grades of SSIs. In our study, all of the SSIs were diagnosed after patients' discharge. With the current trends favoring a shortened postoperative hospital stay, most of our patients with SSI were managed on an outpatient basis (64.8%) and only six (35.2%) needed to be readmitted for management of SSIs. In the present study, despite the fact that *S. aureus* was the primary pathogen isolated from SSIs (41.2%), Gram-negative bacteria were isolated in 29.4% of cases, representing a significant finding. Other studies have reported the same results [34]. However, Mukhtar *et al.* [35] reported Gram-negative bacteria as the most common isolated pathogen. These findings support the importance of the use of empirical broad-spectrum antimicrobial (not only targeting *S. aureus*) coverage until culture results become available.

Conclusion and recommendations

SSIs are important and common complications after breast surgery and can cause adverse operation-related events. They can occur after any type of breast surgery. Microbiological diagnosis is an essential tool for proper management of such patients and therefore we recommend culture and sensitivity testing for every patient with SSI and the use of empirical broad-spectrum antimicrobial (not only targeting *S. aureus*) coverage until culture results become available. Because there are a lot of risk factors that may affect their incidence, we recommend further studies with a larger volume of cases to identify these independent risk factors that can be modified to decrease the incidence of SSIs. Also, we recommend pooling of these data in multivariate analysis to identify these risk factors.

Acknowledgements

Conflicts of interest

None declared.

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Where there is no specialist: surgical care in a secondary health facility in a developing country

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Background
A major deterrent to providing qualitative surgical care in developing countries is the lack of adequate facilities and severe shortage of human resources. Therefore, most of the surgical workforce in rural areas and urban slums predominantly includes general practitioners with little formal training in providing surgical care. There is a need for constant review of patients' care in this setting with the aim of improving service delivery and conforming to the internationally acceptable standard of practice.

Materials and methods
A 5-year descriptive retrospective study, from January 2007 to December 2011, of general surgery cases at State Specialist Hospital Ikere-Ekiti (Nigeria) was carried out.

Results
A total of 80 patients underwent 85 surgical operations. Most of them (86.2%) had ward admission for a mean duration of 4.6±1.4 days. The most frequent elective operation was hernia repair [66 (77.7%)]; whereas that of emergency was appendectomy [seven (8.2%)]. Other operations included lumpectomy [three (3.5%)], hydrocelectomy [two (2.4%)] and orchidectomy and laparotomy [three (3.5%) each]. All patients received postoperative antibiotics, with 71.3% receiving two or more antibiotics. Fifteen (18.8%) patients had surgically excised specimens with no histopathological evaluation. Only four (5%) patients were followed up beyond 4 weeks. No mortality was recorded.

Conclusion
Surgical volume was grossly low and there is a need for the government to equip secondary healthcare centres with basic facilities and strengthen surgical capacity for maximum utilization and improved quality of care. Periodic training programmes for general practitioners to ensure strict adherence to the international best practices will be helpful. In addition, health education should be available for everyone to reduce sociocultural-related problems.

Keywords:
secondary healthcare, semiurban, surgical care

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1110-1121

Introduction

Surgery has assumed a significant role in global health and its importance cannot be overemphasized [1]. The recent estimates suggest that 11% of the global burden of disease can be treated with surgery and these conditions include injuries (38%), malignancies (19%), congenital anomalies (9%), complications of pregnancy (6%), cataracts (5%) and perinatal conditions (4%). These diseases may be cured, palliated or treated with surgical interventions even though they are rapidly growing with the increase in uncontrolled population worldwide [2].

Irrespective of the various preventive strategies in developing countries where conservative treatment is usually not readily available and there are a huge number of untreated surgical pathologies, these diseases will always account for a considerable proportion of a population's disease burden [3]. A major deterrent to providing qualitative and effective surgical care in developing countries is the lack of human resources. There is a critical shortage of surgeons in Africa and rural areas are affected the most. Africa has less than 1% of the surgical workforce in comparison with USA, although a significant proportion of the disease burden is found in Africa [4]. Different studies from sub-Saharan African countries have confirmed the severe deficiencies in surgical capacity [5–7]. Nigeria is not exempt from these severe physician shortages including surgeons who prefer practicing in urban areas or in tertiary institutions that are better equipped and have a higher income base.

The workforce in the rural areas and urban slums predominantly includes medical officers/nonspecialist with only undergraduate formal training in providing surgical care. Henry *et al.* [8] showed that 52.1% of general practitioners constituted most of the surgical workforce in rural southern Nigeria. In an attempt to bridge the gap in the surgical workforce between the rural and urban areas and also to improve on service delivery vis-a-vis provision of safe and affordable surgery to rural and

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urban slum dwellers, the Association of Rural Surgical Practitioners of Nigeria (ARSPON) was established in 2008 by a group of rural surgical practitioners [9]. The objective of ARSPON is to enhance and improve on the quality and standard of rural surgical practice in the country irrespective of where the practice is taking place through provision of training opportunities for doctors to acquire surgical skills in a short period that will enable them to perform safe and affordable surgery.

In Nigeria, most secondary health facilities are situated in rural and semiurban areas, where the majority of the population resides. The present audit of care of surgical patients in secondary health facility, which is the first of its kind in Ekiti State (Nigeria) was carried out. The idea is to determine surgical volume and management of surgical patients with the aim of improving our service delivery and conforming to the internationally acceptable standard of practice.

Materials and methods

This was a descriptive retrospective study of general surgical operations performed over a 5-year period from January 2007 to December 2011 at the State Specialist Hospital (SSH), Ikere-Ekiti, south–western Nigeria. The town is ranked second in terms of infrastructural development and has a population of 147 355 according to the 2006 census [10]. The major occupation of the inhabitants is farming. Besides trekking, their other mode of transportation is by land, using motors, motorcycles and bicycles. In addition to the SSH, where this study was carried out, it has five primary and many private health centres. Also located in the town are two tertiary and many secondary and primary educational institutions.

The hospital

The hospital is a government-owned secondary healthcare facility established in 1970 as a district hospital, but was later upgraded to a SSH in 2001 as one of the three specialist hospitals located each in the three senatorial districts of the state. It is an 80-bed hospital and serves as a referral centre for several private health institutions, maternity homes and primary health centres in the district. There are two tertiary health institutions in Ekiti State. The Ekiti State University Teaching Hospital (EKSUTH) and Federal Medical Centre (FMC), which are located in Ado-Ekiti and Ido-Ekiti, respectively, serve as referral centres for the SSH and all other hospitals in the state.

During the period of this study, there were six medical officers. Only the two surgically inclined medical officers carried out all the surgeries. Currently, the hospital has specialists in the fields of general surgery and obstetrics/gynaecology on a permanent basis and other visiting specialists in paediatrics and orthopaedics.

The theatre registers, admission records in the different wards and follow-up clinic notes provided information on the total number of general surgical cases managed over the period. Surgical procedures such as suturing of lacerations and drainage of abscesses were performed in the outpatient department and were not properly recorded and were thus excluded from the study. The study was carried out after obtaining ethical consent from the hospital authority. Information extracted included the patients' demographic profile, diagnosis, treatment offered, complications and follow-up system. These data were analysed using the statistical package for the social sciences (SPSS, version 16; SPSS Inc., Chicago, Illinois, USA) software.

Results

There were two categories of surgical patients in this study. The first group included 132 patients who underwent surgical operations during periodic free surgical programmes organized by the Ekiti State government in collaboration with specialists from tertiary centres. There was paucity of information in the record of these patients. However, the theatre record showed that they had mainly herniorrhaphies, hydrocelectomy and lumpectomies and were treated as day cases.

The second group included 80 patients who underwent 85 general surgical procedures over the 5-year period. They were the routine patients who were duly registered, investigated properly and prepared for surgery. Their ages ranged from 8 to 95 years (mean 45.8±9.7 years) and the majority [74 (92.5%)] were male patients. In terms of occupation, the patients were farmers [26 (32.5%)], students [22 (27.5%)], civil servants [13 (16.3%)], artisans [10 (12.5%)], commercial drivers/conductors [four (5.0%)] and others [five (6.2%)]. Most patients [69 (86.2%)] were admitted into the wards (mean duration 4.6±1.4 days). Hernia repair [66 (77.7%)] was the most frequent procedure performed and this included 63 (74.1%) inguinal, [two (2.4%)] femoral and an incisional hernia (1.2%). Other elective surgeries included hydrocelectomy [two (2.4%)] and lumpectomy [three (3.5%)]. The emergency procedures were appendectomy [seven (8.2%)], orchidectomy [three (3.5%)] and exploratory laparotomy [three (3.5%)] in patients with traumatic splenic rupture, typhoid ileal perforation and adhesive intestinal obstruction with a gangrenous bowel.

The procedures were performed under general anaesthesia (GA) and local anaesthesia in 51 (63.8%) and 29 (36.2%) patients, respectively. All patients were administered antibiotics and 57 (71.3%) of them received two or more antibiotics for a variable length of time ranging from 3 to 8 days. Fifteen (18.8%) patients had postoperative surgical specimens, but none was submitted for histopathology evaluation in either of the tertiary health institutions (EKSUTH and FMCI) as the only centres with the facility for this analysis.

Postoperative complications were observed in 21 (26.3%) patients (Table 1).

Discussion

A total of 85 general surgical operations were performed over a 5-year period, about 0.3 case per week and an average of six procedures per 10 000 individuals. This showed a grossly low volume and significant gap between the range of surgeries that the WHO expects even in a district hospital and what is actually delivered in this specialist hospital and highlights underprovision of surgical services at this secondary level of care [11]. An average of 6–8 patients/month were being booked for elective surgery, but quite a number did not turn up perhaps because of financial constraints as more patients turned up for the free health programmes. The other more important reason could be the lack of specialists in this centre and the fact that the medical officers were not proficient in surgery. Also, cultural reasons and belief in alternative or traditional medicine are still very common among Africans. The Galukande *et al.*'s [12] study of three sub-Saharan African countries also showed a low number of surgical procedures ranging from 5 to 45 per 10 000 individuals. Although the incidence and prevalence of surgical conditions are not known here, global data have shown limited access to essential surgery in low-income and middle-income countries, which account for 70% of the world's population, with only 26% of 234 million estimated surgical procedures performed in these countries [13].

Table 1 Postoperative complications

Complications	*N* (%)
None	59 (73.7)
Pain	7 (8.7)
Wound infection	4 (5.0)
Chemical burns (scrotal)	2 (2.5)
Haematoma (wound, scrotal)	4 (5.0)
Bleeding	1 (1.3)
Urinary retention	2 (2.5)
Enterocutaneous fistula	1 (1.3)
Total	80 (100.0)

The reasons for the shockingly low surgical cases may not be unconnected with the deficiency of the surgical workforce during the period, which only comprised two of each medical officers, perioperative nurses and paramedical staff, with no specialist surgeon, nurse or physician anaesthetist. Many of the surgical cases did not go beyond the emergency department before referral to the tertiary health institutions in the state where the different specialist surgeons are concentrated. Ketamine was used for the procedures performed under GA and was administered by the paramedic who served in the 'anaesthetist' capacity on the instruction of the medical officer performing the surgery. This kind of task shifting is often considered a potential solution to the medical workforce crisis in low-income and resource-poor countries [14,15]. Although this might have aided healthcare delivery, the quality in the standard of care might not have been maintained.

During the period, the 132 patients who received free surgical operations were all treated as day cases and they had no case notes and proper documentation, and hence, were not available for analysis. This underscores the poor record-keeping system of the hospital, which is common in our healthcare facilities. Also contributing towards the low surgical procedures and male preponderance was the exclusion of obstetric and gynaecological cases.

The vast majority (86.2%) were admitted for a mean duration of 4.6±1.4 days despite undergoing minor/intermediate surgeries. This could have increased the cost of care unnecessarily as most of these procedures could as well be performed as day cases with better patient selection and preparation had there been more expertise [16]. This was because the traditional practice of preoperative and postoperative admissions was still strictly observed. However, close interaction with the involved doctors showed that the type of anaesthesia (mainly GA) and the patient's anxiety about complications or undesirable conditions following discharge from hospital affected the length of stay postoperatively. It is worth noting that the other category of patients with similar diagnoses who received free surgical operations performed by specialists were treated as day cases in this same centre. This is to further buttress the unnecessary admission with attendant financial and physical burdens on the part of patients.

Hernia repair (77.7%) was the most frequent elective procedure performed, of which inguinal herniorrhaphy constituted the majority. This is similar to other studies in different countries worldwide. Approximately 75% of all abdominal wall hernias are seen in the groin and

about 20 million inguinal hernia repairs are performed globally every year [17–19]. In this study, about one-third of the patients (32.5%) were peasant farmers and this could have been the predisposing factor toward the development of hernia.

Only seven (8.2%) patients underwent appendicectomy, which was the most common emergency procedure performed. Most patients who required this surgery could have been referred because of lack of human resources or could have presented at private hospitals in the area. The three patients who presented with testicular torsion all underwent orchidectomy. This was because of late presentation (>48 h) to the hospital, which is common in this part of the world. Rampaul and Hosking [20] also showed in their study that the major factor leading to orchidectomy in patients with testicular torsion was delayed presentation. Three (3.5%) patients underwent exploratory laparotomy for acute abdominal conditions – splenic rupture, typhoid ileal perforation and gangrenous bowel from adhesive intestinal obstruction. However, the patient who underwent splenectomy developed intraperitoneal haemorrhage that warranted re-exploration, whereas the one who underwent resection and anastomosis developed enterocutaneous fistula and was referred. The high complication rate following laparotomy might not be unrelated to the technical incompetence of the medical officers involved. A study in Malawi district hospitals also showed a low rate of laparotomies because only a few doctors were confident to 'open acute abdomen' for fear of encountering pathologies beyond their level of competence and thereby refer such cases [21].

All patients (100%) were prescribed a postoperative antibiotic, with 57 (71.3%) of them receiving two or more postoperative antibiotics. This routine antibiotic use was considered a preventive measure for surgical site infections in view of theatre inadequacies ranging from the lack of an ideal scrubbing room, free flowing water and sterilization equipment, making it difficult to achieve strict aseptic conditions. However, this routine practice of administration of antibiotics for every surgical intervention by the 'surgeons' in the hope of eliminating infection is short-sighted and is usually founded on custom, unsupported beliefs and adherence to dogma. However, the ideal would be to achieve standard of care by strict asepsis and using antibiotics for indicated purposes without masking poor clinical practice with antibiotics. Irrational or inappropriate prophylaxis, characterized by unnecessary use of broad-spectrum antimicrobial agents and continuation of therapy beyond the recommended period, can lead to bacterial resistance and unwanted side effects [22]. Besides, this also adds to the cost of care.

Fifteen patients had postoperative surgical specimens taken, but these were not submitted for histopathological examination. Interaction with the theatre staff showed that the patients were usually reluctant to submit a specimen, believing that it would add to the cost of care and also considered it unnecessary as the primary pathology had been removed. Also, it was possible that the stress of travelling to another place for submission could be responsible for the poor handling of the specimens, although some studies have shown that routine histopathological examination of certain specimens in the absence of any macroscopic abnormality may not be necessary considering the rarity of incidental findings relevant to patient management [23,24]. Raymond *et al.* [25] highlighted the importance of sending excised tissue for microscopic examination to confirm diagnosis and avoid missing unexpected malignancy with serious medicolegal consequences and Swank *et al.* [26] showed that routine histopathology of appendicectomy specimens cannot be judged as useless. Considering the lack of trained surgeons who are experienced in detecting a macroscopic abnormality of excised surgical specimens in this hospital and most secondary health centres in the country, it is advisable that specimens are sent for further investigations not to compromise the quality of care. Therefore, the practice of leaving it to the discretion of the patients to take a specimen for histopathological examination should be stopped as most patients will not comply because, as far as they are concerned, their problems have been solved and they therefore would not see any reason to 'waste' money and time pursuing investigations of little benefit.

That no mortality was recorded might delude one into thinking that the quality of care was acceptable. However, a true indication of the quality of care is the fact that all three patients who underwent laparotomies developed complications, two of which were serious enough to warrant re-exploration in one case and referral in the other. Other morbidities such as acute urinary retention, scrotal burns and haematoma following herniorrhaphy were managed successfully. Long-term complications such as hernia recurrence could not be ascertained because of the short follow-up period as only four (5%) of patients were seen beyond 4 weeks.

Conclusion/recommendation

Eighty-five general surgical procedures over 5 years in a secondary health facility are grossly low on the basis of the average of 6–8 patients being booked for operation in a month. There is a need for the government to equip these institutions with basic facilities for smooth and safe administration of anaesthesia and monitoring

of patients and also to strengthen surgical capacity by engaging the services of anaesthetists and specialist surgeons. This will restore confidence at this level of care, improve patients' patronage and reduce delay in management associated with referral to tertiary centres with attendant morbidity and mortality. Financial incentives and special welfare packages should be instituted to encourage specialists to work in rural hospitals or secondary healthcare facilities. Also, periodic training programmes should be organized for medical officers and theatre staff with the aim of improving their knowledge of patients' management and conform to internationally acceptable practices. Health education should be available for everyone to eradicate patients' belief in alternate practitioners who are actually practising without any scientific proofs.

Acknowledgements

Conflicts of interest

None declared.

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Permanent catheters for hemodialysis is not ideal but sometimes considered a necessity: a prospective study

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Background
It is not always easy to achieve an adequate arterio venous fistula in long-term dialysis patients; hence, permanent cuffed tunneled central venous catheters represent necessity in some ESRD patients like those with advanced age and/ or comorbid conditions.

Purpose
To report the technique and the results of the permanent tunneled catheters as a vascular access .

Patients and methods
This report describe the technique and the results of the permanent tunneled catheters as a vascular access for hemodialysis at Mansoura University Hospitals. Catheter was inserted by seldinger percutaneous technique with the use of radioscopic guidance by an experienced vascular surgeon.

Results
The study included 33 patients for whom 38 catheters were inserted (17 males,16 females), nine of whom were hypotensive, with a mean age of 48,9 years.The cumulative primary patency rate at 1 year was 52.6% and at 2 years, 21.05%. Complications developed including ,tunnel haematoma, thrombosis, and infection.

Conclusion
Permanent cuffed, tunneled catheters play a larger role, particularly among those in whom finding a vascular access can be challenging.

Keywords:
bactremia, hemodialysis, thrombosis, tunneled catheters

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Introduction

Creation of functional native or prosthetic arteriovenous fistula (AVF) is desirable according to the NKF/DOQI [1] guidelines, as it is more durable and has reduced complication rate. However, it is not always easy to achieve an adequate AVF in long-term dialysis patients [2,3], as most of these patients will lack adequate vein for creation of AVF [4].

Adequate superficial veins may be exhausted owing to repeated cannulation or previously failed arteriovenous vascular access [5]; hence, permanent cuffed tunneled central venous catheters represent necessity in some end-stage renal disease (ESRD) patients such as those with advanced age and comorbid conditions such as peripheral vascular disease, diabetes, and/or the cardiac status [6].

In this study, we report the technique and the results of permanent tunneled catheters as a vascular access for hemodialysis in patients who have inadequate conditions for creating an AVF or graft.

Patients and methods

This was a prospective clinical study conducted on 33 patients at Mansoura University Hospitals, which are a tertiary referral center, from April 2011 to April 2013.

Patients chosen for this technique were those with ESRD requiring hemodialysis with failure of previously established AVF and for whom there were no availability of vascular access. Routine duplex examination of the neck and femoral veins was performed before de-novo catheter placement, but duplex examination was not performed before catheter exchange. All patients signed written consent. Those with thrombosed femoral and neck deep veins were not chosen for this technique.

Technique

The skin was draped in the usual sterile manner with betadine, then the planned venotomy site and subcutaneous tunnel area was anesthetized with 1% lidocaine. Standard tunneled cuffed, silicone, double-lumen catheters were used.

Hemodialysis catheters (Medcomp, Harleysville, PA, USA) were tunneled using tunneling instrument, inserted by Seldinger percutaneous technique with the use of radioscopic guidance by an experienced vascular surgeon. Provided its tip at the right atrium, the peel-away sheath was then removed after verification of the

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localization of the catheter by C-arm. Bleeding from the venotomy site or the tunnel was managed with manual compression. After insertion of a single dose of 500 mg vancomycin, the catheter was locked with heparinized saline. The patient was discharged from the hospital on the same day. A card of instructions, antibiotic, and oral anticoagulant were given to the patient. Patients were recruited within week of catheter insertion and were prospectively followed up. Patency was defined as ability to successfully dialyze through the catheter. No secondary procedures were performed to extend patency of thrombosed catheters; hence, no secondary patency rate but only primary patency was calculated. Bacteremia or catheter thrombosis was considered malfunction.

Statistical methods

Patency rate was assessed with the Kaplan–Meier method for survival analysis.

Results

From April 2011 to April 2013, 33 patients with ESRD underwent this technique (17 male patients, 16 female patients, age range 12–84 years, mean age ± SD 48.9 ± 19.7). Nine patients (27.3%) were hypotensive (systolic pressure>90), eight patients (24.2%) had no suitable veins for access, six patients (18.7%) had hypercoagulable state (five systemic lupus erythematosus and one nephrotic syndrome), and eight patients (24.2%) were diabetic.

The follow-up period ranged 2–24 months, with a mean of 12.6±8. The patients in this study had undergone AVF reconstruction 2.09 times on average. Access was right internal jugular in 25 catheters (65.79%), left internal jugular in five catheters (13.16%), left subclavian in four catheters (10.53%), right subclavian in two catheters (5.26%), and left femoral in two catheters (5.26%) (Tables 1 and 2) (Figs. 1–4).

The cumulative primary patency rate at 1 year was 52.6% and at 2 years was 21.05% (Fig. 4b and c).

Complications developed in 17 of 38 catheters. Thrombosis developed in seven catheters and resulted in catheter malfunction. Nine catheters were infected, and bacteremia developed in six patients, which required catheter removal. A repeated procedure was performed for five patients (15.2%); hence, for the 33 patients, 38 catheters were inserted. Only two patients (6%) used this access as temporary line before successful transplant. No early thrombosis, catheter malposition, or early postoperative infection was noted. No pneumothorax, hemothorax, or operative deaths occurred, but two patients (6%) died during follow-up with functioning catheters because of nonrelated causes. One patient developed intraoperative tunnel hematoma that improved by compression (Table 3).

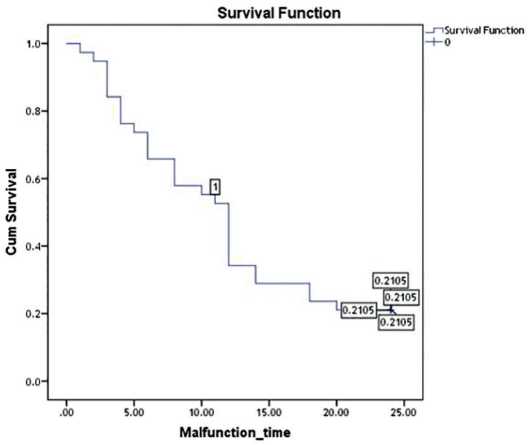
Discussion

Successful dialysis is mandatory for patients with ESRD, and the lack of it may become life limiting. Permanent catheters may serve as a critical permanent access when all other options have been exhausted [7].

Table 1 T ype of access for the permanent catheters

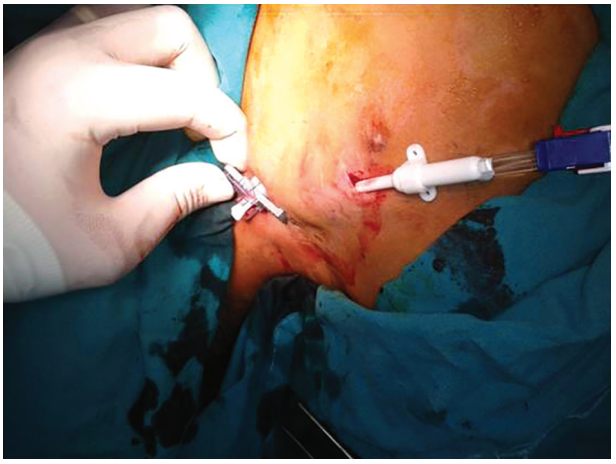
Type of access	Number of cases [*n* (%)]
Right internal jugular	25 (65.79)
Left internal jugular	5 (13.16)
Left subclavian	4 (10.53)
Right subclavian	2 (5.26)
Left femoral	2 (5.26)

Figure 1



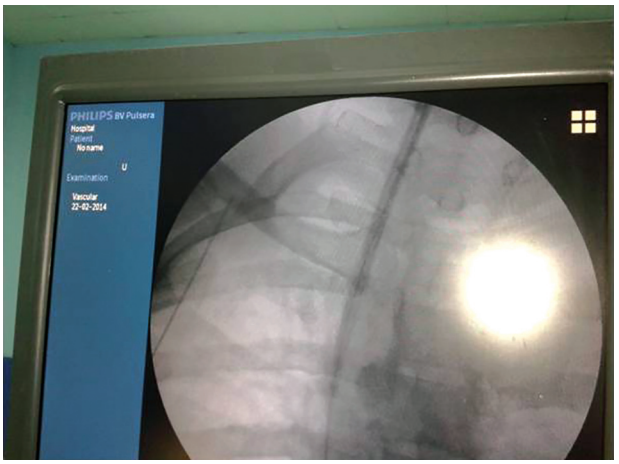
Survival curve of the catheters.

