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ORIGINAL ARTICLE

Comparison of prosthetic mesh repair and tissue repair in the emergency management of incarcerated para-umbilical hernia: a prospective randomized study

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Abstract
Background Although prosthetic repair has become the gold standard for elective management of para-umbilical hernia (PUH) its use in the setting of acute incarceration is still limited for fear of prosthetic-related complications, mainly infection. The objective of this study was to compare results from prosthetic repair and tissue repair in the management of the acutely incarcerated PUH.
Patients and methods Forty-two patients were prospectively randomized to either the prosthetic-repair group (group 1 = 21 patients) or the tissue-repair group (group 2 = 21 patients). In group 1, an onlay polypropylene mesh was inserted and the presence of non-viable intestine was not considered a contraindication for mesh repair. Operative time, postoperative hospital stay, and postoperative complications were recorded. Follow-up was performed by physical examination to detect recurrence.
Results Mean operative time was significantly longer for group 1 (96.9 ± 14.6 compared with 65.5 ± 14.6 min for group 2, $P < 0.05$). Postoperative hospital stay did not differ significantly between the groups (3 ± 1.6 compared with 3.5 ± 2.2 days for groups 1 and 2, respectively). Postoperative complications did not differ significantly between the groups (28.6 vs. 23.8% for groups 1 and 2, respectively). No mesh had to be removed. At follow-up (mean 16 ± 5.5 months) there were four recurrences in group 2 (4/21, 19%) and no recurrences in group 1 ($P < 0.05$).
Conclusion Use of prosthetic repair for emergency management of incarcerated PUH is safe and leads to superior results, in terms of recurrence, compared with conventional tissue repair. The presence of non-viable intestine cannot, furthermore, be regarded as a contra-indication for prosthetic repair.

Keywords Incarcerated para-umbilical hernia · Prosthetic repair · Tissue repair · Polypropylene mesh · Intestinal ischemia

Introduction

Para-umbilical hernia (PUH) is a relatively common condition which is an acquired defect in over 90% of cases [1–3]. It is seen mainly in obese and multiparous women and in patients with cirrhosis [1–4]. Herniorrhaphy using simple suture or Mayo's repair (vest over pants) has been the most frequently used technique in the past century [2]. Many retrospective studies have revealed excessively high recurrence (10–30%) associated with these repairs, however[5–7]. Several recent studies have recently shown that recurrence is significantly lower for prosthetic repairs than for traditional repairs in the elective management of PUH [8–11]. This has led some authors to suggest that prosthetic repair may be best for management of PUH [8, 9]. At our university a substantial number of these hernias present with acute incarceration. Classic surgical teaching contraindicates the use of prosthetic material in the setting of incarceration for fear of prosthetic infection

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[1, 2]. This policy leaves these patients with an unacceptably high risk of recurrence. The objective of this prospective randomized study was to compare results from prosthetic repair and tissue repair in the management of acutely incarcerated PUH.

Patients and methods

The study was approved by the ethics committees of both the Department of General Surgery and the Faculty of Medicine of the University of Alexandria. From May 1st 2004 until December 1st 2005, 42 consecutive patients with acutely incarcerated PUH admitted to the emergency department of the Alexandria main university hospital were operated upon. The duration of incarceration was defined as "the time elapsed from the start of incarceration until the start of surgery". After preoperative evaluation and preparation for surgery, patients were randomly assigned using the closed-envelope technique to either the prosthetic-repair group (group 1) or the tissue-repair group (group 2). After randomization, informed consent to operative intervention was obtained from all patients. In the prosthetic-repair group the benefits and risks involved were explained to the patients and their consent to participation in the study was obtained.

