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ORIGINAL ARTICLE

Prognostic factors of postoperative morbidity and mortality in strangulated groin hernia

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Abstract
Objective Strangulated groin hernia is a serious surgical emergency, as it is associated with high morbidity and mortality (2.6–9 %). This retrospective study aimed to find significant prognostic factors of postoperative morbidity and mortality.
Methods From January 2000 to August 2011, we analyzed all patients who had undergone surgery in emergency for strangulated groin hernia. Forty-nine patients out of 2,917 were operated on strangulated groin hernia in an emergency.
Results The occurrence of strangulated hernia during this period was 1.7 %. Thirty patients out of 49 had inguinal (61.2 %) and 19 femoral (38.8 %) strangulated hernias. The median age was 68.9 years ± 15.3. Patients with strangulated femoral hernia were significantly older than those with inguinal hernia ($P = 0.03$). There was a significant predominance of men in the inguinal hernia group and a female predominance in the femoral hernia group ($P = 0.001$). An additional exploration was performed on 12 patients (24.5 %). This exploration was done through a midline laparotomy in 8 patients, a laparoscopy in a single patient and the hernioscopy technique was beneficial in exploring the peritoneal cavity in 3 patients. Intestinal resection was necessary in 10.2 %. In our experience, 50 % of midline laparotomies were performed without any intestinal resection. Fisher's test identified midline laparotomy as the only prognostic factor of postoperative morbidity.
Conclusion First intention exploratory laparotomy in strangulated hernia surgery was, in our study, a major cause of postoperative complication.

Keywords Strangulated hernia · Midline laparotomy · Hernioscopy · Laparoscopy · Complications

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Introduction

Strangulated groin hernia is a life-threatening condition, requiring prompt and urgent surgical intervention. The rate of strangulated inguinal hernia varies between 0.29 and 2.9 % [1]. A diagnostic delay of more than 6–12 h increases the likelihood of intestinal necrosis, and in 15 % of cases, a bowel resection will be needed [2, 3]. The delay in diagnosis can also affect the length of hospital stay and hospital costs. Mortality risk was increased sevenfold after emergency strangulated groin hernia surgery and 20-fold if bowel resection was undertaken [4]. Some series recorded a mortality rate ranging from 2.6 to 9 % [5].

There is still a debate on the surgical management for strangulated inguinal and femoral hernias, as it differs between institutions. The surgical basics consist of obtaining a good exposure and an easy access if resection is necessary; the hernial sac and its contents are to be reduced without causing any damage or inducing a bowel perforation, and the hernia should be repaired adequately through the same incision.

Several alternatives are discussed in the literature in regard to diagnose a small bowel ischemia. The midline

laparotomy is still the classical procedure, although it carries a significant postoperative morbidity. Laparoscopy is feasible and allows an easy diagnosis of bowel suffering with a 4 % morbidity rate [6, 7]. After reviewing the literature, little data were available concerning this challenging problem. The aim of this study was to study prognostic factors of morbidity and mortality in our cohort of strangulated groin hernia patients who had undergone surgery in emergency.

Patients and methods

Study population

Emergency surgery for acutely strangulated groin hernia was performed on 49 (1.7 %) out of 2,917 patients in the Surgical Department at the University Hospital Hautepierre (Strasbourg, France) from January 2000 to August 2011. The study was designed as a retrospective clinical observational cohort. Patient demographics were noted, as was the initial clinical presentation, the type of hernia encountered, the length of hospitalization stay, the in-hospital morbidity and mortality. All patients with strangulated hernias were included. Strangulated hernia was defined as irreducible hernia by manual maneuver, with objective signs of ischemia or gangrene. Surgical complication was defined as any complication that needed surgical re-intervention under general anesthesia. Medical morbidity was defined as any medical complication that did not require surgical management. The Dindo–Clavien classification [8] was used in our study as to rank complications in objective and repeatable manner: medical complications were classified grade I or II, whereas complications requiring surgical treatment were classified grade III. Patients with life-threatening complications or who died were, respectively, grade IV and V.