Figure 2



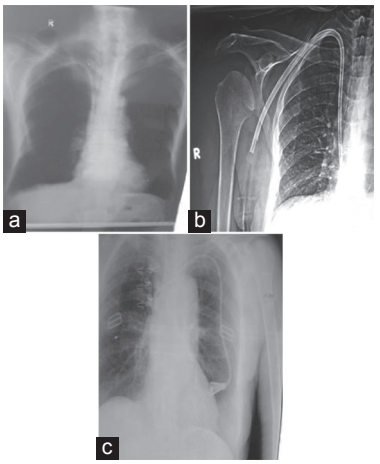
The catheter within the peel-away sheath (right internal jugular access).

Figure 3



Intraoperative C-arm use.

Figure 4



Postoperative radiographs: right subclavian access (a), right internal jugular access (b), and left subclavian access (c).

In this study, we decided to insert tunneled catheter for hemodialysis in patients who have inadequate conditions for creating an arteriovenous access, which is not common; this may explain the small study sample.

In this study most of our practice is catheter exchange (over a wire replacing temporary or malfunctioning – permanent catheters) than de novo catheter placement this is accepted by Oliver and Garofalo [8,9]. This technique is successful; in addition, it uses the same venotomy site, has low complication rate, and spares future access sites; this is in agreement with the study by Schwab and Beathard [10].

In this study, the internal jugular vein is preferred to other access veins on the basis of decreased rate of venous thrombosis (<5%) [11,12]. Subclavian site access was only used when the ipsilateral extremity can no longer be used for permanent access and when there is fear of venous hypertension. Femoral site access was only used when the other options do not exist [13]. This study indicates that there is no difference in the rate of catheter-related bloodstream infections between these three sites [14].

Here, we report that the patients who received permanent catheters represent a worst selection, as most of them had a history of multiple failed vascular access, were elderly, hypotensive, and/or had hypercoagulable state. In these patients, an increased risk for catheter thrombosis was assumed; hence, postoperative warfarin was routinely applied and titrated to an international normalized ratio target of 2–2.5, as the literature to date suggests that an international normalized ratio target of 1.5–2.5 should suffice [15].

Catheter salvage procedures such as thrombolytic therapy can improve patency rate [16]. We consider thrombosis as malfunction due to lack of recent lytic therapy agents, and the catheter is shortly lived after lytic therapy than exchange.

Table 2 Comorbid conditions

Comorbid conditions	Number of patients [*n* (%)]
Hypotension	9 (27.3)
No suitable veins for access	8 (24.2)
Hypercoagulable state	6 (5 SLE, and 1 nephrotic syndrome) (18.7)
Diabetes mellitus	8 (24.2)

SLE, systemic lupus erythematosus.

Table 3 Complications

Complications	Number of cases [*n* (%)]
Thrombosis	7 (18.42)
Infection	9 (23.68)
Intraoperative tunnel hematoma	1 (2.63)
Total number of complicated catheters	17 (44.73)

Our data indicate decreased placement-related complication as most of the cases are catheter exchange than *de novo*, whereas infection and thrombosis are the main long-term complications with high incidence [17,18].

McIntyre and colleagues[19,20] proved that antibiotic/anticoagulant treatment can improve infection rate. However, when we used this treatment, six of the nine infected catheters in this study necessitated catheter removal and did not respond to antibiotic treatment even based on blood culture; this may be due to delayed referral until bacteremia developed.

At our center, permanent catheter placement procedures are performed on an ambulatory basis; this has an impact on the cost and the burden for the hospital.

These catheters can be used immediately after insertion; no vein puncture is required three times weekly, and they are associated with relatively little cosmetic disfigurement and easy removal when complication occurs. Although that seems very logical, they must be weighted against the risk for thrombosis and infection with potentially life-threatening complications such as endocarditis. These values indicate the need for further improvement in the development of dialysis catheters. Failed permanent catheter does not preclude subsequent use of peritoneal dialysis.

Conclusion

Permanent cuffed, tunneled catheters play a larger role, particularly among those in whom finding a vascular access can be challenging. Catheter exchange shows less placement complications than *de novo*. Thrombosis and catheter-mediated bacteremia are still the primary reasons for catheter removal.

Acknowledgements

Conflicts of interest

None declared.

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Splenectomy for patients with β-thalassemia major: long-term outcomes

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Background/aim
The use of splenectomy for thalassemia major is restricted over concerns of its long-term outcome. The aim of this study was to assess the long-term outcomes of splenectomy for patients with β-thalassemia major.

Patients and methods
This study included 70 patients with β-thalassemia major. Patients were classified into two groups: 35 patients underwent splenectomy (S group) and 35 patients did not undergo splenectomy (NS group). Patients were assessed by review of medical records, assessment of medical history, and a clinical examination. In addition to complete blood count, liver function tests and serum ferritin were performed. Assessment of lymphocyte populations was carried out by flow cytometry. These investigations were performed at least 2 years after splenectomy in the S group.

Results
The mean age of the patients who underwent splenectomy was 6.68 ± 2.54 years and the mean postoperative follow-up period was 6.26 ± 3.03 years. Splenectomy improves anemia, but does not reduce iron burden; more patients were found to be on regular iron chelation after splenectomy. Hematocrit and red blood cell indices were significantly increased after splenectomy. Platelet count increased significantly in the S group (644.700 ± 299.400/mm^3). There were no significant differences in T-lymphocyte populations between both groups. IgM memory B lymphocytes were lower in the S group compared with the NS group. No overwhelming postsplenectomy infection was reported in this series. Postsplenectomy portal vein thrombosis was reported in one (2.9%) case.

Conclusion
With long-term follow-up after splenectomy for treatment of thalassemia major, thrombocytosis and the risk of thromboembolic persist. Splenectomy improves anemia, but does not reduce iron burden or the requirement for blood transfusion. Proper preoperative vaccination can reduce the risk of overwhelming postsplenectomy infection.

Keywords:
complications, hematologic disorders, immune system, lymphocytes, splenectomized

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Introduction

Thalassemia is a group of disorders of the red blood cell (RBC) protein, hemoglobin, which is the primary carrier of oxygen in the blood. β-Thalassemia major is one of the most prevalent disorders in Mediterranean regions, caused by mutations in the gene responsible for producing β-globin chain on the chromosome 11 [1]. Worldwide, β-thalassemia is believed to affect about one in 100 000 live births [2].

The treatment of thalassemia major has traditionally included transfusion of RBCs, iron chelation, and splenectomy. The need for splenectomy in thalassemia major is more likely where the disease is not suppressed efficiently by transfusion treatment.

Yet, even after decades of experience, important questions on splenectomy for thalassemia major remain unresolved, such as long-term hematological and immunological response. The aim of this study was to evaluate the long-term outcomes of splenectomy for the treatment of β-thalassemia major.

Patients and methods

This study was carried out at Assiut University Hospitals and included 70 patients with β-thalassemia major. An informed written consent in accordance with Assiut University Ethical Committee guidelines was obtained.

Patients were classified into two groups: 35 patients who had previously undergone splenectomy (S group) and 35 patients with β-thalassemia who had not undergone splenectomy (NS group). Splenectomy was performed from January 2004 to December 2011. The indications for splenectomy were a hugely enlarged spleen with blood transfusion requirement more than 250 ml/kg/year and any clinically significant

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complications such as pancytopenia. Preoperative vaccination against *Streptococcus pneumoniae*, *Haemophilus influenza* type B, and *Neisseria meningitides* was administered to all patients who underwent splenectomy 2–4 weeks before surgery. There was no regular prophylactic antibiotic administration, parenteral or oral, because of poor patient compliance. Antiplatelet was administered if the platelet count exceeded 1000 000/mm^3. Patients with known diabetes, cardiac, renal, infectious, inflammatory, or pulmonary diseases, and newly diagnosed β-thalassemia cases yet to receive a blood transfusion were excluded from the study.

All children in the study were assessed by review of medical records, assessment of medical history, and clinical examinations. In addition to complete blood count, liver function tests and serum ferritin were performed. Assessment of lymphocyte populations was carried out by flow cytometry using Cell Quest software (Becton Dickinson Biosciences, San Jose, California, USA). In the S group, these investigations were performed at least 2 years after splenectomy.

Monoclonal antibodies against surface markers were used. In immunofluorescence staining of the antibodies, cells were incubated with antibodies conjugated to a fluorochrome (e.g. fluorescein isothiocyanate). The percentages of CD19$^+$ (total B lymphocytes), CD19$^+$ CD27$^-$ (naive B cells), CD19$^+$ CD27$^+$ (total memory B cells), CD19$^+$ CD27$^+$ IgM$^+$ (IgM memory B cells), CD19$^+$ CD27$^+$ IgM$^-$ (switched memory B cells), CD3$^+$ (T lymphocytes), CD4$^+$ (T-helper cells), and CD8$^+$ (T-cytotoxic cells) were assessed. The data of flow cytometry were saved on a computer and plotted on a graph called a histogram (Fig. 1).

Statistical analyses

Statistical analyses were carried out using the statistical package for the social sciences (version 16.0; SPSS Inc., Chicago, Illinois, USA). Data are expressed as mean ± SD for continuous variables and percentages for categorical variables. An independent sample *t*-test was used to analyze continuous variables, whereas the χ^2-test was used to analyze categorical variables. The *P*-value was considered statistically significant when less than 0.05.

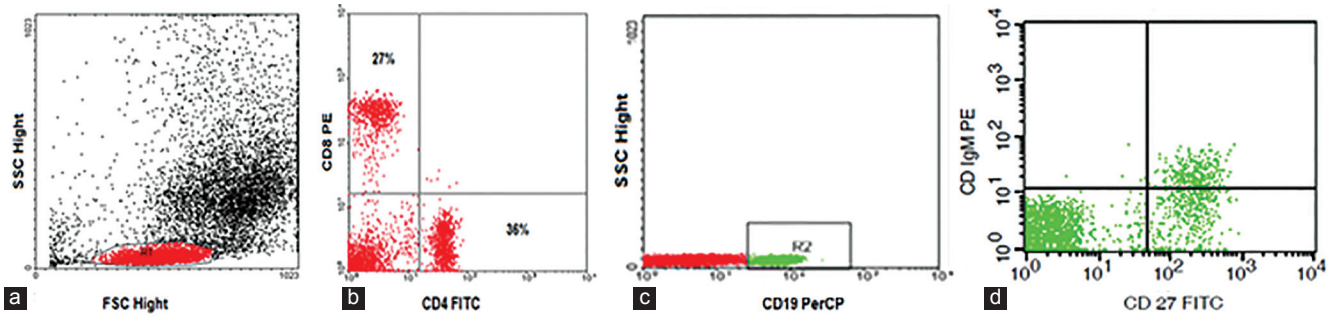
Results

The mean age of the patients at splenectomy was 6.68 ± 2.54 years. After a mean postoperative follow-up period of 6.26 ± 3.03 years, the mean white blood cells and platelet counts were 16.490 and 644.700/mm^3, respectively (Table 1). RBC count, mean hemoglobin level, hematocrit, and RBC indices were significantly elevated after splenectomy. Splenectomy did not reduce iron burden; more patients were found to be on regular iron chelation after splenectomy. Total and indirect bilirubin were significantly higher in the NS group compared with the S group (Table 2).

Splenectomized patients showed a significant increase in total lymphocytes and B lymphocytes. However, IgM memory B lymphocytes were significantly lower in the S group compared with the NS group. There was no significant difference in total T lymphocytes, CD4 helper T lymphocytes, CD8 cytotoxic T lymphocytes, or CD4$^+$/CD8$^+$ ratio among both groups (Table 3).

There was no history of overwhelming postsplenectomy infection (OPSI) in this series. An 18-year-old man had liver abscess; the abscess was in the left lobe of the liver and developed 8 years after splenectomy. The liver abscess was treated by pigtail percutaneous drainage and antibiotics. The culture and sensitivity of the aspirated pus showed Gram-negative bacilli, *Klebsiella* spp., which was sensitive to amikacin and ciprofloxacin.

Figure 1



Representative flow cytometric analysis of lymphocyte subsets in thalassemia patients. (a) Forward and side scatter histogram was used to define the lymphocyte population (R1). (b) The expression of CD4$^+$ and CD8$^+$ in T lymphocytes. (c) CD19$^+$ cells were then gated for further analysis. (d) The expressions of IgM and CD27 in B cells were detected. FITC, fluorescein isothiocyanate; FSC, forward scatter; perCP, peridin chlorophyll protein; PE, phycoerythrin; SCC, side scatter.

Postsplenectomy portal vein thrombosis was reported in an 8-year-old female patient (2.9%). The preoperative platelet count was 410 000/mm^3. One year after the operation, she developed severe abdominal pain with fever. Laboratory investigation showed thrombocytosis with a platelet count of 1 000 000/mm^3. Portal vein thrombosis was diagnosed by abdominal ultrasonography and confirmed by color

Table 1 Characteristics of splenectomized and nonsplenectomized thalassemia patients

Variable	Splenectomized thalassemia patients (n = 35)	Nonsplenectomized thalassemia patients (n = 35)	P-value
Age (years)	12.94 ± 2.44	5.54 ± 3.01	0.000
Sex			0.21
Male	24 (68.6)	19 (54.3)	
Female	11 (31.4)	16 (45.7)	
Weight (kg)	29.85 ± 6.04	16.82 ± 5.43	0.000
Height (cm)	131.94 ± 11.27	102.42 ± 17.51	0.000
BMI (kg/m^2)	17.05 ± 2.15	15.86 ± 2.25	0.017
Age at first transfusion (months)	9.62 ± 5.25	10.23 ± 7.52	0.680
Patient on regular chelation	24 (68.5)	15 (42.9)	0.030
Frequency of blood transfusion (duration between each transfusion in days)	34.26 ± 8.18	31.60 ± 13.91	0.316
Liver size (cmBCM)	7.09 ± 3.25	4.35 ± 2.13	0.000

Data are represented as means ± SD or n (%); cmBCM, centimeter below the costal margin; $P \leq 0.05$ was considered significant.

Table 2 Some hematological parameters and liver function tests in splenectomized and nonsplenectomized thalassemia patients

Variable	Splenectomized thalassemia patients (n = 35)	Nonsplenectomized thalassemia patients (n = 35)	P-value
WBCs (10^9/l)	16.49 ± 11.01	9.62 ± 3.40	0.000
RBCs (10^6/μl)	3.10 ± 1.2	3.4 ± 0.64	0.000
Hemoglobin (g/dl)	6.74 ± 1.27	5.75 ± 1.02	0.000
MCV (fl)	73.2 ± 8.5	62.45 ± 8.7	0.000
HCT (%)	22.70 ± 5.42	18.80 ± 5.3	0.000
MCH (pg)	21.7 ± 4.5	19.17 ± 2.6	0.000
MCHC (g/dl)	30.5 ± 1.8	29.6 ± 2.2	0.000
Platelet count (10^9/l)	644.700 ± 299.4	340.700 ± 160.9	0.000
Total bilirubin (μmol/l)	23.73 ± 7.59	39.56 ± 42.60	0.010
Indirect bilirubin (μmol/l)	17.67 ± 6.02	32.89 ± 48.84	0.029
Albumin (g/dl)	3.56 ± 0.64	3.97 ± 0.56	0.002
ALT (IU/l)	81.27 ± 27.02	49.19 ± 52.48	0.001
AST(IU/l)	112.38 ± 66.50	49.87 ± 29.58	0.000
Serum ferritin (mcg/l)	2893.2 ± 1409.0	1700.4 ± 1648.4	0.001

Data are represented as means ± SD; ALT, alanine aminotransferase; AST, aspartate aminotransferase; HCT, hematocrit; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration; MCV, mean corpuscular volume; RBC, red blood cell; WBC,white blood cell; $P \leq 0.05$ was considered significant.

Table 3 Lymphocytes subsets in splenectomized and nonsplenectomized thalassemia patients

Variable	Mean percentage ± SD		P-value
	Splenectomized thalassemia patients	Nonsplenectomized thalassemia patients	
Total lymphocytes	67.05 ± 10.48	58.06 ± 12.37	0.026
B lymphocytes (CD19$^+$)	16.27 ± 2.42	13.83 ± 2.06	0.001
Naive B lymphocytes (CD19$^+$ CD27$^-$)	76.69 ± 10.61	67.65 ± 11.66	0.044
Total memory B lymphocytes (CD19$^+$ CD27$^+$)	23.31 ± 10.67	32.25 ± 11.96	0.034
IgM memory B lymphocytes (CD19$^+$ CD27$^+$ IgM$^+$)	8.66 ± 3.23	17.09 ± 6.23	0.000
Switched memory B lymphocytes (CD19$^+$ CD27$^+$ IgM$^-$)	15.06 ± 7.11	15.77 ± 5.74	0.921
T lymphocytes (CD3$^+$)	63.89 ± 10.45	60.31 ± 14.53	0.686
CD4$^+$ (%)	42.02 ± 7.10	36.96 ± 8.01	0.091
CD8$^+$ (%)	25.47 ± 6.24	23.24 ± 6.16	0.505
CD4$^+$/CD8$^+$ ratio	1.70 ± 0.43	1.66 ± 0.44	0.929

CD, cluster of differentiation.

Doppler ultrasound and computerized tomography scan. Liver function tests, prothrombin time, partial thromboplastin time, bleeding time, and clotting time were within normal limits. The patient was treated by an anticoagulant and antiplatelet agent (low-dose aspirin). During regular follow-up at the outpatient clinic, the dose of warfarin was adjusted to maintain the international normalized ratio between 2 and 3.

Discussion

Since the first deliberate removal of a diseased spleen by Quittenbaum in 1826, splenectomy has become a well-established surgical procedure [3]. A spleenless existence was considered to be quite safe as the spleen was considered unnecessary for life until 1952, when King and Schumacher [4] drew attention to the risk of OPSI. Since then, interest in splenectomy has reduced. The spleen clearly serves very important hematological and immunological functions [5].

Elective splenectomy is indicated in the management of a wide variety of medical disorders [6,7]. In patients with thalassemia, there is an increased rate of RBC removal by the spleen; therefore, RBCs, hemoglobin, hematocrit, and RBC indices are elevated after splenectomy. Transfusion frequency, and its subsequent complication, is expected to be reduced after splenectomy. In this study, despite the significant increase in the hemoglobin level after splenectomy, the reduction in blood transfusion frequency did not reach statistical significance. In splenectomized patients, blood transfusion is needed every 34 days on average.

The primary underlying pathology of red cell dysfunction persists after splenectomy; the risk of damage to different organs because of iron overload still remains significant. Aydinok *et al.* [8] reported that splenectomized patients had a higher incidence of myocardial siderosis (48%) compared with those with an intact spleen (28%). In the present study, more patients were found to be on regular chelation after splenectomy because of the significantly higher ferritin level, suggesting that splenectomy does not alleviate the iron burden in patients with thalassemia. After splenectomy, the transaminases were higher and serum albumin was lower compared with nonsplenectomized patients. A recent observational study found that the rates of iron overload-related organ damage in splenectomized patients were comparable with those who had not been splenectomized [9].

In the present study, a high leukocytic and lymphocytic count was found in splenectomized thalassemic patients, mainly B lymphocytes. The significant increase in lymphocytes after splenectomy may suggest that the spleen could play a role in the control of lymphocyte counts and may act as a reservoir for lymphocytes. Our results are consistent with other studies in which splenectomized thalassemia patients show a large increase in the number of B lymphocytes [10,11].

Splenectomized thalassemia patients had lower IgM memory B cells than nonsplenectomized patients. IgM memory B cells express IgM; it develops in the marginal zone of the spleen, and requires the spleen for survival and/or generation [12–14]. Opsonized bacteria are removed efficiently by macrophages in the spleen and liver. However, poorly opsonized bacteria, such as encapsulated bacteria, are only cleared by the spleen. For removal of these bacteria during the course of initial infection, natural antibodies are needed, which are pentameric IgM that can facilitate phagocytosis either directly or through complement deposition on the capsule [12,15,16].

Patients with thalassemia major are predisposed to infection by altered complement activation and immunoglobulin levels, cardiopulmonary disease, and hematochromatosis. Splenectomy further increases the risk of infection [17]. The term OPSI defines fulminating sepsis, meningitis, or pneumonia mainly caused by encapsulated bacteria, such as pneumococci, meningococci, and *H. influenza* type b. Characterized by evolution in a just a few hours, in association with hypotension, alteration of consciousness, or shock, OPSI is a major concern after splenectomy, with a high mortality risk of ~40–50% [18]. Preventive measures (new protein conjugate vaccines, antibiotic prophylaxis, increased awareness, and patient education) are believed to considerably reduce the risk of OPSI. In the present study, with strict application of preoperative vaccination, there were no reported cases of OPSI.

Thrombosis following splenectomy had been reported in the literature [19–21]. Splenectomy leads to immediate reactive thrombocytosis and an increase in circulating microparticles, with an increased risk of subsequent venous thromboembolism particularly within the splenoportal system [18,22–25]. In the literature, the incidence of postsplenectomy portal vein thrombosis ranges from 0.7 to 8%; patients usually present with fever and abdominal pain [26–28]. With long-term postsplenectomy follow-up (mean 6.26 years) in this study, the thrombocytosis persisted. One (2.9%) patient developed portal vein thrombosis 12 months after splenectomy. A high index of suspicion, early diagnosis, and prompt anticoagulation are keys to a successful outcome [29].

In thalassemia, splenectomy is reserved for patients with marked symptoms related to the extent of splenomegaly, increased transfusion requirements, and complications such as pancytopenia. Splenectomy should not be undertaken lightly and the risks should be weighed against the potential benefits in each individual case. Most of this risk seems to be because of the underlying splenectomy indication and not splenectomy alone [5].

This study had some shortcomings. Only patients with severe thalassemia major underwent splenectomy. It cannot, therefore, be excluded that the high serum ferritin level and low serum albumin in the splenectomized group were caused by severe disease before the splenectomy. Moreover, there was a discrepancy between both groups in age, body weight, and height.

Conclusion

With long-term follow-up after splenectomy for the treatment of thalassemia major, thrombocytosis and the risk of thromboembolic remain. Splenectomy improves anemia, but does not reduce iron burden or blood transfusion requirement. Proper preoperative vaccination can reduce the risk of OPSI. Splenectomized β-thalassemia patients had a significantly high absolute lymphocytic count and significantly low level of IgM memory B cells; the abnormal distribution of lymphocytes does not affect T-cell subgroups.

Acknowledgements

Conflicts of interest

None declared.

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Prognostic factors affecting disease-free survival after hepatic resection for hepatocellular carcinoma in cirrhotic liver

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Aims
Hepatic resections for hepatocellular carcinoma (HCC) in the cirrhotic liver are characterized by early recurrence. In this study, we analyzed several factors affecting disease-free survival after hepatic resection.

Settings and design
A retrospective and prospective study.

Materials and methods
From January 2002 to July 2012, 208 patients underwent hepatic resections for HCC in the cirrhotic liver in the Gastroenterology Surgical Center, Mansoura University, Egypt. There were 157 male (75.5%) and 51 female (24.5%) patients, with a mean age of 55.4 ± 9.3 years. Recurrence rates were analyzed using the Kaplan–Meier curve. The prognostic significance of the tested factors was investigated by univariate analysis using the log-rank test and by multivariate analysis using the Cox proportional hazards model. Statistical analysis was performed using SPSS18.

Results
Most patients were in Child–Pugh class A (88%). Major hepatic resection was performed in 73 patients (35.1%), segmentectomy was performed in 74 patients (35.6%), and localized resection was performed in 61 patients (29.3%). Hospital mortality occurred in 19 (9.1%) patients, whereas hospital morbidity occurred in 37% of the patients. The 1-, 3-, and 5-year survivals were 62.9, 25.9, and 19.1%, respectively. The prognostic factors predicting early tumor recurrence were the Child class, multifocality, portal vein (PV) invasion, perioperative blood transfusion, microvascular invasion, local spread, cut margin infiltration, lymph node infiltration, lack of a capsule, the tumor grade, the tumor stage, and preoperative alpha feto protein (AFP). However, tumor multifocality, perioperative blood transfusion, and cut margin infiltration were the main factors predicting early recurrence on multivariate analysis.

Conclusion
Factors predicting disease-free survival are different and multifactorial. However, the resection of HCC in a cirrhotic liver with preserved liver function is the treatment of choice and can be performed with favorable results.