Perioperative intra-venous antibiotics (a third generation cephalosporin and metronidazole) were given to all patients at the start of operation and were continued on an eight-hourly basis for 48 h postoperatively. Obese patient were given perioperative prophylactic low-molecular-weight heparin that was also continued for 48 h postoperatively. All patients were operated upon under general or epidural anesthesia. A transverse elliptical incision overlying the hernia was used. The umbilicus was included in the ellipse whenever its preservation was technically impossible or inadvisable. After excision of the sac and dealing with its contents, the defect was vertically closed by use of simple interrupted non-absorbable sutures (Prolene 1, Ethicon). In the tissue-repair group, herniorrhaphy was performed by inverting the medial 1.5–2 cm of the rectus sheath on either side over the closed defect and suturing both sides together using simple interrupted non-absorbable sutures (Prolene 1, Ethicon), thus creating a second layer of repair and simulating the so-called Keel method [2]. These sutures extended for at least 2–4 cm beyond the defect. This is the technique adopted in our department for repair of the incarcerated PUH and we have no experience with Mayo's repair in the setting of incarceration. In the prosthetic-repair group, the operative field was first soaked with povidone iodine for 10 min. Next, skin and subcutaneous flaps were elevated to fit a 15 cm × 15 cm monofilament polypropylene mesh (Prolene, Ethicon). The mesh was then fixed to the abdominal wall muscles as an onlay patch, (i.e. between the abdominal wall and the subcutaneous tissue) using interrupted non-absorbable sutures (Prolene 2/0, Ethicon). The center of the mesh overlaid the closed abdominal wall defect. In both groups an 18 Fr Redivack suction drain was inserted subcutaneously and was removed when its daily effluent was <50 mL per 24 h for two consecutive days.

The presence of intestinal ischemia or necrosis and thus the need to perform intestinal resection was not considered a contraindication for mesh repair unless there were signs of generalized peritonitis. Resection-anastomosis of non-viable bowel was performed in a single layer, sero-muscular extra-mucosal manner using interrupted absorbable sutures (Vicryl 3/0, Ethicon). Before bowel resection the operative field was protected from contamination with povidone iodine-soaked towels taking great care not to spill intestinal contents into the field.

Operative time, length of postoperative hospital stay, and postoperative complications were recorded. Follow-up was performed in the outpatient clinic by physical examination on a weekly basis for the first six postoperative weeks and then on three-monthly basis thereafter, to detect recurrence. Recurrence was defined as "the presence of a defect on the central part of the midline aponeurosis where the operation had been performed previously".

Statistical analysis was performed using Student's *t*-test and the Chi-square test. Data are expressed as mean ± SD. Statistical significance was assumed if $P < 0.05$.

Results

This study included 42 patients, 41 females (97.6%) and 1 male (2.4%). Their age ranged from 22 to 83 years with a mean of 48.9 ± 15.5 years. Thirty-one patients (73.8%) were obese and 11 patients (26.2%) had recurrent hernias after previous tissue repairs. After randomization, patients were assigned to either the prosthetic-repair group (group 1 = 21 patients) or the tissue-repair group (group 2 = 21 patients).

The patients' characteristics in each group are listed in Table 1. No statistically significant difference was found between age, sex, body-mass index (BMI = wt/ht^2), American Society of Anesthesiologists (ASA) grade, incidence of associated co-morbidity, or recurrent PUH in the groups.

Table 1 The patients' age, sex, BMI, ASA grade, associated diseases, and previous surgery in each group

	Prosthetic-repair group (group 1 = 21 patients)	Tissue-repair group (group 2 = 21 patients)	*P*
Age (years)			
Range	22–83	26–80	
Mean ± SD	49.6 ± 15.8	48.1 ± 15.5	NS[a]
Sex			
Female	20 (95.2%)	21 (100%)	NS
Male	1 (4.8%)	0	NS
BMI (kg m^{-2})			
Range	26–37	22–38	NS
Mean ± SD	32.8 ± 3.4	32.1 ± 4.3	NS
Obese (i.e. >30)	16 (76.2%)	15 (71.4%)	NS
31–35	11 (52.4%)	9 (42.9%)	NS
>35	5 (23.8%)	6 (28.6%)	
ASA grade			
I and II	18 (85.7%)	19 (90.5%)	NS
III	3 (14.3%)	2 (9.5%)	NS
Associated co-morbidities			
Diabetes mellitus	4 (19%)	5 (23.8%)	NS
Hypertension	5 (23.8%)	5 (23.8%)	NS
Ischemic heart disease	1 (4.8%)	0	NS
Bronchial asthma	2 (9.5%)	4 (19%)	NS
Cirrhosis	2 (9.5%)	1 (4.8%)	NS
Previous surgery			
PUH repair	5 (23.8%)	6 (28.6%)	NS
Caesarian section	3 (14.3%)	2 (9.5%)	NS
Modified radical mastectomy	0	1 (4.8%)	NS
Total abdominal hysterectomy	1 (4.8%)	0	NS