Surgical technique

The surgeon individually decided which surgical technique to use according to the intra-operative observations. No preference criterion was employed for the repair method to be used, but the inguinal approach was the standard one. All patients were operated on under general anesthesia. Intestinal ischemic signs such as necrosis or shady peritoneal liquid were absolute contraindications for a mesh repair. The different techniques used were Shouldice, Bassini or Mac Vay for nonmesh techniques and Lichtenstein or Rives (repairs with the tension-free Cooper ligament repair using a polypropylene mesh) for mesh techniques. The Lichtenstein tension-free and Rives repair were used with a monofilament polypropylene mesh (Prolene®, Ethicon, USA). We have used, in one case, a bovine pericardium mesh (Tutomesh®, Novomedics GmbH, Germany; Table 1).

Every surgical intervention began with an inguinal incision. Abdominal exploration was performed when there was any intraoperative doubt of intestinal ischemia. The technique of exploration was not preliminarily defined whether midline laparotomy, laparoscopy or hernioscopy. A laparoscopy and a hernioscopy were usually performed as a result of the hernia contents reducing spontaneously during induction of anesthesia, skin incision or prior to evaluation of sac contents. For the laparoscopy technique, we performed an open supra-ombilical technique with insertion of a 10-mm port. The hernioscopy technique is as follows. After a standard open approach to the hernia and identification of the hernia sac, the sac is opened and an absorbable purse-string suture is placed in the apex of the sac and left untied. A 10-mm port is inserted gently into the peritoneal cavity using a blunt trocar and the suture tied, thus securing the port in place. The port is connected to the insufflation, and carbon dioxide is instilled, maintaining an intra-abdominal pressure of 10–12 mm Hg for laparoscopic and hernioscopic techniques. Having established the pneumoperitoneum, a 0° laparoscope is inserted through the port and a diagnostic examination performed. The laparoscope permits the meticulous examination of the entire peritoneal cavity. Bowel appearance is noted, including color, congestion and contractility. After completion of laparoscopy or hernioscopy, and in absence of intestinal ischemia, the laparoscope is withdrawn, the pneumoperitoneum released and the hernia repaired in a conventional manner. In case of intestinal ischemia, an intestinal resection was performed through a midline laparotomy.

Statistics

Variables studied were age ($\leq$69 or >69 years), sex (male or female), localization (inguinal or femoral), duration of complaints (<12 h or >12 h), mesh repair, midline laparotomy and intestinal resection. Logistic regression and Fisher's test were used to assess multiple factors associated with surgical complications, medical complications, surgical and medical complications and mortality. A difference was considered significant when the $P < 0.05$. All statistical calculations were performed with SPSS 10.0 (SPSS Inc., Chicago, IL).

Results

Out of the 2,917 hernias, 49 patients had strangulated hernia (1.7 %), 30 of which were inguinal (61.2 %), 19

Table 1 Patients' clinical characteristics and postoperative course

	Inguinal hernia	Femoral hernia	Total	*P*
No. of patients	30	19	49	<0.001
Median age (years)	66.85 ± 13.2	76.2 ± 18.3	68.9 ± 15.3	0.03
Sex ratio H/F	20/10	3/16	23/26	0.001
Median hospitalization length (days)	4 ± 8.9	5 ± 4.8	4 ± 7.5	ns
Mesh				
No mesh	13 (43 %)	6 (33.3 %)	19 (38.8 %)	–
PPL mesh	17 (56.7 %)	12 (63.2 %)	29 (59.1 %)	–
Biological mesh	0	1 (5.6 %)	1 (2 %)	–
Mesh techniques				
Lichtenstein	15	2	17	–
Rives technique	2	8	10	–
Plug	0	2	2	–
Nonmesh techniques				
Shouldice	3	0	3	–
Bassini	10	0	10	–
Mac Vay	0	6	6	–
Duration of complaints				
<12 h	11	4	15	ns
>12 h	19	15	24	
Exploration				
Yes	7 (23.3 %)	5 (27.8 %)	12 (24.5 %)	ns
No	23 (76.7 %)	14 (73.7 %)	37 (75.5 %)	
Exploration technique				
Midline laparotomy	3	5	8	–
Laparoscopy	1	0	1	–
Hernioscopy	3	0	3	–
Intestinal resection				
Yes	3	2	5 (10.2 %)	ns
No	27	17	34 (69.4 %)	
Postoperative medical complications (Grade I and II)	4	3	7 (14.3 %)	ns
Postoperative surgical complications (Grade III)	1	1	2 (4.1 %)	ns
Life-threatening complications and deaths (Grade IV and V)	2	0	2 (4.1 %)	ns