Keywords:
hepatic resection, liver cirrhosis, localized, segmentectomy

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Introduction

Hepatocellular carcinoma (HCC) is a primary malignancy of hepatocellular origin [1]. It is the fifth most common tumor world-wide, and it is currently the third leading cause of cancer-related death [2,3], and accounts for more than 90% of all primary liver cancer. In the past, Egypt was similar to the western countries with an overall frequency of 2.3% among other types of cancer. However, currently, HCC appears to have been increasing over the last decade [4]. In Egypt, over a decade, there was nearly a two-fold increase in the proportion of HCC among chronic liver disease (CLD) patients, with a significant decrease in hepatitis B virus and a slight increase in hepatitis C virus (HCV) as risk factors. Increased detection of small lesions at presentation reflects increased awareness of the condition [5]. It is common in areas with endemic viral hepatitis B or C, which is the usual scenario in many African countries [6]. Hepatic resection and liver transplantation are the main stay of treatment with curative intent [7–9]. For patients with early HCC and decompensated cirrhosis, liver transplantation is the treatment of choice because the procedure potentially cures both the cirrhosis and the HCC, and the outcome after liver transplantation is universally accepted to be better than that after hepatic resection [9,10]. In Egypt, liver transplantation is performed, but the practice is still limited to a few centers due to shortage of living donors and legal handles with cadaveric transplantation, and because of the high technical and financial demands. Hence, hepatic resection is the main line of treatment presented for patients with HCC in most centers in our country. As reported previously, most of our patients developed HCC on the background of cirrhosis, and this poses a

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lot of challenges in their management [11,12]. Hence, only a few of these patients could benefit from liver resection because of the stage of the tumors and their clinical status at presentation.

Despite improved resection techniques and subsequent decreased operative morbidity and mortality in hepatic surgery, there are frequent intrahepatic recurrences of HCC after radical hepatic resections [12,13]. Several factors have been suggested to be responsible for the recurrence and the possible reduced survival after liver resection for HCC [14–16]. Liver cirrhosis has been documented to be an independent risk factor for reduced disease-free survival and overall survival in patients with HCC [17]. However, there are few reports about independent factors affecting the disease-free survival after hepatic resection for this group of patients with liver cirrhosis. Hence, the aim of this study was to determine factors affecting disease-free survival after hepatic resection for patients with HCC in a cirrhotic liver.

Participants and methods

From January 2002 to July 2012, 650 patients underwent hepatic resections for different malignant and benign lesions, of whom 208 patients had HCC in cirrhotic liver in the Gastroenterology Surgical Center, Mansoura University, Egypt.

Preoperative assessments

All the patients underwent clinical evaluation, laboratory investigations, and imaging studies. The imaging studies include ultrasonography (US), enhanced computed tomography scan (CT scan), Doppler examination, MRI, and occasional angiography using iodized oil (Lipiodol, Guerbet LLC, Bloomington, Indiana, US) as the contrast medium followed by CT. The aim of the imaging studies was to confirm the diagnosis of HCC and for its initial staging regarding the size, the number of lesions, the affected segments, and vascular invasion. Laparoscopic assessment was performed if the radiological assessments were inconclusive. A chest radiography was performed to rule out metastasis to the chest. Upper gastrointestinal endoscopies were performed routinely for all the patients, and obliteration of esophageal varices was carried out using injection sclerotherapy or band ligation. Patients were candidates for surgery if the serum total bilirubin level was below 2 mg/dl, the serum albumin above 3 g/dl, the prothrombin level above 60%, and there was an absence of ascites, main portal vein thrombosis, and extrahepatic metastasis. Patients considered to have potentially resectable tumors underwent cardiorespiratory evaluation and were also reviewed by the anesthesiologist.

Surgical technique and procedures

The surgery was performed through a bilateral subcostal incision with an upward midline extension when necessary. The operative field was kept open using special retractors. Thorough exploration of the liver with intraoperative US was performed after its partial mobilization, sectioning the falciform and the triangular ligaments, and pulling the liver caudally to better expose its diaphragmatic surface. Definition of the area to be resected and marking the dissection line were performed under intraoperative US guidance.

Child A patients had all types of resection mentioned according to the case, but Child B patients had only localized resection.

The types of hepatic resection were defined according to a recent consensus classification [Terminology Committee of the International Hepato-Pancreato-Biliary Association (2000)]. Right hepatectomy, left hepatectomy, extended right hepatectomy, and extended left hepatectomy were considered as major hepatic resections (three segments or more), whereas segmentectomy of one or two segments and nonanatomic wedge resection were classified as minor hepatic resections (two segments or fewer). For each patient, the extent of surgery was decided preoperatively on the basis of the radiologic characteristics of the tumor. This was however subjected to modification by the surgeon on the basis of intraoperative findings, such as the gross severity of cirrhosis and the size of the liver remnant. In general, minor hepatic resection was the preferred procedure if macroscopic tumor clearance could be achieved, but major hepatic resections were performed quite liberally for patients with more centrally located tumors close to a major portal vein or hepatic vein, provided their liver function reserve was considered adequate. Blood loss during the procedures was minimized by performing liver transection under warm ischemia, using the Pringle maneuver with clamping for 15 min at 5-min intervals and hemihepatic selective vascular occlusion. Liver dissection was performed using a harmonic scalpel and an ultrasonic device in the majority of the cases while artery forceps fracture in some cases. Bleeding from the cut surfaces of the liver was controlled using under-running stitches, electrocautery, and an argon plasma coagulator. Intraoperative cholangiography was performed to detect any intraoperative bile leakage and to assess the integrity of the biliary system.

Follow-up

All patients were followed up at the outpatient clinic monthly for the first 3 months and then three times

monthly as long as the patients survived. At each follow-up, clinical, biochemical, and US assessments of patients were carried out. The level of the tumor marker, α-fetoprotein, was also measured. On suspicion of recurrence, an abdominal CT scan was performed.

Data and statistical analysis

The sociodemographic, clinical, laboratory, operative, and pathological data were recorded. The collected data were organized, tabulated, and statistically analyzed using SPSS (SPSS Ltd, Hong Kong) software statistical computer package, version 18. For quantitative variables, the range, the mean, and the SD were calculated. The difference in mean age was tested using analysis of variance. Most of the studied variables were not found to follow the normal distribution. For qualitative variables, the number and the percent distribution were calculated. Univariate analysis for factors predicting the time to recurrence (disease-free survival) was performed using the Kaplan–Meier product limit method. Variables that were significant by univariate analysis were subsequently analyzed using the Cox proportional hazard model. The log-rank (Mantel–Cox) test was used to test the significance. Significance was adopted at a P value less than 0.05 for the interpretation of results of tests of significance.

Results

Table 1 shows the clinical data of our patients. There were 157 male (75.5%) and 51 female (24.5%) patients, with a mean age of 55.4 ± 9.3 years (range from 26 to 75 years). The most common symptom was right hypochondrial dull aching pain in 152 (73.1%) patients and was accidentally discovered in 31 patients (14.9%); jaundice was found in four patients (1.9%) due to infiltration of the biliary system, weight loss, and internal hemorrhage, which account for 1% each. A total of 165 patients (79.3%) patients were positive for HCV markers, five patients (2.2%) were positive for hepatitis B virus surface antigens (HBsAg), whereas seven patients (3.4%) were positive for both virus markers. Most of the patients were in Child–Pugh class A [183 (88%)], and the other 25 (12%) patients were in Child–Pugh class B.

Table 2 shows operative data of the studied cases. Major hepatic resection was performed in 73 (35.1%) patients, Segmentectomy was performed in 74 (35.6%) patients, and localized resection was performed in 61 (29.3%) patients. The mean operative time was 3.1 ± 0.9 h. Blood transfusion was required in 131 (63%) patients.

As shown in Table 3, sizes of the tumors vary from less than 5 cm in 39 (18.8%) patients to more than 10 cm in 58 (27.9%) patients. Postoperative pathological examination revealed well-differentiated tumors in 48 (23.1%) patients, moderately differentiated tumors in 91 (43.7%) patients, and poorly differentiated tumors in 69 (33.2%) patients. All other pathological findings are shown in Table 3.

The mean hospital stay was 9.6 ± 4.7 days. Hospital morbidity includes acute liver cell failure in 20 patients (9.6%), bile leak in 10 patients (4.8%), and upper gastrointestinal bleeding in one patient (0.5%) due to rupture of esophageal varices, and were treated by emergency injection sclerotherapy. Pleural effusion on

Table 1 Clinical data of the studied cases

Clinical data	N = 208 [n (%)]
Age (years)	
Range	26–75
Mean	55.4
SD	9.29
Sex	
Males	157 (75.5)
Females	51 (24.5)
Residence	
Urban	71 (34.1)
Rural	137 (65.9)
Clinical presentation at diagnosis	
Pain	152 (73.1)
Accidentally discovered	31 (14.9)
Mass	17 (8.2)
Jaundice	4 (1.9)
Weight loss	2 (1.0)
Internal hemorrhage	2 (1.0)
Past history of diseases	
Absent	159 (76.4)
Diabetes	28 (13.5)
Hypertension	18 (8.7)
Others	3 (1.4)
Past history of surgery	
Absent	157 (75.5)
Splenectomy	13 (6.2)
Cholecystectomy	9 (4.3)
Others	29 (13.9)
Sclerotherapy for esophageal varices	
No	204 (98.1)
Yes	4 (1.9)
Past history of anti-Bilharzial treatment	
Absent	108 (51.9)
Oral treatment	36 (17.3)
Injections	64 (30.8)
Viral hepatitis infection	
Absent	31 (14.9)
HCV	165 (79.3)
HBV	5 (2.4)
Both	7 (3.4)
Child classification	
A	183 (88)
B	25 (12)

HBV, hepatitis B virus; HCV, hepatitis C virus.

Table 2 Operative data of the studied cases

Operative data	*N* = 208 [*n* (%)]
Type of resection	
Major hepatic resection	73 (35.1)
Segmentectomy	74 (35.6)
Localized resection	61 (29.3)
Blood transfusion	
No	77 (37)
Yes	131 (63)
Pringle's maneuver	
No	117 (56.2)
Yes	91 (43.8)
Operative time (h)	
Range	1–6
Mean	3.08
SD	0.94
Hospital stay (days)	
Range	4–32
Mean	9.04
SD	4.68

Table 3 Pathological data of the studied cases

Pathological data	*N* = 208 [*n* (%)]
Tumor's size (cm)	
<5	39 (18.8)
5–10	111 (53.4)
>10	58 (27.9)
Cut margin	
Free	168 (81.2)
Infiltrated	40 (18.8)
Microvascular invasion	
Absent	151 (72.6)
Present	57 (27.4)
LNs	
Negative	194 (93.3)
Positive	14 (6.7)
Tumor's capsule	
Absent	154 (74)
Present	54 (26)
Tumor grading	
I	48 (23.1)
II	91 (43.1)
II	69 (33.2)
Tumor stage	
I	133 (63.9)
II	31 (14.9)
IIIa	27 (13)
IIIb	4 (1.9)
IIIc	13 (6.2)
Local spread	
No	203 (97.6)
Yes	5 (2.4)

LNs, Lymph nodes.

the right side occurred in 15 patients (7.2%), which was treated by the insertion of a chest tube for 1 week. Wound infection occurred in only seven patients (3.4%). Hospital mortality occurred in 19 patients (9.1%) from liver cell failure: 10 of them were Child B and 9 of them were Child A (Table 4).

Table 4 Morbidity, mortality, and recurrence in the studied cases

Character	*N* = 208 [*n* (%)]
Postoperative complications	
Absent	132 (63.0)
LCF	20 (9.6)
Pleural effusion	15 (7.2)
Bile leak	10 (4.8)
Wound infection	7 (3.4)
Internal hemorrhage	6 (2.9)
Injury of diaphragm	7 (3.4)
Injury of CBD	2 (1.0)
DVT	3 (1.4)
Hematemesis	1 (0.5)
Abdominal collection	5 (2.4)
Recurrence	
Absent	120 (57.7)
Present	88 (42.3)
Site of recurrence	
Liver	68 (77.3)
Distant	8 (9.1)
Both	12 (13.6)
Treatment of recurrence	
RF	5 (5.7)
TACE	15 (17)
Medical	68 (77.3)
Mortality	
Hospital	19 (9.1)
Late	114 (54.8)
Cause of death (*n* = 133)	
LCF	70 (58.8)
Malignant cachexia	44 (37)
Others	19 (4.2)

Mean time presented as estimated mean ± SE, Median time presented as estimated median ± SE, Other factors such as age, sex, the type of resection, pringle maneuver, and the size of the tumor were not statistically significant, LCF, liver cell failure, RF, radiofrequency; DVT, deep venous thrombosis; TACE, trans arterial chemo embolization.

Disease-free survival

Late complications included recurrence of HCC in 88 (42.3%) patients. Most of the recurrences occurred within the first year (55 (62.5%) patients) compared with 33 (37.5%) cases after the first year. The most common site for recurrence was the liver in 68 (77.3%) patients, whereas distant metastasis occurred in 8 (9.1%) patients. Factors affecting the time to recurrence are shown in Tables 5 and 6.

Significant factors predicting early tumor recurrence in the univariate analysis were Child class B (16.3 ± 2.4 vs. 44.8 ± 3.7 months), tumor multifocality (19.6 ± 2.5 vs. 48.6 ± 4.1 months), PV invasion (10.4 ± 1.7 vs. 44.6 ± 3.9 months), perioperative blood transfusion (27.5 ± 2.2 vs. 59.4 ± 5.7 months), microvascular invasion (28.2 ± 4 vs. 47.5 ± 4.2 months), local spread (15.7 ± 6.8 vs. 44.8 ± 3.7 months), cut margin infiltration (16.9 ± 2.9 vs. 51.8 ± 3.4 months), lymph node infiltration (14.2 ± 1.8 vs. 46.5 ± 3.8 months), lack of a capsule

Table 5 Univariate analysis for factors predicting the time to tumor recurrence

Variable (n = 189)	Recurrence (n = 88) [n (%)]	Mean time of recurrence in months	Median time of recurrence in months	P value
Child class				
Child A (n = 174)	83 (47.7)	44.8 ± 3.7	36 ± 3.3	0.039
Child B (n = 15)	5 (33.3)	16.3 ± 2.4	17 ± 6.7	
Blood transfusion				
No (n = 76)	30 (39.4)	59.4 ± 5.7	52 ± 12.6	0.000
Yes (n = 113)	58 (51.3)	27.5 ± 2.2	24 ± 1.7	
Tumor multifocality				
Single (n = 157)	67 (42.6)	48.6 ± 4.1	38 ± 4.3	0.000
Multiple (n = 32)	21 (65.6)	19.6 ± 2.5	18 ± 3.3	
Portal vein invasion				
Free (n = 174)	80 (45.9)	44.6 ± 3.9	36 ± 5.7	0.007
Right portal vein invasion (n = 10)	5 (50)	46.1 ± 1.6	21 ± 1.8	
Left portal vein invasion (n = 5)	3 (60)	10.4 ± 1.7	12 ± 0	
Cut margin				
No (n = 153)	60 (39.2)	51.8 ± 4.3	39 ± 4.5	0.000
Yes (n = 36)	28 (77.7)	16.9 ± 2.9	12 ± 2.9	
Microscopic vascular invasion				
No (n = 137)	61 (44.5)	47.5 ± 4.2	36 ± 2.7	0.005
Yes (n = 52)	27 (51.9)	28.2 ± 4	20 ± 1.9	
Lymph nodes				
No (n = 177)	78 (44)	46.5 ± 3.8	36 ± 4.5	0.000
Yes (n = 12)	10 (83.3)	14.2 ± 1.8	13 ± 2.6	
Tumor capsule				
Present (n = 53)	12 (22.6)	78.2 ± 7.8	95 ± 25	0.000
Absent (n = 136)	76 (55.9)	31.6 ± 2.6	24 ± 1.7	
Tumor grade				
Grade I (n = 41)	12 (29.2)	70 ± 9.3	88 ± 35	0.000
Grade II (n = 83)	40 (48.2)	42.3 ± 4.5	36 ± 3.6	
Grade III (n = 65)	36 (55.4)	28.9 ± 4	18 ± 3.8	
Local spread				
No (n = 184)	84 (45.6)	44.8 ± 3.7	36 ± 3.5	0.013
Yes (n = 5)	4 (80)	15.7 ± 6.8	9 ± 3	
Stage of the tumor				
Stage 1 (n = 121)	45 (37.1)	55.7 ± 4.9	48 ± 6.3	0.000
Stage >1 (n = 68)	43 (63.2)	21.1 ± 3.4	14 ± 1.6	
Preoperative AFP				
<400 (n = 107)	43.2 (40.5)	14.7 ± 2.2	10 ± 1.7	0.012
>400 (n = 82)	40 (50.9)	11.8 ± 1.4	6 ± 0.8	

Table 6 Univariate and multivariate analyses for factors predicting the time to tumor recurrence

Variable	Univariate analysis	Multivariate analysis			
	P value	P value	Exp(B)	95% CI for Exp(B)	
				Lower	Upper
Child class	0.039	0.087	2.578	0.872	7.618
Tumor multifocality	0.000	0.037	2.184	1.048	4.555
PV invasion	0.007	0.822	0.921	0.451	1.881
Blood transfusion	0.000	0.013	2.023	1.163	3.518
Microvascular invasion	0.005	0.547	1.193	0.672	2.116
Local spread	0.013	0.496	1.657	0.387	7.097
Cut margin infiltration	0.000	0.015	1.984	1.142	3.449
Lymph node infiltration	0.000	0.939	0.942	0.204	4.353
Tumor capsule	0.000	0.179	0.574	0.255	1.291
Tumor grade	0.000	0.401	1.166	0.815	1.668
Tumor stage	0.000	0.589	1.123	0.737	1.710
AFP	0.012	0.223	1.373	0.825	2.286

CI, confidence interval.

(31.6 ± 2.6 vs. 78.2 ± 7.8 months), the tumor grade (28.9 ± 4 vs.70 ± 9.3 months), the tumor stage (21.1 ± 3.4 vs. 55.7 ± 4.9 months), and preoperative AFP (11.8 ± 1.4 vs. 14.7 ± 2.2 months); however, in the multivariate analysis, tumor multifocality (P = 0.037), perioperative blood transfusion (P = 0.013), and cut margin infiltration (P = 0.000) were the main factors predicting early tumor recurrence.

The treatment for recurrence was conservative in 68 (77.3%) cases, chemoembolization in 15 (17%) cases, and radiofrequency in five (5.7%) cases.

Discussion

The high incidence of recurrence has long been a challenge in the rationale for hepatic resection in patients with HCC in cirrhotic liver, which may be

more than 50% within 5 years of resection [18,19]. The different timings of recurrence are thought to represent disease of differing biologies that have very different prognoses.

Early recurrence usually represents residual tumor spread from the primary main tumor and that left in the remnant liver, and is a poor prognostic sign. Significant risk factors for early recurrence include preoperative tumor rupture, venous invasion, and nonanatomic resection [20,21].

Late recurrence usually results from metachronous multicentric hepatocarcinogenesis. Possible risk factors for late recurrence include cirrhosis, a higher grade of hepatitis activity, a high preoperative aspartate aminotransferase level (especially in an HCV-positive patient), and multiple tumors [21–23]. As reported previously, most of the recurrence in our patients and in other series are multicentric in location and distant from the resection margin [11,18,19]. This implies that a wide resection margin does not convey much additional benefit in preventing recurrence [23]. Most surgeons advocate limited resection of the tumor, especially in patients with liver cirrhosis. However, some studies challenged this opinion. It is believed that HCC has a high propensity to metastasis through the portal veins even when diagnosed at an early stage [20,21,24].

This finding has empowered aggressive surgeons to carry out major resection in this group of patients so that proper clearance of the portal channels can be performed. However, Abdel Wahab *et al.* [11] found that there was no significant difference in the recurrence rate that occurred between major resection and minor or localized resection of the liver. Recurrence in the present study was about 42.3%. This was essentially similar to findings in previous reports. Most of the recurrences are found in the liver [18,19,25].

About 9% of the recurrence occurred at a site far away from the liver. This implies that there was possible systemic involvement before surgical interference. This was described by Jeng *et al.* [26] on the basis of the fact that patients with high circulating HCC cells had a high risk of early recurrence (Fig. 1).

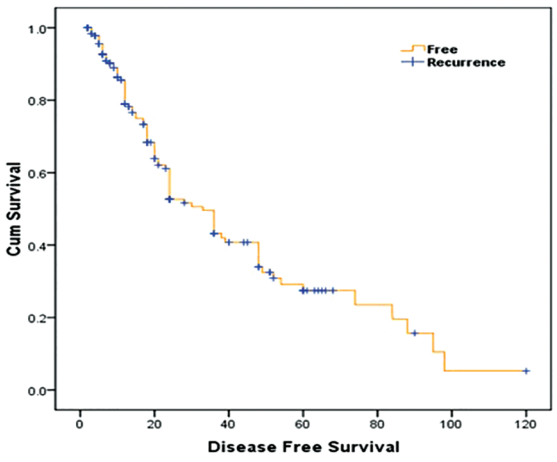
In our study, tumor multifocality was an independent factor for early tumor recurrence (Fig. 2).

In cases of tumor multifocality, tumor recurrence may reflect either residual tumor at the resection margin or persistent residual microscopic disease in the liver at the time of resection [27,28].

In this study, perioperative blood transfusion was found to be an independent risk factor for early recurrence (Fig. 3). The role of perioperative blood transfusion on the intrahepatic recurrence of HCC was first suggested by Yamamoto *et al.* [29], whereas Matsumata *et al.* [30] reported that the association between blood transfusion and recurrence-free survival was recognized, but only in patients without intrahepatic metastasis. Furthermore, Makino *et al.* [31] found that the association between perioperative blood transfusion and cancer-free survival could be detected only in HCC patients with portal vein invasion.

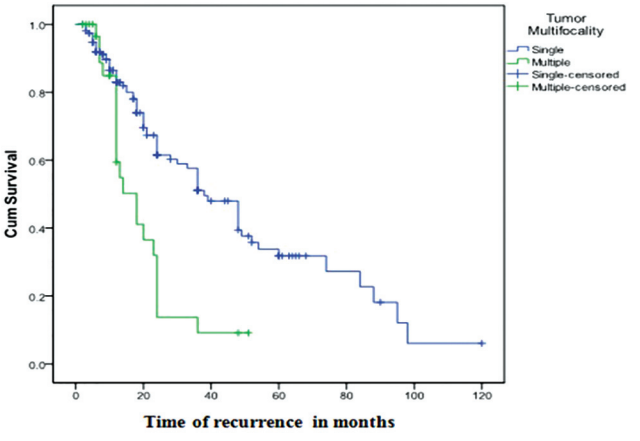
The detrimental effect of blood transfusion could be attributed to the induction of nonspecific immunosuppression [31,32]. To improve the prognosis of patients with resectable HCC, it is worthwhile to reduce intraoperative blood loss and avoid blood transfusion when possible.

Figure 1



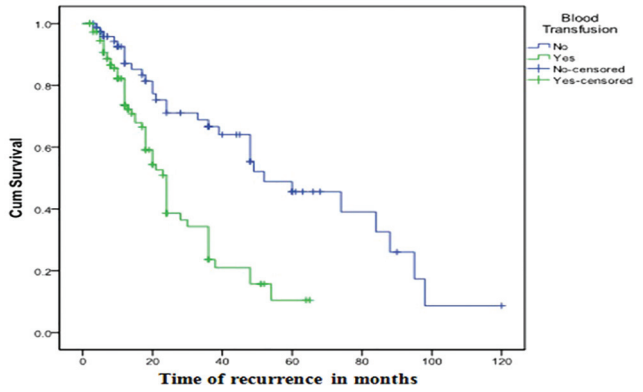
Disease-free survival rates by the Kaplan–Meier product limit method.

Figure 2



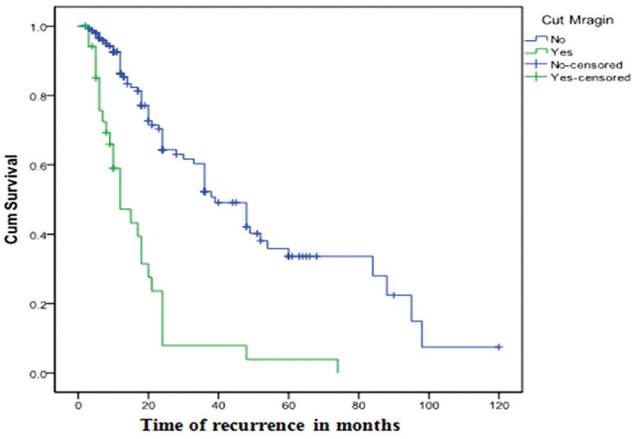
The Kaplan–Meier curve of recurrence in relation to tumor multifocality ($P = 0.000$).

Figure 3



The Kaplan–Meier curve of recurrence in relation to perioperative blood transfusion ($P = 0.000$).