[a] Not significant

The duration of incarceration, operative time, size of the defect, and the non-viable sac contents that had to be resected in each group are shown in Table 2. The mean operative time for group 1 was longer than that for group 2, with the difference being statistically significant ($P = 0.000$). No statistically significant difference was found between both groups as regards the mean duration of incarceration, the mean size of the defect, the percentage of defects larger than 3 cm in diameter, or the percentage of non-viable sac contents that had to be resected. Resection of non-viable small intestine was performed in three patients (14.3%) in each group.

In group 1 the postoperative hospital stay ranged from 2 to 6 days with a mean of 3 ± 1.6 days whereas in group 2 it ranged from 2–10 days with a mean of 3.5 ± 2.2 days with the difference being statistically insignificant. There were no mortalities. Postoperative complications were encountered in six patients (28.6%) in group 1 and in five patients (23.8%) in group 2 with the difference being statistically insignificant. Table 3 illustrates the postoperative complications

Table 2 Duration of incarceration, operative time, size of the defect, and non-viable sac contents in each group

	Prosthetic-repair group (group 1 = 21 patients)	Tissue-repair group (group 2 = 21 patients)	*P*
Duration of incarceration (h)			
Range	3–24	3–36	NS[a]
Mean ± SD	10.7 ± 7.1	12 ± 9.7	
Operative time (min)			
Range	80–140	40–90	0.000*
Mean ± SD	96.9 ± 14.6	65.5 ± 14.6	
Size of the defect (cm)			
Range	3–6	3–6	NS
Mean ± SD	4.7 ± 0.9	4.5 ± 0.8	NS
>3 cm	20 (95.2%)	19 (90.5%)	
Non-viable sac contents	6 (28.6%)	7 (33.3%)	NS
Omentum	3 (14.3%)	4 (19%)	NS
Small intestine	3 (14.3%)	3 (14.3%)	NS

[a] Not significant

*Statistically significant

Table 3 The postoperative complications encountered in each group

	Prosthetic-repair group (group 1 = 21 patients)	Tissue-repair group (group 2 = 21 patients)	*P*
Wound infection	2 (9.5%)	3 (14.3%)	NS[a]
Seroma	2 (9.5%)	0	NS
Prolonged Redivack effluent (>2 weeks)	1 (4.8%)	0	NS
Chest infection	1 (4.8%)	1 (4.8%)	NS
Deep vein thrombosis	0	1 (4.8%)	NS

[a] Not significant

encountered in each group. All wound infections encountered in this study were limited to skin and subcutaneous tissue and were successfully treated by local measures and appropriate antibiotics guided by culture and sensitivity studies. Only one of the patients who had a mesh implanted after bowel resection developed wound infection. Seroma developed in two patients (9.5%) in group 1 and necessitated re-insertion of a catheter tube drain under local anesthesia for an extra 10 and 14 days, respectively. Removal when the effluent became <50 cc per 24 h for two consecutive days was not followed by recollection. In one patient (4.8%) in group 1 the Redivack effluent was not <50 cc per 24 h for two consecutive days until the end of the third postoperative week.

Follow-up duration ranged from 6 to 24 months with a mean of 16 ± 5.5 months. No patients were lost to follow-up. Four recurrences (19%) were encountered in group 2 and no recurrences were encountered in group 1, with the difference being statistically significant ($P = 0.036$). All recurrences occurred after the first postoperative year. There were no long-term complications related to the presence of the mesh and no mesh had to be removed throughout the study period.