Statistical analyses using Fisher's test

ns nonsignificant, *PPL* polypropylene mesh, – statistics not performed

femoral (38.8 %). The median age was 68.9 years ± 15.3. Patients with strangulated femoral hernia were significantly older than those with inguinal hernia ($P = 0.03$). The sex ratio was 23 men (46.9 %) for 26 women (53.1 %). There was a significant predominance of men in the inguinal hernia group (2/3; 66.67 %) and a female predominance in the femoral hernia group (5 women for 1 man; 83.3 %) ($P = 0.001$; Table 1).

Operative techniques performed are listed in Table 1. A reinforcement mesh was used in 29 cases (59.1 %). The prosthetic material used was a polypropylene mesh (PPL) in 28 cases (98 %); in a single patient (2 %), a biological mesh was used for a femoral hernia repair (Table 1).

An additional exploration was performed on 12 patients (24.5 %). This exploration was done through a midline laparotomy in 8 patients, a laparoscopy in a single patient and the hernioscopy technique was used for exploration of the peritoneal cavity in 3 patients (Table 1). In five patients (n = 5/49 patients; 10.2 %), intestinal resection was necessary and performed through a midline laparotomy in four. In one patient with Amyand's hernia (defined by the presence of inflamed appendix inside an inguinal hernia), the appendix was resected through the inguinal incision.

The median length hospitalization stay was 4 ± 7.5 days, and there was no significant difference between the different groups. Seven patients (14.3 %) had

Table 2 Morbidity–mortality according to exploration techniques: midline laparotomy, laparoscopy, hernioscopy

	Midline laparotomy ($n = 8$)	Hernioscopy or laparoscopy ($n = 4$)
Intestinal resection	4 (50 %)	0
Postoperative medical complications (Grade I and II)	3 (37.5 %)	0
Postoperative surgical complications (Grade III)	2 (25 %)	0
Life-threatening complications and death (Grade IV and V)	1 (12.5 %)	0

one or more postoperative medical morbidities as postoperative ileus, heart rate irregularity, heart failure, autonomy loss, sigmoiditis, confusion, severe hyponatremia, stroke and multi-organ failure. Two deaths were observed with one patient dying postoperatively within 48 h and the other dying during surgery (Table 1).

No postoperative surgical or medical complications were encountered in the patients without midline laparotomy. In the midline laparotomy group, two postoperative surgical complications were encountered in this series: one patient with a small bowel injury with intestinal leakage that was not detected during laparotomy and one patient with an evisceration (Table 2). In both cases, no bowel resection was performed at the time of the first explorative laparotomy. There was no initial intestinal resection during the two laparotomies, which encountered surgical postoperative complications. The patient with intestinal leakage was dead 48 days later in intensive care due to multi-organ failure. The patient with evisceration required 21 days hospitalization.

Having tested according to age ($\leq$69 and >69 years), sex, strangulated hernia localization, evolution length (<12 h and >12 h), mesh repair, midline laparotomy and intestinal resection on surgical, medical morbidity and death (Table 3), we have found midline laparotomy to be the only prognostic factor of postoperative surgical morbidity ($P = 0.024$) and surgical or medical morbidity ($P = 0.017$). The other factors did not affect morbidity or mortality in our series. The Fisher's test identified midline laparotomy as the only prognostic factor of postoperative morbidity.

Discussion

In approximately 1 % of cases, incarcerated hernias will reduce spontaneously following administration of curare during induction of anesthesia [9], and in such cases, the traditional options available to the operating surgeon have been to perform an exploratory laparotomy. We analyzed 49 consecutive strangulated hernias during a period of 11 years. Sex ratio, median age and rate of intestinal resection were similar to other series [10]. The present study showed that age, hernia localization, intestinal resection and mesh utilization were not significant prognostic factors of postoperative morbidity and mortality. However, midline laparotomy was the only significant prognostic factor of surgical or medical postoperative complications.