Figure 4



The Kaplan–Meier curve of recurrence in relation to cut margin infiltration ($P = 0.000$).

We found that the resection margin is an independent factor affecting both disease-free survival and recurrence after hepatic resection (Fig. 4).

A few studies have shown that a resection margin smaller than 1 cm was an adverse prognostic factor for long-term survival [33,34]. However, others have found no correlation between the width of the resection margin and the long-term outcome. These seemingly conflicting results have resulted in a discrepancy among hepatic surgeons in the definition of curative resection for HCC. In general, it is thought that both the surgical curability and the postoperative hepatic functional preservation are crucial for the successful treatment of patients with HCCs [18–20,32]. Especially in patients with cirrhosis, smaller surgical margins would prevent postoperative complications better, including liver failure, although there is a concern of recurrence in the remnant liver. For patients with cirrhosis, the balance between the surgical curability and the preservation of function of the remnant liver is of considerable importance.

Shah and colleagues reported that despite the fact that a negative cut margin is one of the main risk factors for both tumor recurrence and disease-free survival, preservation of liver parenchyma to prevent hepatic decomposition, however, continues to be a much more important consideration than a negative margin. This is because even with positive resection margins, liver resection still provides the best survival when compared with other available treatment modalities for HCC patients [28].

Conclusion

The prognostic factors after resection for disease-free survival were different and multifactorial. However, resection of HCC in a cirrhotic liver with preserved liver function is the treatment of choice and can be performed with favorable results and long-term survival. In our study, the Child class, multifocality, PV invasion, perioperative blood transfusion, vascular invasion, local spread, cut margin infiltration, lymph nodes infiltration, lack of a tumor capsule, the tumor grade, the tumor stage, and preoperative AFP significantly predict disease-free survival in univariate analysis, whereas tumor multifocality, perioperative blood transfusion, and cut margin infiltration were the main factors predicting disease-free survival in the multivariate analysis.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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Treatment options for HCC: a combined hospital experience

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Background
In past years, the diagnosis of hepatocellular carcinoma (HCC) was always made when the disease was advanced, when patients were symptomatic. However, due to the revolution in the diagnostic tools many patients now are diagnosed at an early stage while liver function is still preserved. In addition, there are different treatment modalities available that will have a positive impact on survival.

Patients and methods
This prospective study was conducted upon 50 patients with HCC, treated and followed up from March 2008 to May 2012 at Zagazig University hospitals, AL-Azhar University hospitals, and International Medical Center.

Results
Regarding liver resection, nine patients underwent right hepatectomy, two patients had left hepatectomy, and atypical (localized) resection had been performed in four patients. With respect to living donor liver transplantation, 15 patients had right lobe graft. Regarding radiofrequency ablation, 10 patients underwent this procedure under general anesthesia. With respect to transarterial chemoembolization, 17 sessions were performed for 10 patients.

Conclusion
Radiofrequency ablation and liver resection are comparable in small HCC lesions. Transarterial chemoembolization is sometimes the only available way for unfit patients and when surgical resection is contraindicated. Liver transplantation is the remaining treatment left for many patients with end-stage liver disease who fulfill Milan criteria.

Keywords:
hepatocellular carcinoma, liver resection, living donor liver transplantation, radiofrequency ablation, transarterial chemoembolization

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1110-1121

Introduction

The accurate knowledge of parenchymal structure, blood supply, lymphatic drainage, and variant anatomy is very important in hepatobiliary surgery [1–3]. In the past few decades, the development of hepatic surgery, with appreciation for the complex anatomy, has overcome the misleading minimal external knowledge of hepatic secrets [4]. The risk of developing hepatocellular carcinoma (HCC) correlates with:

(a) Etiology,
(b) Duration, and
(c) Inflammatory activity of the liver disease.

However, about 15% of HCC patients had no risk factors [5].

Unfortunately, Egypt has the largest epidemic hepatitis C virus (HCV) in the world, and this is documented in the international medical scientific literature. The recently released Egyptian Demographic Health Survey tested a representative sample of the entire country for HCV antibody. The overall prevalence (percentage of people) positive for antibody to HCV was 14.7% [6].

Investigations

Usually, the combination of imaging studies is superior to any one test alone in diagnosis of liver pathology. Triphasic computed tomography (CT) is the gold standard imaging modality in diagnosis of HCC. MRI identifies certain intrahepatic tumors better than CT scan but does not outline anatomic borders similar to CT. PET scans are sensitive in detecting up metastatic disease. Ultrasonography (US) is an excellent screening test for many patients; however, operator experience, underlying hepatic disease, and overlying bowel gas can limit its use [7].

Surgical resection is the treatment of choice for HCC in noncirrhotic patients, who only account for 5% of the cases in Western countries and 40% in Asia, as they could tolerate major resections with low morbidity, but in cirrhotic patients it could lead to liver failure [8]. After resection, tumor recurrence rate reaches up to 70% at 5 years, due to dissemination and de-novo tumors. The most powerful predictor of recurrence is the presence of microvascular invasion. Recurrence due to dissemination usually appears during the first 3 years of follow-up [9].

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Complications of hepatic resection include hemorrhage (intraoperative or postoperative), hepatic insufficiency (ascites, encephalopathy, jaundice, gastrointestinal bleeding), bile leak, acute hepatic failure, sepsis, abscess, or biliary stricture [10].

Child–Pugh scoring system is used to assess the degree of liver dysfunction due to cirrhosis, which consists of clinical and biochemical measurements. More recently, model for end-stage liver disease has been used as a predictor of death within 3 months due to chronic liver disease. Model for end-stage liver disease is calculated from serum creatinine, bilirubin, and international normalized ratio [11].

Multidisciplinary team consisting of hepatologists and surgeons, dieticians, psychologists, social workers, transplant coordinators, and radiologists is needed for evaluating patients undergoing liver transplantation. A comprehensive medical assessment is essential to determine significant comorbid conditions that may have an impact on the patient's perioperative and/or postoperative course. In addition, evaluation of the extent of liver disease, the presence of complications of cirrhosis, and the need of urgency for transplantation are important [12].

Milan criteria for liver transplantation for HCC include single tumor less than 5 cm diameter or up to three tumors less than 3 cm diameter, no vascular invasion, and no extrahepatic disease. However, University of California, San Francisco criteria include single tumor less than 6.5 cm diameter or no more than three tumors largest less than 4.5 cm and total diameter less than 8 cm [13]. The right lobe allograft, accounting for greater than 60% of the donor's total liver mass, is the most commonly used allograft for living donor liver transplantation (LDLT) worldwide. Utilization of a right lobe allograft was initially described by Habib (Hammersmith hospital London) and Tanaka of Kyoto, who were attempting to obtain left lobe for LDLT when anatomical considerations favored a right lobe hepatectomy [14].

Postoperative complications are a major issue both in the donor and in the recipient. Bile leak, bleeding, thrombosis, or infection may occur in either the recipient or the donor or both. Rejection is an additional complication in the recipient [15].

Radiofrequency ablation (RFA) has a specific role in dealing with small single lesions. However, it also has a role in multiple lesions. In patients who were considered unsuitable for surgery at initial presentation due to the presence of multiple or bilateral lesions, surgical resection could be achieved in one segment or lobe, whereas the multiple lesions in the remaining lobe or segments could be successfully ablated. Hence, the resectability of those patients was increased [16]. Common complications following RFA are bile leaks, liver abscesses, hemorrhage, and heat damage to surrounding organs. Local recurrence is variable and often unacceptably high. Once these tumors recur, they are often more difficult to treat and are associated with a worse prognosis [17].

In transarterial chemoembolization (TACE), three-step mechanism can explain the way of TACE function. First, delivering high concentrations of chemotherapeutic agents directly to the tumor cells. Second, the oily medium (lipiodol) enhances the antitumor effect of chemotherapy because it remains within HCC nodules for long periods of time. Third, particle embolization of the tumor-feeding arteries renders the tumor ischemic, which may also potentiate the effects of the chemotherapy by allowing the drugs to penetrate inside the cancer cells with greater ease [18,19]. Procedural errors and complications after chemoembolization make it hazardous. Liver failure, abscess or infarction, biloma, cholecystitis, and the effects of extrahepatic embolization are the usual complications [20].

Patients and methods

Group A (surgical intervention) (30 patients 60%): subgroup 1: liver resection

In all, 15 patients were managed by liver resection (30%); nine of them underwent right hepatectomy (18%), two left hepatectomy (4%), and four nonanatomical resection (8%) (Fig. 1).

Follow-up: early postoperative (2–4 weeks)

Complete laboratory investigations were performed including complete blood count (CBC), liver function test (LFT), kidney function test (KFT), and coagulation profile. Clinical and radiological evaluation were performed by abdominal US for detection of early postoperative complication. CT was performed if US is not conclusive.

Long-term follow-up

Patients' data were collected at 3, 6, 12, and 18 months, including clinical follow-up, laboratory results (CBC, LFT, KFT, bleeding profile, and level of α-fetoprotein), and radiological changes (CT).

Subgroup 2: living donor liver transplantation

In all, 15 patients were managed by LDLT (30%) with right lobe graft.

Inclusion criteria for LDLT

Patients with Child class B and C and Milan criteria fulfillment were the inclusion criteria. After fulfillment of these investigations, there was informed special consent for each of these patients; they had to sign it.

Follow-up: short term: for donor

Patients were admitted to ICU for 1–2 days, then for about another 5 days in ward with daily laboratory tests (CBC, LFT, KFT, bleeding profile) and abdominal US. After discharge, the patients were followed up for 1 month with weekly investigations as before (Fig. 2).

For recipient

Patients were admitted to ICU for about 1 week with daily tests such as CBC, LFT, KFT, random blood sugar (RBS), blood gases, lactate dehydrogenase, ammonia, bleeding profile, chest radiography, liver duplex, and abdominal US.

Thereafter, patients were admitted to isolation room for about another 2 weeks with daily laboratory tests (CBC, LFT, KFT, and RBS). CT, abdominal US, chest radiography, and liver duplex were performed as needed. The level of immunosuppressive was determined every 3 days to adjust the dose and to change the regimen when needed (Fig. 3).

Long-term follow-up

Data of the patients were collected at 3, 6, 12, and 18 months, including clinical follow-up, laboratory results (CBC, LFT, KFT, and bleeding profile), radiological changes (US), level of α-fetoprotein, and immunesuppressive level.

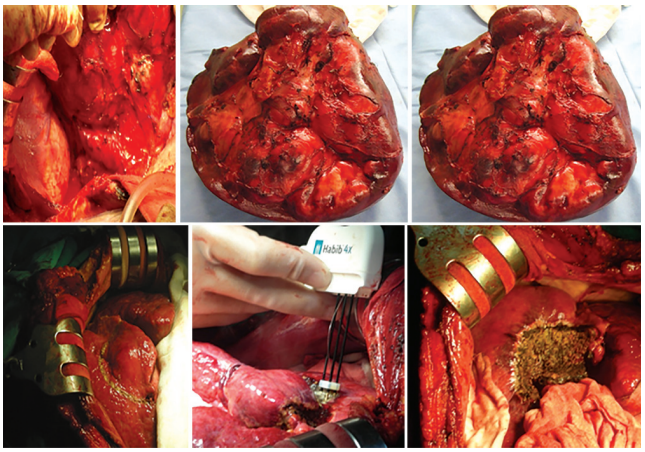
Group B (nonsurgical management) (20 patients 40%): subgroup 3: radiofrequency ablation

Ten patients were managed by RFA (20%). We assessed the efficacy of the RFA using spiral CT and α-fetoprotein assays within 1 month after the procedure. The presence of well-defined, nonenhancing tissue on images obtained during both phases of contrast-enhanced CT was indicative of tissue necrosis. Long-term follow-up studies included serum α-fetoprotein assay and triphasic CT every 3 months in the first year and every 6 months thereafter up to 2 years.

Subgroup 4: transarterial chemoembolization

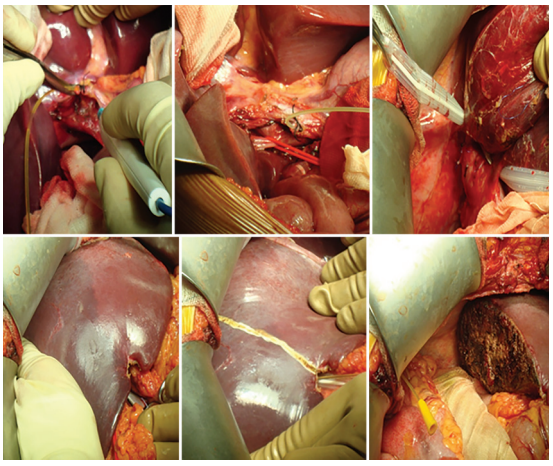
Ten patients were managed by TACE (20%). Noncontrast CT scan was performed on the second day after the procedure to assess postembolization lipiodol distribution. Follow-up US and liver function assessment were performed after 3 weeks. Precontrast and postcontrast CT scan was performed after 6 weeks to determine the residual lipiodol distribution, residual enhancement within the lesion to detect development of recent tumor nodule and to plan the next chemoembolization session.

Figure 1



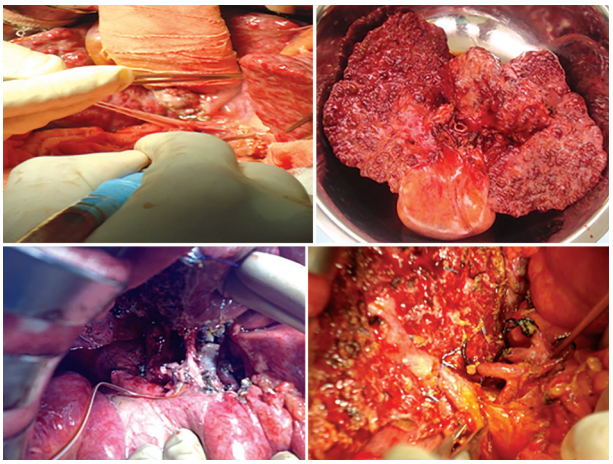
Liver resection operation.

Figure 2



Donor operation.

Figure 3



Recepient operation.

Results

Laboratory investigations

According to Child–Pugh classification, our patients were classified into 20 patients with class A, another 20 patients with class B, and 10 patients with class C (Tables 1).

Radiological investigations

Preoperative abdominal US and triphasic CT revealed site and size of the tumor (Tables 2).

Group A (surgical management): subgroup 1: liver resection (15 patients): morbidity and mortality

Mortality

Six- and 18-month mortality was 13.3 and 26.6%, respectively. The causes of death in this group were intraoperative bleeding in one patient, liver cell failure in three patients, and progression of the tumor with local and distant metastasis in two patients (Tables 3-4).

Subgroup 2: living donor liver transplantation (15 patients): morbidity and mortality

Recipient

Mortality: Six-month and 2-year mortality was 13.3 and 26.6%, respectively. The causes of death in this group were intraoperative bleeding in one patient, septicemia in another patient, liver cell failure in one patient, and progression of the tumor with local and distant metastasis in one patient (Tables 5).

Donors

Wound infection was present in two patients. Only one patient was complicated with bile leak, which was managed conservatively. Another one patient was complicated with biloma.

Mortality: No mortality was present in our donors.

Group B (nonsurgical management): subgroup 3: radiofrequency ablation (10 patients): morbidity and mortality

Generally, the patients tolerated the procedure well. No fatal or major complications were related to this way of management.

Three (30%) of the 10 patients experienced mild to moderate abdominal pain during the RF procedure; this was treated medically. Other three patients (30%) complained from persistent fever for 24 h. Ascitis was found in two patients (20%) diagnosed by follow-up US. One patient (10%) was with hematoma, which was managed conservatively. No late complications were observed. One patient (10%) died of unrelated cause (cardiac cause; heart failure).

Subgroup 4: transarterial chemoembolization (10 patients): morbidity

Post-TACE syndrome in the form of persistent unrelieved pain, fever, and vomiting for more than 1 week occurred in one patient. Other complications were mild anaphylaxis, puncture site hematoma, fever, and ascitis in four patients with complete rapid relieve on the same or next day.

Mortality

Six-month, 1-year, and 18-month mortality was 80, 50, and 20%, respectively. The causes of death in this group were liver cell failure in two patients, progression

Table 1 Age and sex distribution of our patients

Variables	Surgical [*n* (%)]		Nonsurgical [*n* (%)]	
	Subgroup 1	Subgroup 2	Subgroup 3	Subgroup 4
Age				
<50	2 (4)	2 (4)	1 (2)	0
50–60	11 (22)	13 (26)	8 (16)	5 (10)
>60	2 (4)	0	1 (2)	5 (10)
Sex				
Male	11 (22)	13 (26)	9 (18)	9 (18)
Female	4 (8)	2 (4)	1 (2)	1 (2)

Table 2 Tumor size and number of masses in our patients

Variables	Surgical		Nonsurgical	
	Subgroup 1	Subgroup 2	Subgroup 3	Subgroup 4
Tumor size (cm)				
≤3 cm	5	7	10	0
>3 cm	10	8	0	10
Number of masses				
Single	15	11	8	1
Multiple	0	4	2	9
Site (lobe)				
Right	11	11	6	4
Left	4	4	2	2
Both	0	0	2	4

Table 3 Complications of surgery in the liver resection group

Variables	*N* (%)
Surgical resection	15 (100)
Early	
Intraoperative bleeding	2 (13.3)
Acute LCF	2 (13.3)
Bile leak	2 (13.3)
Intraperitoneal collection	2 (13.3)
Wound infection	1 (6.7)
Pleural effusion	2 (13.3)
Late	
Recurrence	3 (20)
6 month	1 (6.7)
Within 2 years	2 (13.3)
Liver cell failure	2 (13.3)

LCF, liver cell failure.

Table 4 Factors affecting recurrence rate in the liver resection group

Pathological variables	Number	χ^2	*P*
Vascular invasion			
With (2)	2	4.36	0.03*
Without (13)	1		
Grade of differentiation			
Well differentiated (3)	0	3.28	0.19 NS
Moderately differentiated (8)	1		
Undifferentiated (4)	2		
Active cirrhosis			
With (3)	2	5.1	0.02*
Without (12)	1		
Satellites			
With (1)	1	4.29	0.03*
Without (14)	2		
Tumor size			
≤3 cm (5)	0	0.47	S
>3 cm (10)	3		
Hepatitis virus			
Positive B&C (2)	1	0.04	0.81 NS
Positive C (15)	2		
Type of surgery			
Right (9)	3	2.5	0.28 NS
Left (2)	0		
Nonanatomical (4)	0		
Blood transfusion			
Without (4)	0	0.19	0.66 NS
With (11)	3		

NS, nonsignificant; S, significant.

Table 5 Complications of surgery (LDLT group) (recipient)

Variables	*N* (%)
Liver transplantation (recipient)	
Early complications	
Bleeding	1 (6.7)
Wound infection	2 (13.3)
Bile leak	2 (13.3)
Septicemia	1 (6.7)
Pleural effusion	2 (13.3)
Late complications	
Bile stricture	2 (13.3)
Recurrence	1 (6.7)
Liver cell failure	1 (6.7)

LDLT, living donor liver transplantation.

of the tumor with incomplete response to therapy in three patients, and local and distant metastasis in three patients.

Discussion

HCC typically arises in the setting of underlying liver disease or cirrhosis, which makes it difficult in management. Hence, if damage to the underlying functioning liver is obvious, actual destruction of HCC is not enough to cure the patient. This may explain the relative failure of the traditional weapons against liver cancer. Surgical resection and liver transplantation are the only two treatment options that may lead to cure. However, only 10–15% of patients with HCC are suitable for such treatments, either because of the advanced stage of the disease at the time of diagnosis or because of the presence of comorbid disease [21].

There are limitations of the ordinary weapons against liver cancer (surgery, systemic chemotherapy, and radiation therapy), besides the fact that liver cancer has a tendency to stay confined to the liver. These factors have led to locoregional therapy [22].

Our study included 15 patients who underwent liver resection; regarding age, two patients were less than 50 years, 11 were between 50 and 60 years, and two patients were more than 60 years. Eleven were male patients and four were female patients. In the LDLT group (15 patients), two patients were less than 50 years and 13 patients were between 50 and 60 years. In all, 13 patients were men and two were women. In the RFA group (10 patients), one patient was under 50 years, eight patients were between 50 and 60 years, and one patient was above 60 years. Nine patients were men and one patient was woman. In the TACE group, five patients were between 50 and 60 years and another five patients were above 60 years. Nine patients were men and one was woman.

Hepatitis C infection was positive in our 50 patients, but combined HBV and HCV infection was present in eight patients. Mass size less than or equal to 3 cm was found in 22 patients. In all, 28 patients had mass size more than 3 cm. A total of 35 patients were with single masses and 15 patients with multiple masses. Regarding the site of masses, 31 patients were with right lobe masses, 10 with left lobe masses, and nine patients were with bilateral masses.

Regarding biliary anastomosis in the LDLT group, which is the most common complication in LDLT, we used duct-to-duct technique in biliary anastomosis in seven patients and hepaticojejunostomy in three patients; in addition, we put stents in all our cases.

Biliary anastomosis in the study by Kyoden *et al.* [23] was as follows: of the 310 patients reviewed, hepaticojejunostomy was primarily performed in 87 patients (28%) and duct-to-duct anastomosis was performed in 223 patients (72%). A biliary anastomotic stent tube was placed in 266 patients (86%) at the time of transplantation in this series.

Complications following hepatectomy in cirrhotic patients are common. This is attributed to inadequate liver reserve, bleeding tendency, and usually poor

general condition. Complications may be early in the first 30 days postoperative or late after this period. The most important and common late complication of liver resection is recurrence. Regarding our results, recurrence was in three patients (12%); one patient developed recurrence after 6 months and two patients within 2 years. Recurrence incidence was 8, 52.5, and 71% at 6 months, 1 year, and 2 years, respectively [24]. After a median follow-up period of 34 months, 98 patients (51%) had recurrent cancer; initial tumor recurrence was confined to the liver in 86 patients (88%).

Regarding the LDLT group, early complications were seen in one patient complicated with intraoperative bleeding. Septicemia was present in one patient. Wound infection (seroma) was observed in two patients. Bile leak was present in two patients in which both cases underwent re-exploration with hepaticojejunostomy bile diversion after evacuation of the biloma. Finally, pleural effusion was seen in two patients. Tanaka [25] had encountered 50 complications in 222 right lobe grafts, mostly biliary. Four of the donors in the LDLT group showed complications; two of them complained from wound infection and another two patients showed biliary leak. These results were comparable with the results of Hwang *et al*. [26], as there was no donor mortality in his series.

Treatment policy

Liver resection still plays a key role in the treatment of patients with HCC and a functional hepatic reserve, after fulfilling of strict criteria. In these cases, surgery achieves good survival rates with acceptable perioperative morbidity. Even in nonanatomic resection, there are no adverse effects on the oncologic outcomes of single and small (≤4 cm) HCC in patients with well-preserved liver function (Child–Pugh class A).

Liver transplantation is the only treatment left for many patients with end-stage liver disease. The optimal candidates for transplantation are patients within Milan criteria. There is really no doubt that liver transplantation offers better survival than liver resection provided the patients with early stage tumors, compensated cirrhosis. However, delay in performing liver transplantation may decrease the benefits of liver transplantation and make liver resection an equivalent or preferable option in regions where time to transplant exceeds 6 months.

Treatment with RFA is safe and effective similar to liver resection in single small lesion with good hepatic reserve (Child A). In addition, it is effective as palliative therapy for patients who cannot undergo resection or as a bridge to transplantation.

TACE is considered for patients with nonsurgical hepatocellular carcinoma who are also ineligible for percutaneous ablation, provided there is no extrahepatic tumor spread.

Recommendation

As we have in Egypt a high incidence of HCV infection, which proved to have a direct relationship with occurrence of HCC, we recommend a surveillance program to provide a data-supported approach to the diagnosis, staging, treatment, and management of HCC.

Acknowledgements

Conflicts of interest

None declared.

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Single-incision laparoscopic cholecystectomy using reusable conventional instruments

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Introduction
Laparoscopic cholecystectomy is considered the gold standard for the treatment of symptomatic cholelithiasis. Single-incision laparoscopic surgery refers to the operative technique in which a surgical procedure is carried out through one incision.

Patients and methods
Prospectively randomly selected 30 patients with chronic calcular cholecystitis or gall bladder polyps for whom single-incision laparoscopic cholecystectomy (SILC) was performed between January 2011 and July 2013 were recruited to evaluate the feasibility of the procedure using conventional reusable cannulas and straight instruments with no more cost than that used in conventional four-port laparoscopic cholecystectomy. The Marionette technique at the three-point suspension of the gall bladder was used.

Results
The operative time ranged from 35 to 110 min, with a mean of 53.3 min. No patient required conversion to open surgery. One patient only required the addition of one more port. Two patients required the placement of a drain. In terms of postoperative complications, no patient developed bile leakage, postoperative bleeding, postoperative jaundice, or incisional hernias.