Discussion

The success of prosthetic repairs in elective management of abdominal wall hernias has led many investigators to attempt the use of prosthetic repairs in the emergency management of incarcerated and/or strangulated hernias using both open and laparoscopic approaches [12–16]. The successful use of prosthetic repairs in the open management strangulated groin hernias has been reported by others [12–15]. Pans et al. [12] treated 35 patients with strangulated groin hernias by insertion of a pre-peritoneal prosthetic mesh. Resection of non-viable intestine was performed on nine patients. Throughout their four-year follow-up, only one recurrence was encountered and no mesh had to be removed [12]. Wysocki et al. [13] reported their experience with use of polypropylene meshes for management strangulated inguinal and incisional hernias. Of 16 patients treated by a Lichtenstein repair for strangulated groin hernias only one developed seroma. In a later report by the same group 27 patients were treated by Lichtenstein repair for incarcerated groin hernias [14]. Resection of non-viable intestine was performed on one patient. Only one of their 25 surviving patients developed a subcutaneous fluid collection. Throughout their 1.5-year follow-up there were no recurrences and no meshes had to be removed [14]. Papaziogas et al. [15] compared the tension-free repair with use of a polypropylene mesh with Andrew's technique for management of strangulated inguinal hernias. Resection of non-viable bowel was performed on four of 33 patients treated with mesh. The postoperative complication rate for the groups was not significantly different. Throughout their nine-year follow-up there was one recurrence in the mesh group and two recurrences in the other group. Again, no mesh had to be removed. Others have reported the successful use of prosthetic repairs in potentially contaminated areas, e.g. in the presence of a stoma or in conjunction with bowel resection [17–19].

That more than 70% of the patients in this study were obese and that more than 25% of the patients had recurrent PUH after previous tissue repairs and that they presented in incarceration explains the need to investigate the safety and efficacy of prosthetic repairs in the management of the incarcerated PUH. To the best of the authors' knowledge this is the first prospective randomized study to address this particular issue.

The significantly longer operative time in the prosthetic-repair group is understandable. We assume, however, that use of mesh staplers, which were not available at our institution at the time of this study, would have greatly reduced this difference. In this study the mesh was placed as an onlay patch for several reasons. First, we assumed from our experience with the pre-peritoneal approach that placing the mesh as an onlay patch would be an easier and a faster procedure. This would have been especially true if mesh staplers had been used. Second, should complications, for example infection or migration, directly related to implantation of the mesh develop, they would be limited to subcutaneous space without the risk of bowel

injury. Finally and again out of caution, should a mesh need to be removed, this would be safer and easier if the mesh was placed subcutaneously.

There was no statistically significant difference between complications in the groups. Use of perioperative antibiotics, meticulous preparation of the operative field, and adequate hemostasis probably contributed to the acceptable rate of wound infection after bowel resection and mesh implantation as described by others [20]. Only one of the three patients who had a mesh implanted after bowel resection developed wound infection. Pans et al. reported no wound infection for nine patients who had bowel resection then implantation of a pre-peritoneal mesh [12]. The incidence of seroma (2/21, 9.5%) reported in the present study is comparable with that reported for elective prosthetic repairs of PUH which ranged from 2.1–6% in some studies [8–10]. Despite implanting the mesh in the setting of incarceration and despite performing resection of non-viable bowel in three patients (14.3%) in the prosthetic-repair group, no mesh had to be removed and all complications were treatable with success. The statistically significant higher recurrence rate in the tissue-repair group emphasizes the benefits and thus the need to use prosthetic repairs for management of the incarcerated PUH.

The early results of this prospective randomized study lead to several conclusions. First, use of prosthetic repair in the emergency management of the incarcerated PUH leads to superior results in terms of recurrence compared with conventional tissue repair. Second, use of a prosthetic material such as prolene mesh as an onlay patch in the emergency management of the incarcerated PUH is safe, easy to perform, and not associated with major systemic or mesh-related complications. Finally, the presence of intestinal ischemia or necrosis, and thus the need to perform intestinal resection cannot be regarded a contraindication for mesh repair, as previously shown by others [12–15]. Larger numbers and longer follow-up duration are still required to draw more definite conclusions.

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