In the literature, advanced age in the patients with incarcerated groin hernia has been associated with an unfavorable outcome [11, 12]. In our experience, patients with strangulated femoral hernia were significantly older than those with inguinal hernia, but advanced age was not a prognostic marker either for morbidity or for mortality. In spite of the higher proportion of strangulated cases and bowel resections in women and in femoral hernia type described in other articles [13], neither female sex nor femoral hernia type has a significant negative influence on morbidity, mortality and intestinal resection rate. In this series, there was not a significant difference between femoral and inguinal hernias for postoperative morbidity and mortality. In the literature, delayed diagnosis of strangulated hernia is considered to be an important prognosis factor of intestinal resection, morbidity and mortality [14, 15]. Tanaka et al. [2] have shown that a delay of 12 h increased significantly intestinal resection rate. In our study, intestinal resection requirement was not significantly affected by delayed hospitalization.

A definitive diagnosis of strangulation of the intestine can only be made through surgical exploration [16]. Very little data have been published with regard to comparing laparoscopy and exploratory laparotomy as a first approach in cases of strangulated groin hernia where intestinal ischemia is suspected. Our results support the choice of opting for alternative techniques during the exploratory phase in cases of strangulated hernia. In our experience, 50 % of midline laparotomies were performed without any intestinal resection. Strangulated hernias are more frequently seen in elderly patients, and their prevalence in the over-60-year-old population has been reported to be 9.8 % compared with 1.8 % for younger patients [17]; morbidity and mortality rates are 55 and 15 %, respectively, for patients over 65 years in case of herniorrhaphy in emergency [18]. It is in this older population, who are likely to have a lot of co-morbidities, that laparoscopy or hernioscopy could be of most benefit. It would avoid the alternative of a laparotomy, which in our series is associated with significant morbidity.

A number of authors have described the interest of laparoscopy in the diagnosis of bowel ischemia [19, 20]. Laparoscopy could help to diagnose bowel ischemia thus

Table 3 Statistical analyses for prognostic factors of surgical complications, medical complications, surgical or medical complications and death

Variable (no of patients)	Medical complications (Grade I-II) ($n = 7$)	Surgical complications (Grade III) ($n = 2$)	Surgical or medical complications (Grade I-II-III) ($n = 8$)	Life-threatening complications and death (Grade IV) ($n = 2$)
Age				
≤69 years (25)				
>69 years (24)	ns	ns	ns	ns
Sex				
M (23)	ns	ns	ns	ns
F (26)				
Localization				
Inguinal (30)	ns	ns	ns	ns
Femoral (19)				
Evolution length				
<12 h	ns	ns	ns	ns
>12 h				
Mesh				
Yes (30)	ns	ns	ns	ns
No (19)				
Midline laparotomy				
Yes (8)	ns	$P = 0.024$	$P = 0.017$	ns
No (41)				
Intestinal resection				
Yes (5)	ns	ns	ns	ns
No (44)				

decreasing both negative and nontherapeutic laparotomy rates [21]. Once the diagnosis of bowel ischemia is established, laparotomy could be performed. In our series, two exploratory laparotomies with severe surgical postoperative morbidity were revealed as unnecessary. One occurred when intestinal perforation during laparotomy was not diagnosed; the other was an early postoperative evisceration. Evisceration, which is a rare occurrence (incidence less than 0.1 %) with any incision, has its incidence increases with age and emergency surgery [22, 23]. This complication could be avoided in emergency in this advanced aged population by alternatives to laparotomy as laparoscopy.

Ishihara et al. [24] reported their experience with six laparoscopic hernioplasties and concluded that the decision to perform a bowel resection can be reliably made using laparoscopy. Morris et al. [25] and Deeba et al. [6] report the use of hernioscopy to inspect intra-abdominal contents and thus prevent unnecessary laparotomy. Watson et al. [26] were the first to report a reduction in the hernia and bowel resection laparoscopically in 1993. The literature compares laparoscopic approach with open surgery only on reducible hernias. However, bowel resection could be undertaken totally laparoscopically or guided by a minilaparotomy as Rebuffat et al. [7] and Legnani et al. [27] have shown. Bowel or omentum needing resection could be found in strangulated hernias and performed in laparoscopy [28].

In conclusion, according to advanced aged population with strangulated groin hernias, first intention exploratory midline laparotomy seems to be a significant prognostic factor of postoperative morbidity. Our study and the literature review argue in favor of replacing midline laparotomy by hernioscopy or laparoscopy.

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