Conclusion
SILC was a technically more challenging but safe procedure compared with conventional laparoscopic cholecystectomy because of the close proximity of the working instruments with limited triangulation; limited range of motion of the laparoscope and instruments, and decreased number of ports all contributed toward increased difficulty. The Marionette technique in three points was a very important step in the procedure. The operating time is long initially, but it reduces as surgeons become more experienced.

Keywords:
SILC, SILS, single-incision laparoscopic cholecystectomy

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Introduction

Calculus disease of the biliary tract continues to be a major national and international health problem [1]. In recent years, laparoscopic surgery has developed rapidly and laparoscopic cholecystectomy is considered the gold standard for the treatment of symptomatic cholelithiasis [2]. With considerable technical progress, the visualization and handling of the instruments has improved markedly. Thus, many diseases can be treated laparoscopically with the same safety standard as conventional surgery [3]. Traditionally, laparoscopic cholecystectomy is performed with four ports using either the American or the French technique. The trend has been toward minimizing the number of incisions and ports required and this has led to the description of three-port and two-port techniques of laparoscopic cholecystectomy [4,5].

The literature provides various definitions such as single-incision laparoscopic surgery (SILS), single-port access, single laparoscopic incision transabdominal surgery, dual-incision laparoscopic technique, and single-incision multiport laparoscopic cholecystectomy [6,7]. Recently, the development of natural orifice transluminal endoscopic surgery (NOTES) has led to advancements in the field of incisionless surgery. The main goal of NOTES is to eliminate the need for skin incisions along with other theoretical advantages [8,9]. In this respect, the introduction of single-incision laparoscopic cholecystectomy (SILC) is not more invasive than NOTES because it does not involve an additional transluminal access [10]. SILS, also known as laparoendoscopic single-site surgery or single-port access surgery, is an area of active investigation for abdominal surgery. A number of advantages have been proposed including cosmesis (scarless abdominal surgery performed through an umbilical incision), less incisional pain, and the ability to convert to standard multiport laparoscopic surgery if needed [10].

SILS refers to the operative technique in which a surgical procedure is carried out through one incision; alternatively, it is also known as laparoendoscopic single-site surgery. Navarra *et al.* [11] described a SILC as a plausible alternative procedure to the

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four-port laparoscopic cholecystectomy. Despite the fact that the SILC does not take into consideration the basic laparoscopic concepts including triangulation and external spacing to limit clashing of instruments [12], numerous series [13–15] have described elective SILC as a safe and feasible technique with high patient satisfaction related to the potential of improved cosmesis because the incision is concealed in the umbilicus [16,17].

Specially designed equipment has been developed for single-incision procedures including purpose-built optics and disposable instruments, such as ports, reticulating devices, and fixation instruments [16,17]. A known issue related to these new instruments is cost. The use of single-use instruments generally increases instrumental costs of conventional four-port laparoscopic cholecystectomy using reusable equipment, and the same may be the case for single-site laparoscopic surgery [18].

This study aimed to present 30 cases of SILC performed between January 2011 and July 2013 to evaluate the feasibility of the procedure using conventional reusable cannulas and straight instruments with no greater cost than that used in the conventional four-port laparoscopic cholecystectomy. However, the safety of the patient was the main issue rather than the cosmetic results.

Patients and methods

This study included 30 prospectively randomly selected patients with chronic calcular cholecystitis or gall bladder polyps as evaluated from assessment of history, clinical examination, and investigations. These patients underwent a single-incision multiports cholecystectomy at Cairo University Hospitals and Military Production Specialized Medical Centre between January 2011 and July 2013.

The patients' ages ranged from 20 to 52 years, mean 32.3 years. Of 30 patients, 24 were women and six were men.

Inclusion criteria

The patients were considered appropriate candidates for the present study if they were willing to provide consent and comply with the evaluation and treatment method. Inclusion criteria were patients of any age with symptomatic cholecystolithiasis or gall bladder polyps confirmed by ultrasound.

Exclusion criteria

The exclusion criteria included acute cholecystitis (diagnosed preoperatively by clinical examination and confirmed by ultrasound), choledocholithiasis (icterus and/or high bilirubin higher than the normal range), cholangitis, patients with a single large stone more than 2 cm in size (as it may lead to widening of the port site to remove it), known pregnancy, moderate to severe systemic disease (ASA III or more), known liver cirrhosis, coagulopathy, and patients with severe chronic obstructive pulmonary disease, history of abdominal malignancy, previous upper abdominal surgery (precluding laparoscopic approach), morbidly obese patients (BMI>40 kg/m^2), and calcified gall bladder.

Methods of study

A full explanation of the procedure was provided and informed consent for the procedure and the research was obtained.

Assessment of history was performed for all patients including symptoms such as biliary colic, fever, nausea, and vomiting. General and abdominal examinations were carried out to confirm the presence of manifestations of cholecystolithiasis, to exclude patients with acute cholecystitis or choledocholithiasis, and to assess the general condition of the patients. All patients underwent a standard evaluation preoperatively. Blood tests were performed such as complete blood picture, fasting blood sugar, serum urea and creatinine, full liver functions (including total bilirubin, direct bilirubin, AST, ALT, alkaline phosphatase, γ-glutamyl transferase, total proteins, and serum albumin), and prothrombin time and concentration. Abdominal ultrasonography was performed preoperatively to assess the condition of the gall bladder and bile ducts.

All patients agreed to undergo single-incision multiports laparoscopic cholecystectomy with the possibility of conversion to conventional laparoscopic cholecystectomy or even open cholecystectomy if needed.

Surgical procedure

Anesthesia and positioning

Surgery was performed under general anesthesia with the patient in a supine position with a 30° reversed trendlenberg position, left tilted position 20–30° (where the left side of the patient is lower than the right one), and with open legs. The operating surgeon stood between the patient's legs, the camera man to the left of the patient, and the assistant to the right of the patient.

Laparoscopic instruments

Straight hook, straight graspers, straight dissector, straight scissors, needle holder, monopolar electrocautery, 5 mm clip applier, one cannula 10 mm for telescope 10 mm, two

cannula 5 mm with 8.5 cm shaft and small cannula (low profile) head for use with instruments size 5 mm, telescope 10 mm with a 30° angle, Veress needle, suction irrigation instrument and three straight needles with polyglactin 910 (2-0 sutures) were used, as shown in Fig. 1.

Cannula placement

A 2 cm incision was performed above the umbilicus along its circumference. Pneumoperitoneum was established with a Veress needle introduced through the umbilicus. A low flow rate of CO_2 was used initially to avoid gas embolism or vagal stimulation from sudden stretching of the peritoneum; increased tympany was confirmed in all four quadrants. The 10 mm cannula was inserted into the middle of this incision with the other two 5 mm cannula on both sides of the 10 mm cannula. The left one was slightly above the main cannula (at 2 o'clock) and the right one was slightly below it (at 8 o'clock). The 10 mm cannula was used for telescope placement, as shown in Figs 2 and 3.

Marionette technique

A Marionette technique was used to elevate the fundus and mobilize Hartmann's pouch to expose the Calot's triangle. Each suture was passed through the abdominal wall from outside to inside, passing the gall bladder, and then returned back from inside to outside using the laparoscopic needle holder. One percutaneous suture (2-0 polyglactin 910) was passed through the right sixth or seventh intercostal space in the anterior axillary line to be stitched to the gall bladder fundus (to achieve adequate retraction and exposure of the gall bladder hilum and the Calot's triangle). The second suture was placed in the epigastrium just below the xiphoid process stitched to the Hartmann's pouch (from medial to lateral to allow medial retraction of the pouch). The last suture was placed in the right lumbar region in the midaxillary line stitched to the Hartmann's pouch (from lateral to medial to allow lateral retraction of the pouch), as shown in Figs 4–7.

Cholecystectomy

When the gall bladder was found to be distended, bile was aspirated with a needle to improve the exposure. The goal of the operative procedure was the same as

Figure 1

Trocars and cannulas used in single-incision laparoscopic cholecystectomy.

Figure 3

Cannula placement with instrument used in single-incision laparoscopic cholecystectomy.

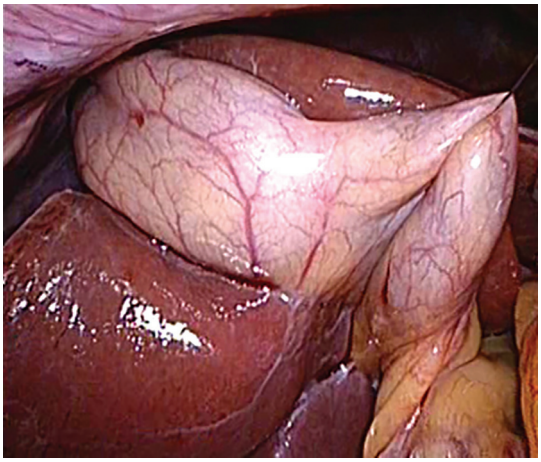
Figure 2

Cannula placement used in single-incision laparoscopic cholecystectomy.

Figure 4

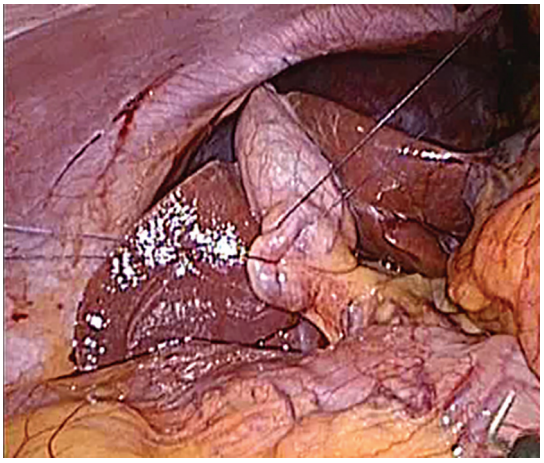
First marionette at the fundus.

Figure 5



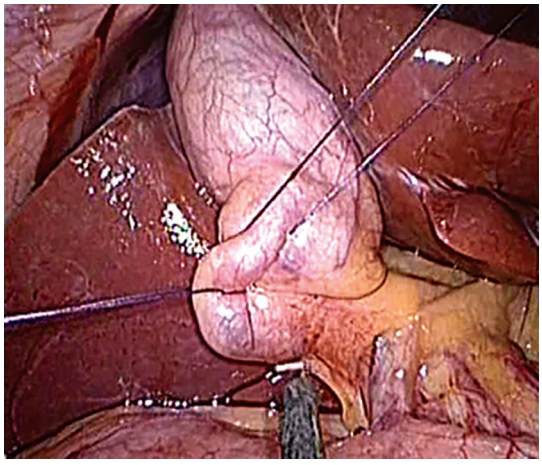
Second marionette at the Hartmann's pouch toward the epigastrium.

Figure 6



Third marionette at the Hartmann's pouch toward the right lumbar region.

Figure 7



The three marionettes with the use of a single instrument.

with conventional laparoscopy, that is, dissection of the gall bladder and cystic duct and artery until the critical view of safety was obtained (usually, using an electrocautery hook and sometimes blunt dissection with a fine dissector). Usually, a single instrument is used at a time to avoid struggling between straight instruments and telescope. The mobilization of the Hartmann's pouch medially and laterally was performed by the retraction and relaxation of the two sutures attached to it (this was done by the assistant). Once the cystic duct and cystic artery were completely exposed and Calot's triangle was well dissected, the artery and duct were clipped using a 5 mm clip applier and transected with laparoscopic scissors. Dissection of the gall bladder from the liver besd was performed using a straight electrocautery hook (usually dissection is performed from medial to lateral until the gall bladder is totally removed from the liver bed). The liver bed was examined for hemostasis before complete removal to obtain adequate exposure using the fundal suture. Suction and irrigation were performed to obtain a clear field as no drains were used (except when necessary).

The specimen was removed by holding it with a grasper, which was removed till the gall bladder reached the abdominal wall, and then all cannulas was removed to allow extraction of the specimen through the 10 mm cannula site using an artery forceps (in most cases, there was no need for more widening of this site). The fascial incision was closed with polyglactin 910 (0-0 sutures) and the skin incision was closed with subcuticular sutures for better cosmetic results.

Outcome assessment

Surgical findings (acute cholecystitis, adhesions, bile spill, and an intrahepatic gall bladder), operative time, technical difficulties encountered, and complications were recorded. Postoperative pain and length of hospital stay were determined. Surgical time was defined as the time between skin incision and closure of the last wound. Data analyzed included patients' age, sex, operative time, intraoperative bleeding, multiple laparoscopic ports conversion or open conversion, and complications (such as bile leak, hemorrhage, jaundice, wound infection, and umbilical sloughing). Data presented are mean ± SD (range). Patients were followed up for 3 months after the operation.

Results

This study was carried out on 30 patients indicated for cholecystectomy and presented to Cairo University Hospitals and Military Production Specialized Medical Centre between January 2011 and July 2013.

Table 1 Characteristic of patients undergoing single-incision laparoscopic cholecytectomy

Age (years)	20–52 (mean of 32.3 years)
Male/female	6/24
Surgical findings [*n* (%)]	
Chronic cholecystitis	26 (87)
Acute cholecystitis	3 (10)
Gall bladder polyp	1 (3)
Operative time minute (mean, min/max)	53.3 (35/110)
Conversion [*n* (%)]	
To open surgery	0
One more trocar required	1 (3)
More than one trocar required	0
Drain required [*n* (%)]	2 (7)
Hospital stay (mean, min/max)	1.2 days (1/2)

The patients' ages ranged from 20 to 52 years, mean 32.3 years. Of 30 patients, 24 were women and six were men. Of 30 patients indicated for cholecystectomy, 26 patients had chronic calcular cholecystitis, three had acute calcular cholecystitis that was accidently discovered intraoperatively, and one patient had a gall bladder polyp.

The operative time (skin-to-skin time) ranged from 35 to 110 min, mean 53.3 min. No patient required conversion to open surgery. One patient only required the addition of one more port as the liver was heavy (fatty liver). Two patients required the placement of a drain as one of them had intraoperative bleeding from the liver bed and the other patient had acute calcular cholecystitis with pericholecystic collection and intraoperative bleeding from the liver bed. One patient had a large impacted stone in the cystic duct; it required no more trocar but the cholecystectomy clips could not overcome the wide cystic duct after dislodgment of the stone. The cystic duct was transfixed with an intracorporeal knot.

In terms of postoperative complications, no patient developed bile leakage, postoperative bleeding, postoperative jaundice, or incisional hernias. However, only three patients developed a minor wound infection; one of them had acute calcular cholecystitis. No patient developed umbilical sloughing. The hospital stay ranged from 1 to 2 days, mean 1.2 days (Table 1).

Discussion

The ultimate goal of surgery has always been to provide the best and most effective procedure with the least amount of postoperative complications and pain, and the best possible esthetic results. Surgery of the biliary tract is by no means the exception. The first reported elective cholecystectomy was carried out by Langenbuch in 1882 [19] and open cholecystectomy became the standard of care well into the 1980s, with mortality rates less than 1% and bile duct injuries affecting 0.1–0.2% of patients [1,20]. This approach, however, required a large abdominal incision associated with significant postoperative pain and a longer convalescence. A revolution in the surgical treatment of biliary disease emerged in the 1980s with the introduction of laparoscopic surgery. Mühe [21] performed the first laparoscopic cholecystectomy; however, his approach did not become popular until both French and American groups popularized the four-port technique in the early 1990s. The idea of minimally invasive surgery for the removal of the gall bladder had now become a plausible technique that has rapidly become the standard of care. Navarra *et al.* [11] described a SILC as a plausible alternative procedure to the four-port laparoscopic cholecystectomy.

The primary disadvantages of SILS are the restricted degrees of freedom of movement, the number of ports that can be used, and the proximity of the instruments to each other during the operation — all of which increase the complexity and technical challenges of the operation. Many of these difficulties can be related to the technique of port placement and utilization during SILS. A number of methods have been described for port access to perform SILS, including multiple fascial punctures through one skin incision, the use of additional transabdominal sutures to stabilize the target organ, and the use of novel port access devices such as the Unix-X TM (Pnavel Systems, Brooklyn, New York, USA) (22) and R-port TM (Advanced Surgical Concepts, Wicklow, Ireland) [23]. However, these devices are expensive compared with the reusable cannulas and in addition to the cost of the angulated instrument (compared with the straight ones).

One of the most important technical challenges is the loss of triangulation of the working instruments with the lens, in addition to the size of the head of the cannulas used. To overcome these technical challenges for SILS, different instruments that provide angulations and small profile trocars have been developed, with greater costs. When comparing the costs, the cost of SILS cholecystectomy increased compared with that of conventional laparoscopy despite the reutilization of as much material as possible by the authors in the study by Bucher *et al.* [24]. They hypothesized that the costs are a reflection of product development, and that as of now, costs are not comparable with those of a routine procedure such as conventional laparoscopy [25]. In contrast, a study by Love *et al.* [26], in which a cost comparison was performed of 20 patients undergoing each procedure, did not yield a significant cost difference [26]. Thus, the issue of comparing costs is far from over, particularly if there are still a myriad

of technical options available for the realization of a SILS cholecystectomy and there is no standardized instrumentation. However, the use of reusable instruments makes the cost of SILS cholecystectomy the same as conventional laparoscopy as there is no difference in the instruments used.

In this study, SILS was attempted using a 2–3 cm periumbilical incision. This consistently allowed for the placement of single 10 mm cannula and two 5 mm cannulas. Placement of the camera inferiorly and the two working ports at two and 8 o'clock was the most consistently successful arrangement in this study. This arrangement allowed for ergonomics similar to that of conventional laparoscopy. However, the most important step was Marionette sutures, which enable elevation of the gall bladder, and the other two sutures allowed movement of the Hartmann's pouch freely without the need or use of more instruments. With this technique, only one instrument was used, any 5 mm cannula. The use of ports with low-profile heads allowed for increased range of motion and better triangulation.

Patient selection in this study was a crucial step to exclude patients with acute cholecystitis or gall bladder neoplasms. Preoperative ultrasonography was performed routinely on all patients in this study. An increase in the thickness of the gall bladder wall, gall bladder neoplasms, and the main biliary ducts provides sufficient information on the status of the ultrasonography. However, we found that three patients had acute cholecystitis as an intraoperative finding. The wrong choice of the first patients leads to higher complication rates and increased frequency of conversions to classic multiport laparoscopy. Bearing this in mind, we were also concerned about previous abdominal surgery, as it is well known that intra-abdominal adhesions are one of the basic factors that increase conversion rates [27–29]. Because of the above concerns, we decided not to qualify patients who had undergone previous abdominal surgery with a scar above the umbilicus. Patients with acute cholecystitis were also excluded because of a potentially increased risk of complications [30].

One of the very important factors assessed during the comparative analysis of surgical techniques is the total operative time. In the present study, the mean operative time of SILC was 53 min (range: 35–110 min). The mean operative time reported by Marks *et al.* [31] was 57.2 min, that by Lai *et al.* [32] was 43.5 min, that by Lee *et al.* [33] was 71.7 min, that by Bucher *et al.* [25] was 66 min, that by Ma *et al.* [34] was 88.5 min, and that by Gangl *et al.* [35] was 77 min. This difference would be much greater if we compared our results with the best achieved operative times for laparoscopic cholecystectomy published by Stephenson *et al.* [36] in the 1990s. In his group of patients, the mean operative time was 39 min (range: 25–60 min). Certainly, the significantly longer operative time of SILS cholecystectomy in comparison with multiport laparoscopy is a weakness of the technique. However, one should keep in mind that this technique is novel. However, the operative time reduced with more experience. The median operative time was 62 min in the first 15 cases and 44 min in the last 15 cases. The operating time reduced significantly as the surgeons' SILC experience increased. In recent articles, Duron *et al.* [37] reported a series of 55 cases performed in a single institution in which a 'learning curve' effect was present with respect to shorter operating times and the inclusion of more technically difficult patients as the surgeons gained experience with the procedure. Mutter *et al.* [38] analyzed the implementation of this type of surgery in a teaching hospital by comparing six surgeons (three senior surgeons and three junior surgeons). They found no significant difference between operating times and complication rates, thus advocating for the safe implementation of SILC in teaching hospitals. Another study that we had carried out previously showed that single-port cholecystectomies and traditional laparoscopic cholecystectomies did not have any statistically significant differences in terms of operating time, length of hospital stay, and conversion to open surgery [39].

In this study, SILC was attempted on 30 patients. It was completed successfully in all patients (100%). In one patient (3%), an additional port was added. Rao *et al*. [40] found a more or less similar rate of introduction of a second trocar (5%). In contrast, other investigators encountered no incidence of additional ports insertion [41]. Similar to other studies [40,41], in this study, there was no conversion to three or four ports or open surgery. Gangl *et al.* [35] reported a SILC completion rate of 85.1%, with conversion to conventional cholecystectomy in nine patients and open cholecystectomy in one patient because of inadequate visualization of the anatomy, versus a 100% completion rate in the conventional cholecystectomy group, with no significant difference with respect to postoperative pain, analgesic use, length of stay, or complications. A postoperative drain was required in two patients (7%); one of them had intraoperative bleeding from the liver bed and the other patient had acute calcular cholecystitis with pericholecystic collection and intraoperative bleeding from the liver bed; this was similar to the finding of Rao *et al.* [40].

In terms of the intraoperative complications, no patient developed bile leakage or bile duct injury. Two patients

had intraoperative bleeding and only one patient had a large impacted stone in the cystic duct; it required no more trocar but the cholecystectomy clips could not overcome the wide cystic duct after dislodgment of the stone. The cystic duct was transfixed with an intracorporeal knot, which was very difficult as the axis of the knotting was in and out with no triangulation. The incidence of biliary injury during standard LC varies from 0.5 to 0.8% [42]. To identify biliary injury, the use of an intraoperative cholangiogram is now considered a standard procedure to assess the anatomy of the biliary tree. The possibility of carrying out a transoperative cholangiogram in SILC was evaluated recently by Yeo *et al.* [43]. In terms of postoperative complications, no patient developed bile leakage, postoperative bleeding, postoperative jaundice, or incisional hernias, despite the fact that the 3-month follow-up was inadequate to exclude incisional hernia and there was no widening of the port as in single-port cholecystectomy (the incidence of hernia was suspected to be the same as any conventional laparoscopic surgery). However, only three patients developed a minor wound infection; one of them had acute calcular cholecystitis. No patient developed umbilical sloughing. The hospital stay ranged from 1 to 2 days, with a mean of 1.2 days. The hospital stay for patients of SILC in this study was similar to the conventional laparoscopic cholecystectomy and to other studies [40,41]. All patients in this study, as in other studies, had very satisfactory cosmetic results.

Conclusion

On the basis of the present findings, SILC was a technically more challenging but safe procedure compared with conventional laparoscopic cholecystectomy because of the close proximity of working instruments with limited triangulation; limited range of motion of the laparoscope and instruments and decreased number of ports all contributed toward increased difficulty. The Marionette technique in three points was a very important step in the procedure that limited the operative time and enabled good exposure of the Calot's triangle. The operating time is long initially, but it reduces as the surgeon becomes more experienced with the procedure.

Acknowledgements

Conflicts of interest

None declared.

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Outcome of the Delorme procedure for the management of complete rectal prolapse in children

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Objectives
The aim of the study was to evaluate the surgical and functional outcome of the Delorme procedure for the management of full-thickness long-segment rectal prolapse (RP) in children.
Patients and methods
This study included 23 patients with a mean age of 5.5 ± 2 years. The severity of incontinence and impact on quality of life (QOL) were evaluated using the Fecal Incontinence Severity Index (FISI) and the Fecal Incontinence Quality of Life (FIQL) questionnaires. The primary outcome was defined as complete recovery of continence, and partial improvement was defined as improvement in either type or frequency of incontinence or both. Recurrence was defined as recurrent incontinence after complete recovery. The secondary outcome was defined as change in the impact of incontinence on patients' QOL as assessed by the FIQL questionnaire.
Results
The mean operative time was 60.7 ± 13 min, the mean time until the first oral intake was 8.7 ± 3.9 h, and the mean postoperative hospital stay was 33.4 ± 12 h. All patients showed significantly lower postoperative scores on individual items and the total FISI score. Surgical repair of RP showed a favorable outcome in the form of significantly higher postoperative scores of individual items of the FIQL questionnaire, with a significantly higher postoperative total FIQL score compared with preoperative scores. Throughout the follow-up duration of 25.6 ± 6.9 months, 18 patients (78.2%) showed complete recovery, four patients (17.4%) showed only partial improvement, and one patient (4.4%) developed recurrence of gas incontinence 6 months after the disappearance of his incontinence; however, in all five patients there was an infrequent occurrence of incontinence at a frequency of 1–3 times/month.
Conclusion
The Delorme procedure is safe and effective for the management of complete RP, with a high complete recovery rate and ability to alleviate the adverse impact of fecal incontinence on QOL even in those with partial improvement. The reported advantages and outcome of the Delorme procedure in children and adulthood could enable discarding old concepts for restricted indications for the procedure for old and/or unfit patients and could make it suitable for all cases with RP without limits of age or general condition.

Keywords:
complete rectal prolapse, Delorme procedure, outcome

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Introduction

Rectal prolapse (RP), the protrusion of the layers of the rectal wall through the anal canal, may be partial (mucosal) or complete (full thickness). Complete prolapse represents a protrusion of the entire layer of the rectum to the outside of the anus and, thus, shows concentric folds. Incomplete prolapse is defined as a condition in which the protruding rectal wall is limited to the inside of the anal canal. In clinical practice, mucosal prolapse is readily confused with RP. Mucosal prolapse is not a protrusion of the entire layer of the rectal wall, but a portion of the rectal wall or only the anal mucosa. It should be differentiated from RP as the surgical treatments are different [1,2].

The pathophysiology of RP remains a matter of debate. Etiologic factors may be congenital or acquired, and include poor bowel habits, diarrheal diseases, neurologic diseases, female sex, nulliparity, and previous anorectal surgical procedures. Anatomic features associated with RP include a deep pouch of Douglas, rectosigmoid redundancy, levator ani diastasis, lack of fixation of the rectum to the sacrum, and weakness of the internal sphincter [3].

RP can present in a variety of forms and is associated with a range of symptoms including mass protrude during defecation, pain, incomplete evacuation, bloody and/or mucous rectal discharge, and fecal incontinence or constipation. Complete external RP may be intermittent or may be incarcerated and poses a risk of strangulation. Although complete prolapse is most common among older women, it affects individuals of all ages, including children [4].

Management of complete RP is still a matter of debate in terms of the choice of approach, abdominal

or perineal, the appropriateness of the procedure to the age of the patient, and the outcome in terms of surgical data and short-term and long-term results. The perineal approach provided multiple advantages over the abdominal approach including the feasibility of using spinal anesthesia or even local anesthesia, early oral feeding, and patient comfort, with little or no postoperative pain, and thus short hospital stay [5,6]. Moreover, the perineal approach did not lead to the documented risks of injury of pelvic or hypogastric nerves causing erection or ejaculatory problems in males [7,8] and the possibility of development of pelvic adhesions that may affect the ovaries and tubes and cause secondary infertility [9].

The Delorme–Thiersch procedure has appeal as a lesser procedure for patients of any age or risk category, especially for elderly low-risk patients, patients with constipation or evacuation difficulties, young males, and patients with symptomatic hemorrhoids or mucosal prolapse [1]. The current prospective study aimed to evaluate the surgical and functional outcome of the Delorme procedure for the management of full-thickness long-segment RP in children and adolescents.

Patients and methods

The current study was carried out at the Department of General Surgery, Al Jafel International Hospital, Riyadh, Kingdom of Saudi Arabia, from January 2009 till June 2013 to allow a minimum follow-up period of 6 months for the last case operated upon. After approval of the study protocol by the Local Ethical Committee and obtaining written fully informed parental consent, patients with long-segment complete RP resisting or recurring after conservative treatment were recruited into the study.

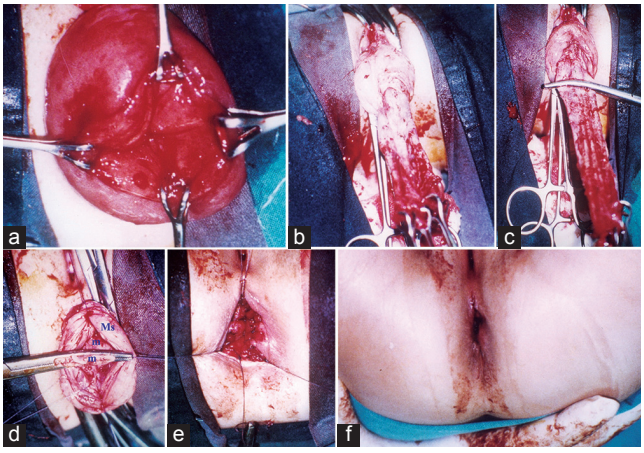
The preoperative data of the patients collected included the following: history of straining at defecation, constipation, fecal incontinence, and previous surgery, full laboratory investigations, proctoscopy and colonoscopy, and radiological investigations including barium enema and defecation proctography.

Parents of enrolled young children and patients who could answer the questions were asked to complete the Fecal Incontinence Severity Index (FISI) and the Fecal Incontinence Quality of Life (FIQL) questionnaires. The FISI questionnaire evaluates the frequency of incontinence for four types of bowel leakage: gas, mucus, liquid stool, or solid stool and the severity of leakage were graded on a six-point scale: 5: ≥2 times/day, 4: once/day, 3: ≥2 times/week, 2: once/week, 1: 1–3 times/month, and 0: never. For calculation of the total FISI score, a higher score indicated greater severity, with 1 = least severe condition and 20 = most severe condition [10]. The FIQL questionnaire included four domains: Lifestyle (10 items), Coping/Behavior (nine items), Depression/Self-Perception (seven items), and Embarrassment (three items). Each item was graded on a four-point scale: 1: most of the time, 2: some of the time, 3: a little of the time, and 4: never. For calculation of the total FIQL score, a higher score indicated lower severity of the impact of incontinence on patients' quality of life (QOL) [11].

Surgical technique

All patients underwent preoperative mechanical bowel preparation. Under general inhalational anesthesia with tracheal intubation, patients received a prophylactic intravenous dose of broad-spectrum antibiotic that was continued postoperatively and urinary catheterization was performed. With the patient in the lithotomy position, the prolapsed rectum was identified and pulled tightly downward with Babcock forceps so that the redundant rectal wall was taken into the prolapsed segment. Adrenaline (1/200 000) in normal saline was injected into the submucous layer above the dentate line to reduce bleeding and define the plane of dissection. A circumferential incision was performed in the rectal mucosa at 1–1.5 cm proximal to the dentate line to preserve a sensitive area of rectal mucosa and to simplify anastomosis. A plane of dissection between the mucosa and the internal sphincter and circular muscle of the rectum was developed, and a sleeve of mucosa of 10–15 cm was mobilized and upwards dissection was performed until rectal mucosa could not be pulled down any further. Careful homeostasis was ensured, and then the rectal muscle was plicated longitudinally in the four quadrants with 2/0 absorbable sutures starting at the apex of the dissection and continuing down to the distal cut edge of the mucosa in the anal canal. Additional sutures were placed in between for a total of eight sutures to plicate rectal muscle on tightening the sutures. Excess mucosa was excised and an interrupted mucosa-to-mucosa anastomosis with 3/0 absorbable sutures was performed (Fig. 1). Immediate postoperative care included an intramuscular injection of nonsteroidal anti-inflammatory analgesia, intravenous antibiotic therapy, and intravenous fluid therapy until oral intake. The urinary catheter was removed on the first postoperative day. Once oral intake was allowed, patients were administered oral antibiotics and analgesia and discharged. Mild laxatives were administered for 2 weeks and the patients were advised not to strain during defecation.

Figure 1



(a) The patient in the lithotomy position, the prolapsed rectum was identified. (b) The prolapsed rectum was pulled tightly downward with Babcock forceps. (c) Mucosal dissection was performed until the end of the redundant segment. (d) The dissected redundant mucosa (m) was excised while the muscle (Ms) layer was plicated and hung in four quadrants with vicryl 2/0. (e) Closure of the mucosal defect. (f) Postoperative appearance of the anal verge.

Outcome

The primary outcome was defined as complete recovery of continence; partial improvement was defined as improvement in either the type or the frequency of incontinence, or both. Recurrence was defined as complaint of recurrent incontinence after complete recovery, irrespective of the type and the frequency of incontinence. The secondary outcome was defined as a change in the impact of incontinence on patients' QOL as assessed by the FIQL questionnaire.

Statistical analysis

The data obtained were presented as mean ± SD, ranges, numbers, and ratios. Results were analyzed using the χ^2-test and the paired *t*-test. Statistical analysis was carried out using the SPSS (version 15, 2006, SPSS Inc., Chicago, IL, USA) for Windows statistical package. *P* value less than 0.05 was considered statistically significant.

Results

The study included 23 patients, 15 males and eight females, mean age 5.5 ± 2, range: 2–9 years. Thirteen patients were younger than 6 years old and 10 patients were in the age range of 6–9 years. The mean weight of the studied patients was 20.6 ± 6.7, range: 11–43 kg. Four patients had a history of constipation and seven patients had a history of previous surgery. All patients had received conservative treatment that failed to control incontinence (Table 1).

Table 1 Patients' enrollment

Data	Findings
Age (years)	
Strata	
<6	
Frequency	13 (56.5)
Mean	4.2 ± 1.1 (2–5)
≥6	
Frequency	10 (43.5)
Mean	7.3 ± 1.3 (6–9)
Total	5.5 ± 2 (2–9)
Sex	
Males	15 (65.2)
Females	8 (34.8)
Weight (kg)	20.6 ± 6.7 (11–43)
History of	
Conservative treatment	23 (100)
Surgical interference	7 (30.4)

Data are presented as mean ± SD and numbers; ranges and percentages are in parentheses.

All patients had an uneventful intraoperative course without excessive bleeding or injury to the rectal muscle layer. The mean operative time was 60.7 ± 13, range: 35–90 min; six patients had an operative time of less than 60 min and 17 patients had an operative time of at least 60 min. The mean length of the excised mucosal sleeve was 14 ± 2, range: 10–18 cm; the length of the excised mucosal sleeve was less than 15 cm in 11 patients and of at least 15 cm in 12 patients. The mean time until the first oral intake was 8.7 ± 3.9, range: 3–15 h; nine patients received their first oral intake within 6 h, six patients received their first oral intake within 12 h, and eight patients received their first oral intake after 12 h. The mean postoperative hospital stay was 33.4 ± 12, range: 24–48 h; 14 patients were discharged 24 h after surgery and nine patients had a postoperative hospital stay for 48 h (Table 2).

Functional evaluation was performed using the FISI questionnaire, and all patients showed improvement in their complaints; however, one patient still had gas incontinence, two had mucus incontinence, and a fourth patient had mucus and liquid stool incontinence, with persistence of incontinence in 17.4%. One patient developed recurrence of gas incontinence 6 months after the disappearance of his incontinence, a recurrence rate of 4.3%. All these five patients had graded their incontinence as one, indicating its infrequent occurrence of 1–3 times/month. The mean postoperative scores of individual items of the FISI questionnaire were compared with the preoperative scores and showed a significant difference in favor of postoperative scoring. The total postoperative FISI score was significantly decreased compared with the preoperative score (Table 3, Fig. 2).

Rectal incontinence had an adverse impact on patients' QOL as shown by low scores of individual items of the FIQL questionnaire; however, surgical repair showed a favorable outcome in the form of significantly higher postoperative scores compared with the preoperative scores of individual items of the FIQL questionnaire (Fig. 3), with a significantly higher postoperative total FIQL score compared with the preoperative total score (Table 4, Fig. 4).

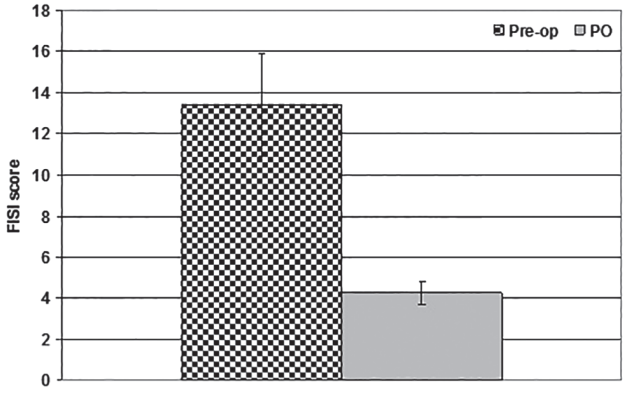
All patients attended the follow-up visits for a mean follow-up duration of 25.6±6.9, range: 8–38 months. Throughout follow-up, 18 patients showed complete recovery without any manifestations of incontinence, a rate of 78.2%. Four patients showed only partial improvement as one patient still had gas incontinence, two patients had mucus incontinence, and the fourth patient had mucus and liquid stool incontinence, a rate of partial improvement incontinence of 17.4%. One patient developed recurrence of gas incontinence 6 months after the disappearance of his incontinence, a recurrence rate of 4.3%; however, all five patients had graded their incontinence as one, indicating its infrequent occurrence of a frequency of 1–3 times/month (Table 5, Fig. 5).

Discussion

The outcome of the current study was bimodal including both surgical and functional outcomes. All patients had an uneventful intraoperative course without excessive bleeding during mucosal dissection or injury to the rectal muscle; thus, no additional morbidities were encountered. Delorme's procedure provided multiple advantages including a short operative time (60.7 ± 13 min), early resumption of oral feeding (13.3 ± 1.4 h), and little need for postoperative analgesia, which provided more patients and parents' comfort and a short duration of postoperative hospital stay (33.4 ± 12 h). These operative and immediate postoperative data show the advantages of Delorme's procedure as a perineal approach for the correction of RP.

In support of the choice of perineal repair for complete RP, Riansuwan *et al*. [12] retrospectively studied 177 patients who underwent abdominal or perineal repair for complete RP and found that those undergoing perineal repair had less procedural blood loss, operative

Figure 2



Mean total PO score of FISI compared with preoperative scores. FISI, Fecal Incontinence Severity Index; PO, postoperative.

Table 2 Operative and immediate postoperative data

Data	Findings
Operative time (min)	
Strata	
<60	
Frequency	6 (26.1)
Mean	42.5 ± 5.2 (35–50)
≥60	
Frequency	17 (73.9)
Mean	67.1 ± 7.5 (60–90)
Total	60.7 ± 13 (35–90)
Length of excised mucosal sleeve (cm)	
Strata	
<15	
Frequency	11 (47.8)
Mean	12.3 ± 1.3 (10–14)
≥15	
Frequency	12 (52.2)
Mean	15.6 ± 0.9 (15–18)
Total	14 ± 2 (10–18)
Time until the first oral intake (h)	
Strata	
≤6	
Frequency	9 (39.1)
Mean	4.9 ± 1.1 (3–6)
>6–11	
Frequency	6 (26.1)
Mean	8.5 ± 1.4 (7–10)
≥12	
Frequency	8 (34.8)
Mean	13.3 ± 1.4 (12–15)
Total	8.7 ± 3.9 (3–15)
Total PO hospital stay (h)	
Strata	
24	14 (60.9)
48	9 (39.1)
Total	33.4 ± 12 (24–48)

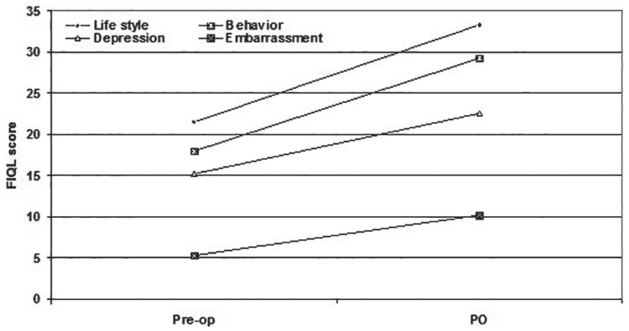
Data are presented as mean ± SD and numbers; ranges and percentages are in parentheses; PO, postoperative.

Table 3 Mean postoperative score of individual items of fecal incontinence severity index and total score compared with preoperative scores

	Preoperative	Postoperative	*P* value
Gases	4 ± 1	0.09 ± 0.3	0.0008
Mucus	3.9 ± 0.9	0.13 ± 0.3	0.0008
Liquid stool	3.1 ± 1	0.04 ± 0.2	0.0008
Solid stool	2.4 ± 1.3	0	0.0006
Total score	13.4 ± 2.5	0.26 ± 0.5	0.0004

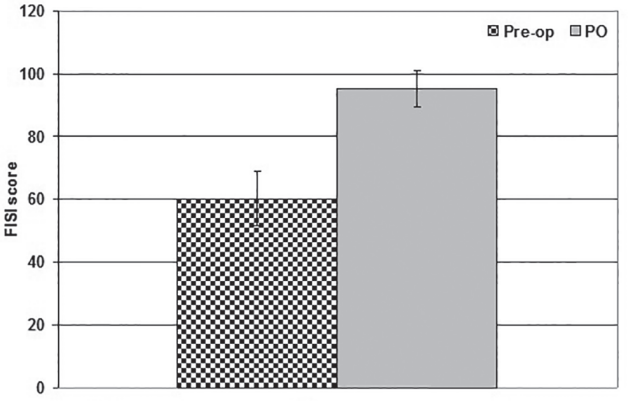
Data are presented as mean ± SD.

Figure 3



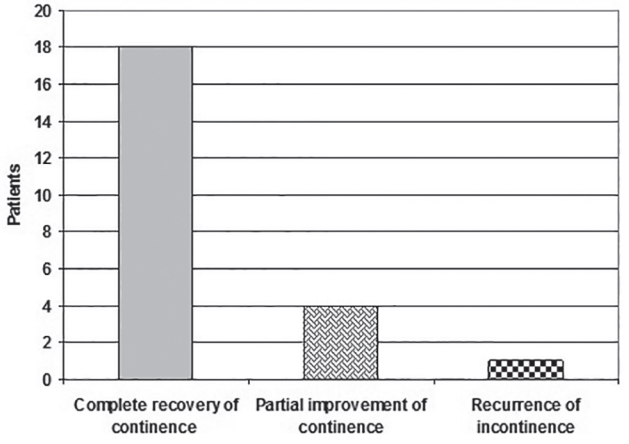
PO scores of FIQL compared with preoperative scores of studied patients. FIQL, Fecal Incontinence Quality of Life; PO, postoperative.

Figure 4



Mean total PO scores of FIQL compared with operative scores. FIQL, Fecal Incontinence Quality of Life; PO, postoperative.

Figure 5



Patients' distribution according to surgical outcome.

time, hospital stay, and dietary restriction. Also, Lee *et al.* [13] retrospectively studied 104 patients who had undergone abdominal or perineal repair for complete RP and found that the abdominal group had significantly longer operative times and postoperative hospital stay than the perineal group.

The results obtained in of the surgical outcome of the Delorme procedure are in agreement with those

Table 4 Mean postoperative score of individual items of Fecal Incontinence Quality of Life and total score compared with preoperative scores

	Preoperative	Postoperative	*P* value
Lifestyle	21.5 ± 5.9	33.3 ± 3.6	0.0006
Coping/Behavior	18 ± 5.8	29.3 ± 2.9	0.0006
Depression/Self-perception	15.2 ± 4.4	22.5 ± 1.2	0.0008
Embarrassment	5.3 ± 1.8	10.2 ± 0.8	0.0009
Total score	60 ± 8.7	95.2 ± 5.8	0.0003

Data are presented as mean ± SD.

Table 5 Follow-up data

Data	Findings
Duration of follow-up (months)	
Strata	
<12	
Frequency	1 (4.4)
Mean	8
12–24	
Frequency	10 (43.5)
Mean	21.7 ± 2.7 (16–24)
>24–36	
Frequency	9 (39.1)
Mean	28 ± 2.4 (25–31)
>36	
Frequency	3 (13)
Mean	37.3 ± 0.6 (37–38)
Total	25.6 ± 6.9 (8–38)
Outcome	
Complete recovery	18 (78.2)
Partial improvement	4 (17.4)
Recurrence	1 (4.4)

Data are presented as mean ± SD and numbers; ranges and percentages are in parentheses.

of Pascual Montero *et al.* [14], who documented that Delorme's procedure for the management of complete RP is associated with low morbidity, improves anal continence, gives rise to no postoperative constipation, and has an acceptable relapse rate with high patient satisfaction because of its (intradural anesthesia, short hospital stay, and little postoperative pain) and optimal results. Lieberth *et al.* [15] reported that most preoperative evacuatory symptoms resolve with the repair of RP and serious complications are uncommon after Delorme's procedure, and the observation that recurrence and complication rates were lower in younger medically fit patients suggests that the Delorme repair need not be restricted specifically to older, medically unfit patients. Mahmoud *et al.* [16] studied 37 patients with full-thickness RP who were operated on by Delorme's procedure and reported a mean operative time of 65±4.5 min, no mortality, and minimal blood loss, with a mean hospital stay of 3.5 days. Recently, Makineni *et al.* [17] documented that the treatment of RP should be individualized to

achieve the best results; abdominal posterior mesh rectopexy can be applied safely in most patients with minimal postoperative increase in constipation and recurrence and Delorme's procedure can be performed with minimal morbidity, shorter hospital stay, and good functional results with an acceptable recurrence rate and can be considered an alternative to rectopexy not only in patients unfit for laparotomy but also in individuals with a short prolapse, avoiding a laparotomy.

Functionally, all patients showed improvement in their QOL as they had significantly higher FIQL scores determined 6 months postoperative compared with their preoperative scores, with significantly higher postoperative scores of individual items of the questionnaire compared with the preoperative scores. These data show the adverse impact of rectal incontinence on patients' QOL and psychological status and to what extent surgical correction can alleviate this adverse effect.

In line with the negative effect of complete RP on patients' QOL and the positive effect of its correction, irrespective of the operative procedure used, Sagar *et al.* [18] reported significantly lower median subscales scores and median global Pelvic Floor Distress Inventory Score 6 months after laparoscopic sacrocolporectopexy compared with preoperative scores. Robert-Yap *et al.* [19] found that on the basis of their continence diaries, nine of 11 patients treated for fecal incontinence by sacral nerve modulation, following transabdominal or transanal repair of RP, reported an improvement in their fecal incontinence and after a median follow-up time of 36 months, fecal incontinence scores decreased from a median of 15 preoperatively to a median of 5, with a significant improvement in all four domains of the QOL questionnaire. Wnęk *et al.* [20] reported that the following RP, if untreated, is a pathology that markedly alters patients' QOL for the worse; an individual, standardized surgical approach to each patient is necessary and transabdominal methods have a low risk of complications and improve QOL of young patients, enabling a relatively quick return to normal life.

Throughout a mean duration of follow-up of 25.6 months, one patient still had gas incontinence, two patients had mucus incontinence, and a fourth patient had mucus and liquid stool incontinence, a partial continence improvement rate of 17.4%. One patient developed recurrence of gas incontinence 6 months after the disappearance of his incontinence, a recurrence rate of 4.3%; however, all five patients had graded their incontinence as one, indicating its infrequent occurrence of 1–3 times/month. Eighteen patients recovered completely from incontinence, yielding a success rate of 78.3%.

The reported improvement rates are in agreement with previous studies that evaluated the outcome of Delorme's procedure, wherein Mahmoud *et al.* [16] reported that of 11 patients who were incontinent preoperatively and underwent Delorme's procedure, seven patients became fully continent (63.6%), two patients (18.2%) showed partial improvement, and two patients (18.2%) showed no response. Lee *et al.* [21] studied 19 patients who had undergone Delorme's procedure for complete RP correction and found that three patients (15.8%) reported RP recurrence and functional outcome evaluated in 16 indicated that five (31.3%) of these 16 patients reported improved continence, seven patients (43.7%) recovered completely from incontinence, and in four patients, incontinence remained unchanged. Fazeli *et al.* [22] reported that fecal incontinence improved in 92.3% and recurrence was observed in 9.75% of patients who had undergone Delorme's procedure.

The results obtained and review of the literature led to the conclusion that the Delorme procedure for the management of complete RP is a safe and effective therapeutic modality with a high complete recovery rate and ability to alleviate the adverse impact of fecal incontinence even in those with partial improvement. The reported advantages and outcome of the Delorme procedure in children and adulthood could enable discarding old concepts for restricted indications for the procedure in old and/or unfit patients and could make it suitable for all cases with RP without limits on age or general condition.

Acknowledgements

Conflicts of interest

None declared.

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Laparoscopic Roux EN-Y gastric bypass technique and results in 150 cases

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Introduction
Obesity is a major public health challenge in the 21st century, where medicopsychological management has shown its limitations. Bariatric surgery is now acknowledged as the most efficient therapy, potentially offered to severely obese patients. Among other options, Roux En-Y gastric bypass (RYGBP) is the most frequently performed procedure.

Patients and methods
This is a retrospective study of 150 patients who underwent a laparoscopic RYGBP at the Saint Maria Nouva Hospital (Reggio Emilia, Italy) and the Ain Shams University hospitals during 2011–2013 with a 1-year follow-up. There were 29 male (19%) and 121 female (81%) patients, with an age range of 18–58 years. Their mean BMI (kg/m²) was 45.The outcome of this technique was evaluated by the incidence of early surgical postoperative complications, including gastrojejunostomy leakage, postoperative intra-abdominal bleeding or hematoma, reoperation, and mortality rate, and late postoperative complications, such as gastritis, vitamin deficiency, gastrojejunostomy stricture, incisional hernia, and internal hernia, after 12 months' follow-up. Weight loss was followed up every 3 months up to 12 months.

Results
The average operative time was ~75–90 min. There was no mortality in our series. Early postoperative intra-abdominal hematoma formation occurred in three cases (2%). Anastomotic leaks occurred at the gastrojejunostomy site in three cases (2%). There was no incidence of pulmonary complications or early postoperative wound infection. With long-term follow-up every 3 months up to 12 months, there was one case of incisional hernia after reoperation for leakage (0.6%) and there was no complain of gastritis, no incidence for gastrojejunostomy stricture, or internal hernia. There was no vitamin deficiency during the 12-months follow-up, except for two cases (1.2%) of iron deficiency anemia that needed additional iron supplementation. Regarding weight loss, the mean weight loss after 12 months' follow-up was 35.2 kg and the mean BMI of the patients decreased from 45 kg/m^2 preoperatively to 32.3 kg/m^2 after 12 months.

Conclusion
The primary desirable outcomes after bariatric surgery include low rates of perioperative and long-term complications, sustained and meaningful weight loss, significant improvement in the quality of life, improvement or resolution of obesity-associated comorbidities, and extension of life span. All the five outcomes have been shown to be feasible results of laparoscopic RYGBP.

Keywords:
bariatric, bypass, obesity, Roux EN-Y

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1110-1121

Introduction

Obesity is defined as 20% or more than the ideal body weight or a BMI [1] of 30 or more; morbid or severe obesity was traditionally defined as a weight of 45 kg or more or 100% over the ideal body weight defined by standard life insurance tables; more recent classification systems define morbid obesity as a BMI of 40 or more or a BMI of 35 or more with the presence of comorbidities [2].

The first-choice therapy for severe obesity is a nonsurgical program that integrates behavior modifications, adequate physical activity, and psychological support. However, in many cases of severe obesity, nonsurgical treatment fails in providing sustained weight loss, and so surgical treatment is indicated [1], because even a modest weight loss (10–15% of the initial weight) usually results in improvement or resolution of multiple medical comorbidities; surgical treatment of severe obesity appears to be cost effective by eliminating the use of medications and absenteeism from work in patients who were previously morbidly obese [3].

Bariatric surgeries are divided into restrictive, restrictive/malabsorptive, and malabsorptive procedures, which are performed either by open or by laparoscopic procedures [4].

Purely restrictive procedures include vertical banded gastroplasties and silastic ring vertical gastroplasties; these procedures are based mainly on the reduction of the gastric capacity and reducing food intake. The weight loss in these techniques is modest in general, and less than that established as the criterion of success

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[excess weight loss (EWL) >50% sustained for at least 5 years after surgery] [5].

The classical restrictive/malabsorptive surgery is the Roux En-Y gastric bypass (RYGBP). In this procedure, the gastric capacity is reduced by 90–95%. It is considered as the most common bariatric procedure because with gastric bypass, weight loss is more rapid as patients undergo 50–77% EWL 1 year after the procedure. The weight loss after gastric bypass most likely results from anatomic changes that confer hormonal and malabsorptive advantages in addition to restriction, with less complication rate, specially with very low vitamin deficiency and protein malnutrition compared with biliopancreatic diversion [4].

Gastric bypass and gastric band are the most common bariatric procedures that are performed nowadays. Gastric bypass was associated with a greater average EWL than gastric band at each postoperative measurement period (6, 12, 18, and 24 months) over the 2-year follow-up. Thus, there was a higher success rate and fewer treatment failures with gastric bypass than with gastric band. Mortality rates are low for both operations: ~1% for gastric bypass and 0.1% for gastric band. The perioperative risk for severe complications is greater with gastric bypass than with gastric band, but the lifetime risk for complications requiring reoperation may be greater for gastric bands. Postoperative care generally entails more treatment visits for band than for bypass patients because band adjustments are needed every 2–6 weeks. Gastric bypass patients, however, need to return to the clinic only three to four times per year after surgery [6].

The National Institutes of Health [2] Consensus Development Conference Panel for gastrointestinal surgery for the treatment of severe obesity identified RYGBP as one of the recommended surgical procedures for the treatment of those with severe obesity. Since then, gastric bypass in its different variations has become the most frequently performed bariatric surgery.

The aim of this study was to evaluate the outcome of this technique with regard to the incidence of early surgical postoperative complications, including postoperative intra-abdominal bleeding, hematoma, reoperation, and mortality rate, and late postoperative complications, such as gastritis, vitamin deficiency, gastrojejunostomy stricture, incisional hernia, and internal hernia, after 12 months of follow-up as well as weight loss follow-up every 3 months up to 12 months.

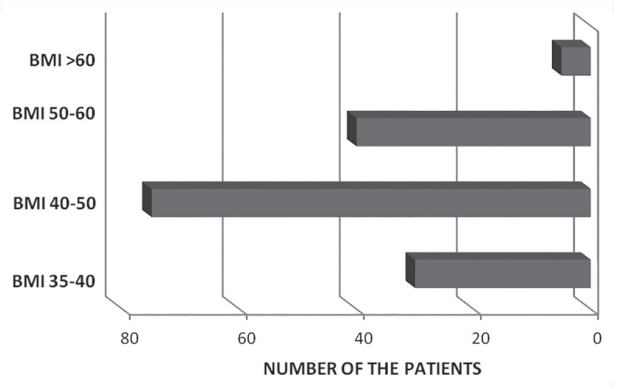
Patients and methods

This is a retrospective study of 150 patients who underwent a laparoscopic RYGBP at the Saint Maria Nouva Hospital (Reggio Emilia, Italy) and Ain Shams University hospitals during 2011–2013 with a 1-year follow-up. There were 29 male (19%) and 121 female (81%) patients, with an age range of 18–58 years. The BMI (kg/m^2) was 35–40 in 30 patients (20%), 40–50 in 75 patients (50%), 50–60 in 40 patients (27.7%), and more than 60 in five patients (3.3%). Patients' criteria are shown in Table 1 and Fig. 1.

The outcome of this technique was evaluated as follows:

(1) The incidence of early surgical postoperative complications, including gastrojejunostomy leakage, postoperative intra-abdominal bleeding or hematoma, reoperation, and the mortality rate.
(2) Late postoperative complications, such as gastritis, vitamin deficiency, gastrojejunostomy stricture, incisional hernia, and internal hernia, after 12 months' follow-up.

Figure 1



BMI (kg/m^2) of the patients preoperatively.

Table 1 Patients' criteria

Patients	(*N* = 150)
Age (years) (range)	18–58
Male/female [*n* (%)]	29/121 (19/81)
ASA [*n* (%)]	
I	15 (10)
II	15 (10)
III	30 (20)
IV	90 (60)
Smoker/nonsmoker (%)	31/69
COPD (%)	40
BMI (kg/m^2) [*n* (%)]	
35–40	30 (20)
40–50	75 (50)
50–60	40 (27.7)
>60	5 (3.3)

ASA, American Society of Anesthesiologists; COPD, chronic obstructive pulmonary disease.

(3) Weight loss follow-up every 3 months up to 12 months.

Preoperative evaluation

Because of the under-nutrition imposed on the patient and inherent complications after all bariatric procedures, patients should be regularly accompanied, in both the preoperative and postoperative periods, by a multidisciplinary team with medical, surgical, psychiatric, and nutritional expertise, which leads to fast improvement of major obesity complications after bariatric surgery; hence, after the patients were evaluated by a surgeon, a dietician, a psychologist, and an anesthesiologist evaluated the patients 5–6 weeks preoperatively, and then the patients went through a preoperative 3–6-week program with minor weight reduction and no smoking (Table 2). Table 3 illustrates the comorbidities that must be detected and controlled preoperatively to improve the postoperative outcome. The preoperative evaluation includes the following sections.

Laboratory evaluation

It included a basic chemistry panel, complete blood count, thyroid function tests, serum cortisol, urine cortisol, serum cholesterol, and serum triglycerides.

Upper endoscopy

It was performed to rule out inflammatory ulcerous gastric pathology, which would no longer be accessible by gastroscopy after the bypass procedure, and also to detect and treat *Helicobacter pylori* infection when present.

Ultrasound of the abdomen

It was performed to rule out cholelithiasis, which would necessitate cholecystectomy along with the gastric bypass procedure.

Cardiovascular evaluation

It was performed to exclude any contraindications to anesthesia, with echocardiography to assess the left ventricle function.

Psychiatric evaluation

It was performed to rule out any behavioral abnormalities that would contraindicate limited food intake.

Endocrine evaluation

It was performed to rule out an endocrine abnormality as the etiology of morbid obesity (Table 4).

Table 2 Comorbidities evaluated as potential predictors of added morbidity after Roux En-Y gastric bypass

System	Disease
Cardiac	Congestive heart failure
	Cardiomyopathy
	Arrhythmia
	Lower extremity edema
	Tobacco abuse
	Hypertension
	Coronary artery disease/myocardial infarction
	Hypercholesterolemia/hyperlipidemia/ hypertriglyceridemia
Respiratory	Obstructive sleep apnea
	Asthma/chronic obstructive pulmonary disease
	History of pneumonia
	Shortness of breath
Gastrointestinal/ hepatic	Alcohol abuse
	Gall bladder disease
	Peptic ulcer disease
	Gastro-esophageal reflux/pyrosis
	Hiatal hernia
	Hepatitis
	Cirrhosis
	Nonalcoholic fatty liver disease
Endocrine	Diabetes
	Hypothyroidism
Hematologic	History of thromboembolism
	Anemia
Vascular	Varicose veins
	Peripheral vascular disease

Table 3 Early postoperative results after laparoscopic RYGB

Early postoperative complication	Number of patients (%)
Mortality	0 (0)
Intra-abdominal hematoma	3 (2)
Leakage	3 (2)
Reoperation	3 (2)
Pulmonary embolism	0 (0)
Wound infection	0 (0)
Total	9 (6)

RYGB, Roux En-Y gastric bypass.

Table 4 Late postoperative results after 12 months' follow-up

Late postoperative complications	Number of patients (%)
Incisional hernia after reoperation	1 (0.7)
Stomal stricture	0 (0)
Gastritis	0 (0)
Internal hernia	0 (0)
Vitamins deficiency	0 (0)
Iron deficiency	2 (1.3)
Total	3 (2)

Operative technique

Set-up and positioning

The patient is placed supine with legs apart on an operating table capable of securely holding someone who may weigh up to 800 lb and is strapped above and below the waist. After the induction of general anesthesia and endotracheal intubation, a bladder catheter is inserted, and then

sequential compression devices are placed around the lower extremities to prevent intraoperative venous thrombosis. A nasogastric tube (18 Fr) was temporarily placed to decompress the stomach (removal before gastric stapling is required). Care is taken to ensure that excessive pressure is not applied to any parts of the limbs to avoid pressure injuries sustained after a lengthy procedure. Intravenous access through the upper extremity is usually sufficient. Occasionally, central access through the internal jugular or subclavian vein is necessary for monitoring. Monitors with the associated equipments (camera box, light source, insufflator) are placed above the patient's shoulders on each side and aimed at the surgical team.

Access pneumoperitonium and port placement

Initial access is obtained by the Veress needle technique at the left anterior subcostal site, because this site is generally a safer position for needle placement than the rest of the abdomen. Carbon dioxide pneumoperitonium is established to a pressure of 15 mmHg. With this technique, we use five ports as shown in Fig. 2.

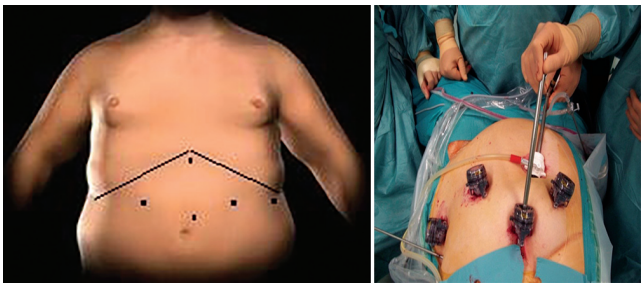
(1) A 10-mm optical port just above the umbilicus and to the left.
(2) A 12-mm port in the right mid-clavicular line (working port).
(3) A 12-mm port in the left mid-clavicular line (working port).
(4) A 10-mm port below the Xiphoid process (liver retractor).
(5) A 12-mm port on the left anterior axillary line.

The surgeon (standing between the patient's legs) operates through the right and the left upper abdominal 12-mm ports, and the assistant surgeon (standing on the left side of the patient) holds a camera in one hand and a grasper device in the other hand; the second assistant on the right side of the patient holds the liver retractor.

Creation of the gastric pouch

After positioning and port placement have been completed, the abdomen is inspected and adhesions are lysed with blunt and sharp dissection as needed; the patient is transferred to a steep reverse Trendelenburg position to facilitate the exposure of the upper abdomen. The upper stomach is exposed by retracting the liver anteriorly with a retractor from the 10-mm port just below the Xiphoid process (Figs. 3–5).

Figure 2

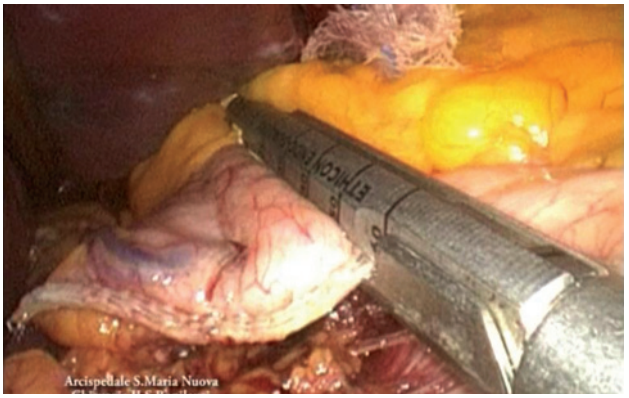


Port positions.

Figure 3

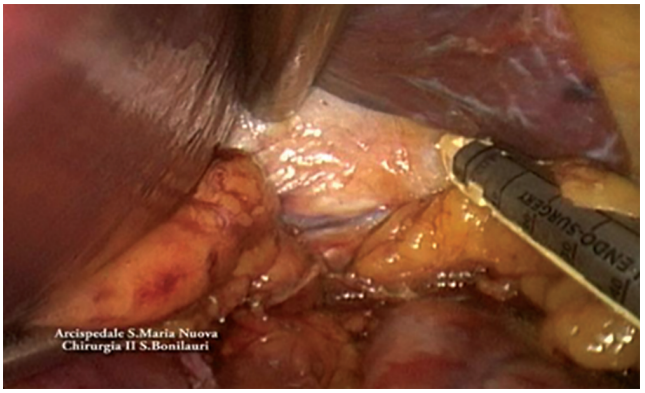
The stapler used in our technique (white 2.5 mm, blue 3.5 mm).

Figure 4



Creation of the gastric pouch.

Figure 5



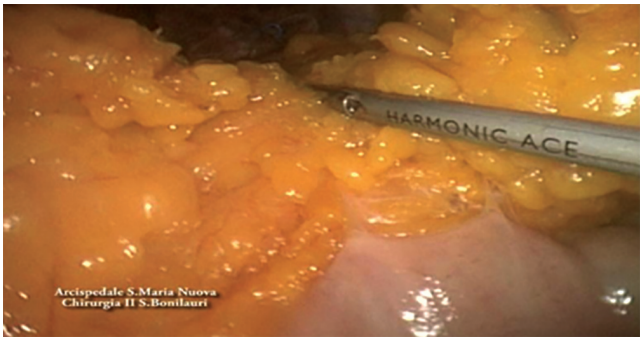
Complete separation of the pouch from the rest of the stomach.

Ultrasonic dissectionis started 5–6 cm from the gastroesophageal junction on the lesser curvature, to access the retro-cavity behind the stomach. After it has been ascertained that the nasogastric tube has been withdrawn, using a Endo-GIA stapler, with 3.8 mm staple height and 60 mm cartridge length, the stomach is dissected horizontally, starting from the lesser curvature level through the 12-mm right port. Then, another Echelon 60 (Ethicon, Cincinnati, Ohio, USA), with 3.8 mm staple height and 60 mm cartridge length, is placed level with the left end of the horizontal suture line in the cranial direction towards the Hiss angle through the left 12-mm port, while the anesthesiologist inserts a calibrated tube through the mouth. After firing the second longitudinal stapler, dissection of the angle of Hiss is performed to ensure proper stapling up to it. Staple lines on both sides of the transected stomach are examined to ensure that they are intact and not bleeding.

Construction of the biliopancreatic limb and gastrojejunostomy anastomosis

First, the omentum is divided by ultrasonic dissection from the transverse mesocolon to its inferior edge.

Figure 6



Omental division by a harmonic scalpel until the transverse colon.

Figure 8

The nearest jejunal loop from the ligament of Treitz for gastrojejunostomy anastomosis.

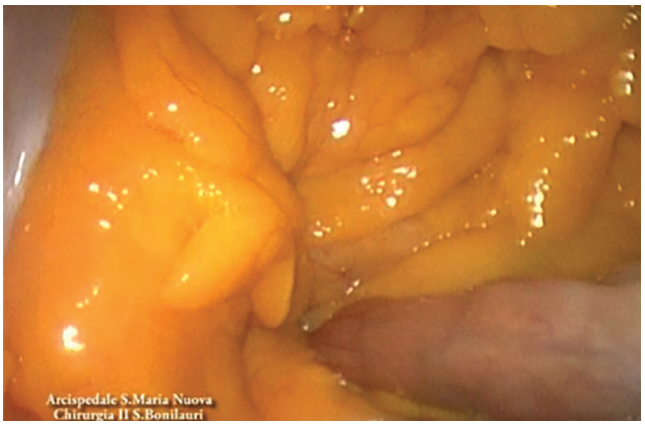
Dividing the omentum reduces tension on the Roux limb as it passes in front of the colon up to the gastric pouch, and then advanced toward the upper abdomen to expose the ligament of Treitz. The nearest jejunum loop that can reach the pouch from the ligament of Treitz without tension is taken (Figs 6–11).

Gastrojejunostomy is performed with a linear stapler by opening the stomach and the jejunum with a harmonic scalpel, then introducing the Endo-GIA stapler, with 3.5 mm staple height and 60 mm cartridge length, through the 12-mm port on the left side of the surgeon, and then closing the opening by a V-LOC continuous stitch.

Construction of the Roux limb and jejuno-jejunostomy anastomosis

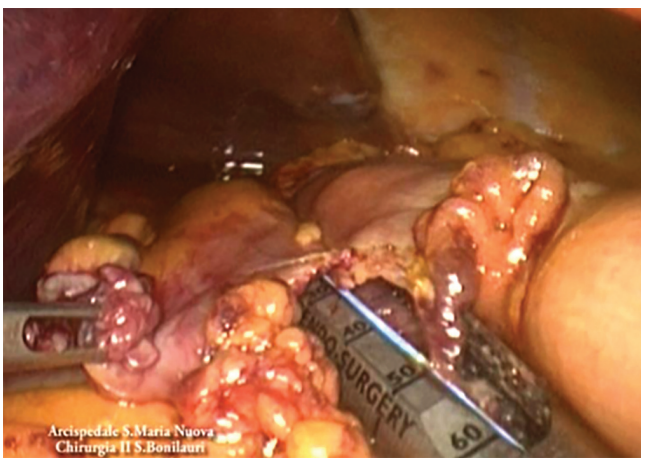
Then we measured 150 cm from the gastrojejunostomy anastomosis as the Roux limb length by a marked

Figure 7



Identification of the Treitz ligament.

Figure 9



Gastrojejunostomy anastomosis using a 60-mm linear stapler.

grasper on the right hand of the surgeon. At this point, the first assistant holds this point on the Roux limb through a grasper in the most lateral port and the second assistant holds the biliopancreatic limb through a grasper in the 10-mm port at the Xiphoid process; a suture is placed to approximate both limbs, and the second assistant, on the right side, holds this suture and then pulls it upward. The jejunum is positioned in a C configuration to facilitate the placement of the Endo-GIA stapler for division. The Endo-GIA stapler is placed through the 12-mm port on the left anterior axillary line, and it is applied perpendicular to the jejunum and parallel to the mesenteric vascular arcade to create the jejuno-jejunostomy with a 1.0 mm cartridge (2.5 mm staple height, 60 mm cartridge length) that is used to minimize staple line bleeding, followed by closure of the entrostomy opening by a continuous V-LOC suture (Figs. 12–15).

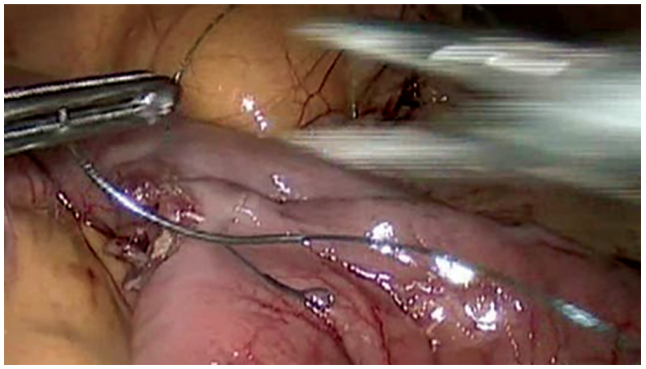
Then, a window is made by a harmonic in the mesentery of the small intestine just at its mesenteric border between the two anastomoses, without opening the jejunum mesentery, and then an Edo-GIA stapler with 2.5 mm staple height and 60 mm cartridge length is introduced through the 12-mm right side port to cut the intestine.

The blue dye test is performed by injecting 50 ml in the nasogastric tube with closure of the Roux limb to ensure the integrity of the gastrojejunostomy, and then a suction drain is placed. All port sites 10 mm and larger are closed with fascia stitches of 0 Polysorb. All carbon dioxide is evacuated, and the skin incisions are closed with interrupted 4–0 Polysorb (Figs. 12-14).

Postoperative management

The nasogastric tube is removed at the end of the procedure. On postoperative day 1 (POD1), the patient is allowed to drink water. The patients were followed for any sign of complication during the 2–3 days of hospital stay before discharge; the patient can leave the hospital on or after POD3. Follow-up is performed 1 week after discharge, when sutures or clips are removed.

Figure 10

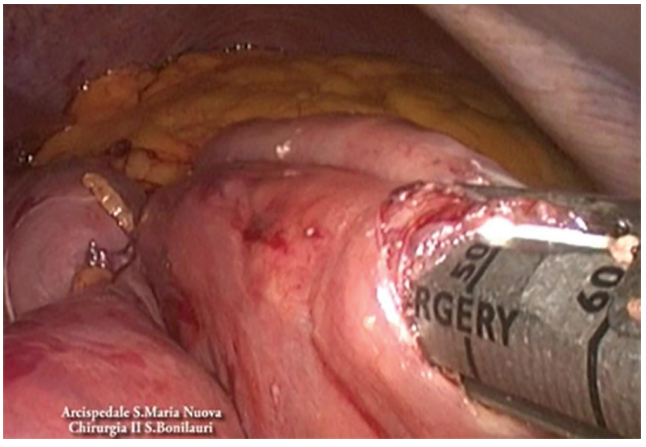


Closure entrostomy and gastrectomy openings by V-LOC.

Figure 11

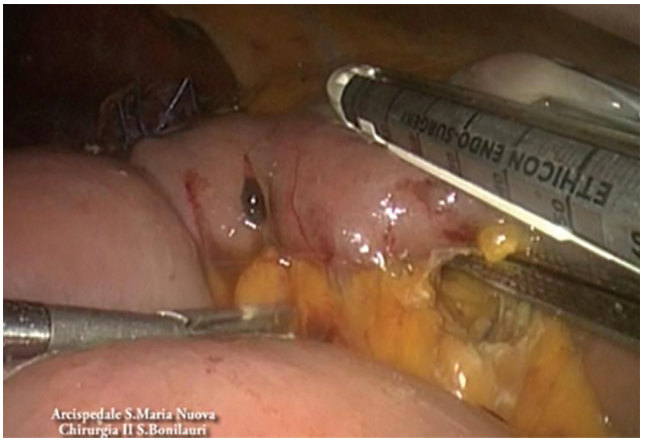
The V-LOC suture used in closing the stomach and the intestinal opening.

Figure 12



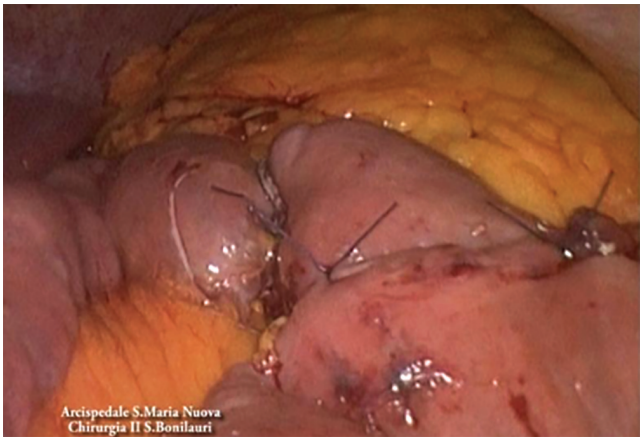
Jejuno-jejunal anastomosis, with Roux limb 150 cm.

Figure 13



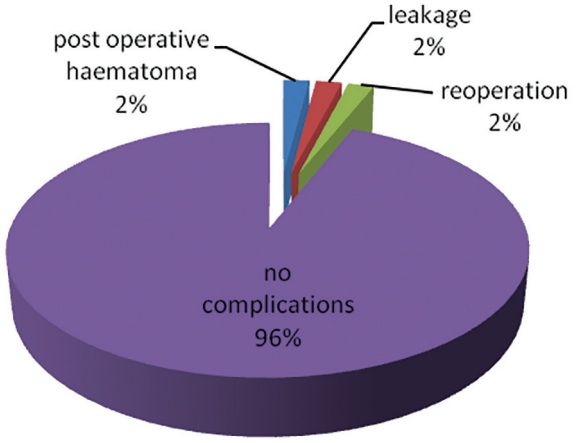
Cutting the jejunum between two anastomoses (gastrojejunostomy and jejuno-jejunostomy).

Figure 14



The blue dye test for the integrity of gastrojejunostomy anastomosis.

Figure 15



The percentage of early postoperative complications.

From POD2 to POD9, the patient remains on a liquid diet. During the 3 weeks after surgery, food must be soft or chopped. After these 3 weeks, the patient may progressively start consuming small bites of food. The patient consults a dietician before discharge and 3 weeks after surgery.

Long-term follow-up

After surgery, patients received long-term follow-up care from a physician specialized in the treatment of obesity, an expert in clinical nutrition, and a psychologist. The purpose of follow-up is not just to achieve a greater loss of weight, but also to prevent nutritional deficiencies. Patients are seen every 3 months in the first year after surgery, because this is the period of most rapid weight loss. The frequency of follow-up appointments depends on the dynamics of weight loss in the individual patient and any problems and complications that may arise.

A well-balanced diet is the best from a nutritional-medical point of view; it should be accompanied during the phase of rapid weight loss, and then permanently, after gastric bypass by the supplementation of vitamins (B_{12} and D), trace elements (iron), minerals (calcium), and, if necessary, protein. With the follow-up, laboratory monitoring is necessary as the dietary supplementation may need readjustment.

Women of childbearing age who undergo bariatric surgery should use contraception during the rapid phase of weight loss to prevent malnutritional developmental disturbances in the unborn child.

Results

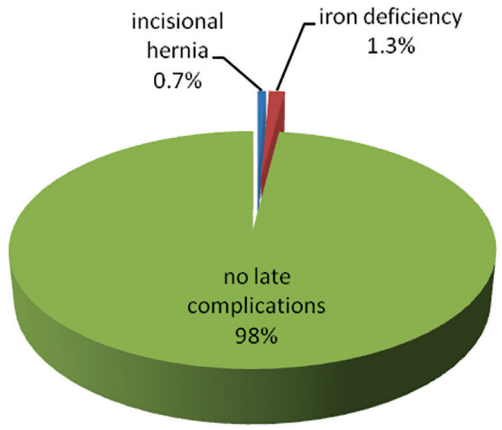
The average operative time was ~75–90 min. There was no mortality in our series. There was early postoperative intra-abdominal hematoma formation in three cases (2%), but it did not require reoperation as these patients were haemodynamically stable and conservative management was carried out.

Anastomotic leaks occurred at the gastroentrostomy site in three cases (2% of cases); postoperative tachycardia unresolved by fluid resuscitation was considered as a sensitive marker for anastomotic leakage; fever, hypotension, and leucocytosis were considered as additional supporting evidence for the presence of an anastomotic leak; if so, the gastrograffin swallow study and/or computed tomography scan with oral contrast were performed, and reoperation was performed by the open technique for refashioning of the anastomosis. There was no incidence of pulmonary complications or early postoperative wound infection (Table 3).

During long-term follow-up every 3 months up to 12 months, there was one case of incisional hernia after reoperation for leakage, and there was no complain of gastritis as the patient took proton pump inhibitors postoperatively. There was no incidence of gastrojejunostomy stricture or internal hernia. There was no vitamin deficiency during 12 months' follow-up, except for two cases of iron deficiency anemia that needed additional iron supplementation after 12 months' follow-up (Fig. 16 and Table 4).

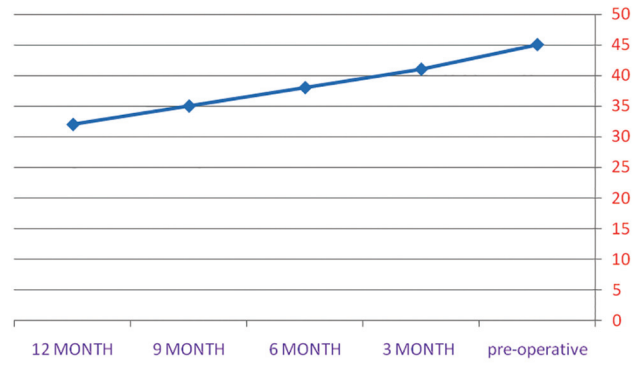
Regarding weight loss, the mean weight loss after 12 months' follow-up was 35.2 kg, and the mean BMI of the patients decreased from 45 kg/m^2 preoperatively to 32.3 kg/m^2 after 12 months. Table 5 shows the mean BMI of the patients at 3, 6, 9, and 12 months postoperatively (Fig. 17).

Figure 16



The percentage of late postoperative complications after 12-month follow-up.

Figure 17



The decrease in patients' mean BMI with follow-up every 3 months for 12 months.

Table 5 The mean BMI of the patients preoperatively and with postoperative follow-up every 3 months for 12 months

Time of follow-up	Mean BMI (kg/m^2) of the patients	SD
0 (Preoperative)	45	8.5
3 months	40.7	8.25
6 months	38	7.36
9 months	34.6	7.52
12 months	32.3	7.13

Discussion

Since the introduction of minimally invasive general surgery, a revolution in surgical techniques has occurred as most surgical procedures have been adapted to limited access techniques; because bariatric procedures are well standardized, they are very suitable for advanced laparoscopic methods. The demonstrated benefits of laparoscopic bariatric surgery include a shorter hospital stay, earlier return to normal activity, superior cosmoses, and less pain. The incidence of incisional hernia is markedly diminished. In addition, there is less systematic stress, less immunologic stress, reduced adhesion formation, and diminished incidence of ileus. Overall, the exposure is actually enhanced in very obese patient when compared with that achieved with laparotomy [7].

The primary desirable outcomes after bariatric surgery include low rates of perioperative and long-term complications, sustained and meaningful weight loss, significant improvement in the quality of life, improvement or resolution of obesity-associated comorbidities, and extension of life span. All five outcomes have been shown to be feasible results of laparoscopic gastric bypass [8]. Since Wittgrove *et al.* [9] described the first laparoscopic gastric bypass, many variations of the original technique have been reported to achieve these outcomes. Some possible technical variations in the laparoscopic RYGBP are the gastrojejunostomy anastomosis technique, the length of the Roux limb, and the use of rings at the gastric pouch (Fig. 15).

Complications involving gastrojejunostomy including stricture, bleeding, leaks, and fistulas frequently result in additional procedures and sometimes require hospital readmission. Recently, Cottam *et al.* concluded that the level of restriction or the presence of stenosis achieved by different stapler sizes does not play a significant causative role in weight loss (Fig. 16). Also, Takata *et al.* [10] concluded that the use of a 21 mm circular stapler (CS) was the only independent predictor of a gastrojejunostomy stricture in 379 patients who underwent RYGBP with four gastrojejunostomy techniques: hand-sewn, linear stapler, 21 mm circular stapler, and 25 mm circular stapler. Giordano *et al.* [11] documented that the use of the linear stapler may be associated with a reduced risk of anastomosis stricture and wound infection and a shorter operative time compared with circular stapler for GJ during laparoscopic RYGBP for morbid obesity. Our results support the study by Giordano *et al.* [11], as we had no gastrojejunostomy stricture with the use of the linear stapler technique with 12 months' follow-up.

The restriction imposed by a small pouch size is one of the most important aspects of RYGBP [12]. Roberts *et al.* [13] demonstrated an inverse correlation between the initial gastric pouch size and EWL after RYGBP and that EWL was poorer in patients with larger pouches. It also demonstrates the variability in how different surgeons in different centers create a gastric pouch, and so we estimated the pouch size by measuring the distance from the estimated location of the gastroesophageal junction to a variable distance (around 6 cm) in the lesser curvature of the stomach; we believe that it is critical to stress the importance

of the creation of a small gastric pouch and to better standardize the technique used for pouch creation.

Extending the alimentary and/or the biliopancreatic limb is one of the few technical variations of RYGBP that have been proposed to decrease the failure rate. Inabnet *et al.* [14] concluded that in patients with a BMI less than 50 undergoing laparoscopic RYGBP, increasing the length of the Roux limb does not improve weight loss and may lead to a higher incidence of internal hernias and increase the risk of nutritional deficiencies. Orci *et al.* [15] suggest that the tailoring of a longer Roux limb might be efficient only in super-obese patients. In this technique, standardizing the length of the alimentary limb to 150 cm showed a decrease in the mean BMI of the patients from 45 preoperatively to 32.3 12 months postoperatively.

The total operative time with this technique was 75–90 min; using the linear stapler for the gastrojejunostomy anastomosis and using V-LOC suturing for the closure of the entrostomy and gastrostomy opening reduces the operative time and makes the technique easier, with a very low rate of leakage, as the V-LOC suture is characterized by the distribution of tension throughout the wound, it grasps tissue at numerous points, spreading tension across the wound, and evenly spaced barbs throughout the strand provide secure closure.

Because the stomach and duodenum are bypassed, iron, vitamin B_{12}, and other micronutrient deficiencies can occur after standard gastric bypass. The incidence of these deficiencies is related to the length of the Roux limb, [16] and according to the literature, more than 44% of the patients have low levels of hemoglobin, iron, and ferritin, especially among menstruating women and one-third of the patients with B_{12} deficiency after 4 years of RYGBP [17]. In our study, there is no detectable vitamin deficiency, but two cases of iron deficiency in the 12-month follow-up were detected, and they had iron supplementation; hence, to avoid severe nutritional deficiencies as seen after bariatric surgery, it is important to predict, prevent, and promptly treat nutritional abnormalities in vulnerable patients.

Successful long-term weight management is a function of intensive long-term patient support and follow-up, built on a foundation of an effective surgical procedure [18]. Because the number of gastric bypass surgery patients is increasing substantially, and because many patients do not follow-up with their surgeons as advised, it is vital for all primary care physicians and others to be aware of the medical complications of weight loss surgery. It is especially important to be cognizant of vitamin deficiencies and their various presentations in this unique patient population. Patient education is paramount, and emphasis regarding the importance of vitamin and other nutrient supplementation should begin before surgery and continue throughout the postoperative period and beyond. Hence, we recommend strict follow-up of these patients with 3-month follow-ups in the first year, with a multidisciplinary team of surgeon, dietitian, and psychiatrist, as bariatric surgery should be performed only in the context of a comprehensive program of weight management [18].

Conclusion

The primary desirable outcomes after bariatric surgery include low rates of perioperative and long-term complications, sustained and meaningful weight loss, significant improvement in the quality of life, improvement or resolution of obesity-associated co-morbidities, and extension of life span. All the five outcomes have been shown to be feasible results of Laparoscopic RYGBP.

Acknowledgements

Conflicts of interest

None declared.

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Laparoscopic excision of benign multicystic peritoneal mesothelioma

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Benign multicystic peritoneal mesothelioma is a rare disease that arises from the peritoneal mesothelium. We report on a 52-year-old woman who presented with a large abdominal multicystic mass presumed to be a pancreatic pseudocyst. Laparoscopic exploration revealed a multicystic mass with area of calcification originating from the lesser curvature of the stomach. The whole tumor was successfully excised laparoscopically. Histopathology revealed benign multicystic peritoneal mesothelioma with an area of calcification. Treatment by a minimal access approach allowed the patient to recover rapidly with a short convalescence. Our case confirms the feasibility and safety of a minimal access surgical approach to a rare pathological entity.

Keywords:
abdominal cyst, abdominal mass, laparoscopy, peritoneal mesothelioma

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Introduction

Benign multicystic peritoneal mesothelioma (BMPM) is a rare disease with annual incidence of 0.15/100 000 arising from the peritoneal mesothelium [1,2]. We report, to the best of our knowledge for the first time in the surgical literature, a case of a BMPM arising from the lesser curvature of the stomach successfully resected by laparoscopy.

Case report

A 52-year-old female patient presented to us by a history of recurrent attacks of dull aching pain in the epigastrium of about 2 years duration. This pain was radiating to the back, increased by food ingestion, and was associated with nausea and vomiting. There was no history of previous surgical operations or other comorbidities. Her abdominal examination was irrelevant with no palpable masses. All laboratory results were within normal ranges. Serological markers for hydatid cyst were negative. Carcinoembryonic antigen was 3.2 ng/ml and carbohydrate antigen 19-9 was 2 U/ml. Esophagogastroduodenoscopy was ordered and showed extrinsic compression on the posterior aspect of body of the stomach, but there were no evident mucosal abnormalities. Abdominal computed tomography (CT) revealed a 7 × 5 cm ill-defined cystic lesion in the lesser sac containing areas of calcification. The lesion was related to anterior aspect of the pancreas with no line of separation. CT diagnosis was mostly a pancreatic pseudocyst (Fig. 1).

The patient was submitted for laparoscopic exploration. A nasogastric tube was placed. The patient was placed in the French position with the surgeon standing between legs. Five ports were used (Fig. 2): a 10-mm port above the umbilicus (for camera), another 10-mm port at the left midclavicular line for the surgeon's right hand, and three 5-mm ports (one at the right midclavicular line for the surgeon's left hand, one at the left anterior axillary line for the assistant, and one just below the xiphisternum for liver retraction).

Laparoscopic examination revealed a grape-like cystic lesion located beneath, but not attached to, the left liver lobe. The lesion was covered by a thin layer of the gastrohepatic ligament, which was divided using Harmonic shears (Harmonic scalpel; Ethicon Endosurgery, Cincinnati, Ohio, USA). Its relationship with the anterior surface of the pancreas was assessed and found no attachment. With gentle traction and countertraction, we could trace the origin of the lesion to be from the lesser curvature of the stomach (Fig. 3). After complete laparoscopic dissection of the lesion until reaching its origin from the stomach, a small portion of the lesser curvature of the stomach to which the lesion was attached was excised using Echelon 60 Endopath stapler (Ethicon Endosurgery). The specimen was placed in an extraction bag and extracted after extending the midline 10-mm port slightly. During surgery, we made every effort to avoid spillage of contents during dissection and manipulation to avoid recurrence. After resection we examined the lesion (Fig. 4). It was a cystic mass measuring about 15 × 10 × 5 cm, multiloculated, thin walled, containing mucin, with some areas of calcification. The patient had an uneventful recovery and she initiated oral intake the night of surgery and was discharged next morning. She was closely followed up by ultrasonography (US)

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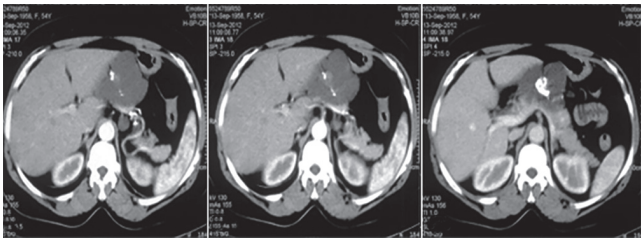
Figure 1

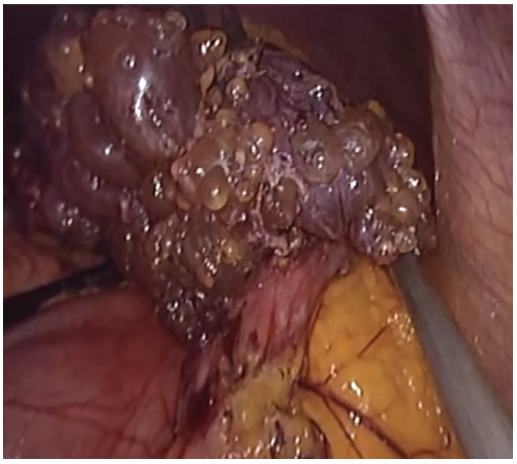


Computed tomographic scan of the patient suggesting pancreatic pseudocyst.

Figure 2

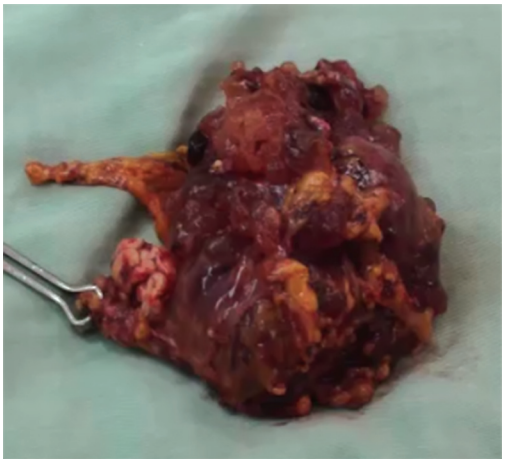
Port design.

Figure 3



After dissection, the tumor was attached by a pedicle to the lesser curve of the stomach.

Figure 4



Tumor after laparoscopic excision.

and CT and remained free of symptoms and had no recurrence for 10 months after surgery.

Microscopic examination revealed multicystic structures lined by flat to cuboidal cells; the wall is fibrous with fibrin deposition and mild inflammatory infiltrate.

Discussion

BMPM, also known as multilocular peritoneal inclusion cysts, is an uncommon lesion arising from the peritoneal mesothelium that covers the serous cavity [3]. It was first identified by Mennemeyer and Smith in 1979 [4]; since then ~150 cases were reported worldwide [5]. Unlike malignant mesothelioma, it is not associated with asbestos exposure [6]. BMPM is characterized by solitary or multiple, thin-walled, multiloculated cysts filled with serous fluid or blood. Their sizes vary from few millimeters to 30 cm [7]. This lesion occurs most frequently in women during their reproductive years [8–10] and is associated with a history of previous abdominal surgery [7], endometriosis [11,12], or pelvic inflammatory disease [7].

Mostly, BMPM is asymptomatic and is often discovered incidentally during examination for other complaints. It may present with vague abdominal pain, nausea, vomiting, and constipation. When it reaches large sizes, it may present as a painful abdominal mass [1]. In addition, its presentation in the form of acute abdomen had been reported [3]. None of the common imaging techniques allow for a definitive differential diagnosis between BMPM and other similar multilocular cystic lesions. In addition, fine-needle aspiration cytology is mostly not specific, and samples show only reactive mesothelial cells. The final differential diagnosis can be obtained from surgical biopsy or through examination of complete surgical specimens [5].

Mesothelioma is a rare tumor arising from the epithelial and mesenchymal elements of the mesothelium, the cellular layer covering most internal organs. The commonest site of mesothelioma is the pleura, followed by the peritoneum and the pericardium [13]. BMPM is also a rare entity with most information coming from individual case reports. It is an intermediate-grade tumor, between benign peritoneal adenomatoid tumors and the more common malignant peritoneal mesothelioma [14].

BMPM mainly involves the pelvic peritoneum, above the Douglas pouch, the uterus, round ligament, spleen, liver, small intestine, appendix, rectum, and previous scars with rare involvement of the upper abdomen and retroperitoneum [15]. A few cases have also been described in the tunica vaginalis [16] and the spermatic cords [17]. The etiology remains unclear and there is no association with asbestos exposure, unlike malignant mesothelioma [6]. Some authors suggest that it is neoplastic, whereas others find it a reactive process. The presence of history of prior surgery, endometriosis, and inflammation suggests that it is a special form of peritoneal reaction to chronic irritation, with mesothelial cell entrapment, reactive proliferation, and cystic formation [3]. Our patient had no history of previous operations. The neoplastic origin is based on slow but progressive growth rates, tendency to recurrence, low incidence of previous abdominal infection, and a high disease-related mortality [8].

The great majority of patients being women of reproductive age suggest a role of female sex hormones in its pathogenesis [18]. BMPM appears typically as solitary or multiple, thin-walled, unilocular cysts filled with serous or mucinous fluid or blood. Their size can vary from a few millimeters to 30 cm. It may be attached or free in the peritoneal cavity. Histologically, the cysts are lined by a single layer of flat or cuboidal cells and mesothelial cells, embedded in fibrovascular stroma. Focal adenomatoid or squamous metaplasia may be seen. Mitosis and atypical cells are usually rare [7]. There have been rare reports of transformation to low-grade malignant mesothelioma, but it is generally classified as a benign process [18]. The gross and histologic findings in our cases were similar to those reported in the literature. Mesothelial cells stain positive for calretinin, thrombomodulin, and cytokeratin 5/6, and these markers allow for a differential diagnosis between BMPM and serum papillar carcinoma of the peritoneum. The cells are negative for endothelial marker CD31 [19].

The differential diagnosis of BMPM includes a variety of malignant and benign lesions that present as solitary or multicystic abdominal masses. Cystic lymphangioma (cystic hygroma), cystic adenomatoid tumor, cystic forms of endosalpingiosis, endometriosis, Mullerian cysts involving the retroperitoneum, and cystic mesonephric duct remnants are the main differential diagnosis among benign lesions. Malignant lesions include malignant mesothelioma and serous tumors of the peritoneum [20]. Multilocular cystic lymphangiomas are the most commonly confused lesions with BMPM. Cystic lymphangiomas usually occur in male children in extrapelvic regions. They are usually found localized to the small bowel, omentum, mesocolon, or retroperitoneum and contain chylous contents. Unlike BMPM, they also have mural lymphoid aggregates and smooth muscle [15].

BMPM usually presents with vague lower abdominal pain, mass, or both, but it is also commonly diagnosed incidentally upon laparotomy for other surgeries [6]. It may also present with obstructive symptoms such as nausea, bloating, or vomiting. In addition, some patients may present with an acute abdomen [3]. Women with this lesion often have a history of prior pelvic surgery, endometriosis, or pelvic inflammatory disease [21]. Physical examination may show abdominal tenderness, distention, or a palpable mass [14]. Imaging modalities that can be utilized include US, CT, or MRI. US demonstrates multiseptated anechoic cysts variable in size and number. The fluid within them is generally anechoic, but they may contain echoes from debris or hemorrhage. CT is often the most useful diagnostic tool as it provides sectional images of the abdominal and retroperitoneal compartments. CT provides information about the location and extent of the mass and demonstrates a well-defined, low-attenuation mass with occasional noncalcified septa. It gives information about relationship with nearby organs, which helps to determine feasibility of resection [22]. MRI provides additional coronal and sagittal planes. The watery serous content has low signal intensity on T1-weighted images and intermediate to high signal intensity on T2-weighted images [23].

Because of its rarity, BMPM treatment options remain an area of controversy. Currently, aggressive surgical resection is the main stay of treatment with palliative debulking and reoperation for recurrence [24]. Aggressive surgical approaches include cytoreductive surgery with peritonectomy and perioperative intraperitoneal chemotherapy to eliminate all gross and microscopic disease [21]. With high recurrence rate and its malignant potential, debulking surgery does not appear to be the most acceptable treatment option for BMPM. Patients may suffer from poorly controlled

chronic abdominal and pelvic pain [24]. There is a 40–55% recurrence rate in female patients and a 33% recurrence rate in male patients [25]. Thus, routine follow-up imaging is required after operation, especially if complete enucleation could not be performed. Because of its rarity, there are no established follow-up or postoperative imaging guidelines. It is recommended to perform follow-up CT scan every 3 months for the first year after operation and then yearly for 5 years due to intraoperative spillage [13]. We followed this follow-up protocol in our patient and the patient remained free of recurrence at 1-year follow-up.

There are few reports of laparoscopic resection for BMPM [26–29], but laparoscopic excision of BMPM of the stomach has not been previously reported in the surgical literature. In our patient, the laparoscopy was undertaken with a presumed diagnosis of a pancreatic pseudocyst. Laparoscopic resection was carried out after verifying the benign nature of the lesion by absence of infiltration to adjacent organs. To ensure a complete excision, the portion of the lesser curvature of the stomach from which the lesion was attached was resected. The use of endo-GIA stapler, not sutures, facilitated this job. Cautious and judicious handling of the tumor is important at laparoscopy to avoid spillage of tumor contents, which is associated with tumor seedlings and recurrence. Laparoscopic surgery for BMPM is far adventitious to open surgery as laparoscopic excision of BMPM does not deprive the patient the benefits of minimally invasive surgery, thus allowing the patient to recover rapidly with minimal pain, and the cosmetic result was excellent.

Finally, preoperative and perioperative recognition of BMPM is difficult but essential for proper surgical management. Although ~150 cases had been described in the literature, publication of more case reports on BMPM is required to better understanding of this entity.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

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