SCIENTIFIC PAPER

Port-Site Hernia Following Laparoscopic Cholecystectomy

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ABSTRACT

Background: Port-site hernia is a rare but potentially serious complication of laparoscopic cholecystectomy. This study aimed to review the current literature, assess the incidence and causes of port-site hernias, and identify methods to reduce the risk.

Methods: A systematic search of the literature published in English from 1995 to 2010 was conducted using PubMed to identify all reports of port-site, trocar-site, or incisional hernia following laparoscopic cholecystectomy. Studies in over 100 patients were identified before the application of defined exclusion criteria. The incidence of port-site hernia was calculated and compared with historical data. Predisposing factors were reviewed.

Results: Seven studies met the search criteria, with 99 port-site hernias in 5984 patients. The overall incidence of port-site hernia was 1.7% (range, 0.3% to 5.4). The most important factors were older age, higher body mass index, preexisting hernia, trocar design, trocar diameter, increased duration of surgery, and extension of the port site for gallbladder extraction.

Conclusion: The incidence of port-site hernia is low but likely to be underestimated and has not declined over time. Awareness of the predisposing factors and modification of techniques may help to reduce the risk.

Key Words: Laparoscopic, Cholecystectomy, Port-site hernia.

INTRODUCTION

Since the first laparoscopic cholecystectomy (LC) performed by Prof. Dr. Med Erich Mühe of Böblingen, Germany on September 12, 1985,[1] the procedure has become widespread, significantly changing the surgical management of gallbladder disease.

Tonouchi et al[2] recognized the first report in the literature of a port-site hernia (PSH) by Fear in the context of gynecological surgery (1968).[3] The first publication of a PSH following LC was in 1991 by Maio et al.[4] Whilst this complication has long since been recognized, its significance is becoming more important with the increasing number of patients being treated in this way. The incidence of PSH in a range of laparoscopic procedures has been described as between 0.14% and 22%.[5–9] In addition to pain, PSH can lead to severe complications, including bowel obstruction, strangulation, and perforation.[2,10–15]

Laparoscopic equipment and techniques have developed considerably over recent years. Numerous types of trocar designs are in use, and opinion on fascial closure varies considerably. It is not known whether the incidence of PSH has changed over time with modifications in technique. One particular variation rapidly gaining popularity is the single incision technique, otherwise known as single port access (SPA), single incision laparoscopic surgery (SILS), single site laparoscopy (SSL), or laparoendoscopic single site surgery (LESS). The procedure is performed through a single skin incision with either multiple trocars piercing the fascia within the skin opening or a larger diameter trocar incorporating several access channels. With only a single incision, one might expect a lower incidence of PSH; however, some authors suggest this technique may be associated with an increase in the incidence.[16]

There are no systematic reviews published in the literature on PSH solely in the context LC. This article reviews the current literature on PSH following LC. It aims to identify the incidence and causes of PSH, whether the incidence has changed over time, and if the single incision technique is associated with a difference in incidence. The intention is to suggest methods for reducing the risk of postoperative PSH.

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METHODS

A systematic search of the literature published in English from 1995 to 2010 was conducted using PubMed to identify all reports of port-site, trocar-site, or incisional hernia following LC. The related articles feature was used to find additional relevant articles. All series including more than 100 subjects undergoing LC were identified. Studies were included if they reported only on patients undergoing LC or if they contained mixed cases but included a breakdown of those undergoing LC. Studies were excluded if their data publication was duplicated in other reports. Reference lists were crosschecked to highlight further suitable reports. A table was constructed of all studies meeting the search criteria. A similar search was conducted for large series published before 1995 to ascertain whether the incidence of PSH has changed over time. Other articles of studies with smaller numbers reporting on the causes or consequences of PSH for background information were identified separately. An extensive survey of individual case reports was not performed.

Data extracted from the articles included the number of patients undergoing LC and the number of PSH reported, allowing the incidence to be calculated. Other data recorded were the interval between surgery and diagnosis of hernia, the site of hernia, the method of primary port insertion (open or closed), the follow-up protocol, the treatment/outcome, the trocar diameter used at the hernia site, and the method of port closure.

RESULTS

Nine papers were identified that met the initial criteria. The data from 2 papers were duplicated in other articles and therefore excluded,[5,17] leaving 7 studies suitable for the main analysis, presented in **Table 1**.

Incidence

The incidence of PSH ranged from 0.38% to 5.4% with an overall incidence of 1.7% (99 of 5984 operations). The incidence was calculated by dividing the total number of PSH identified over the whole follow-up period by the number of patients in the study, expressed as a percentage. A difficulty with interpretation of the incidence is that PSH are often diagnosed late relative to the usual follow-up duration for LC, with many centers not offering any routine follow-up. There are few prospective studies designed with the aim of identifying postoperative PSH.[11,13,18] In these studies, the overall incidence was 3.2%.

Three large studies published prior to 1995 were identified.[19–21] The incidence of PSH reported in each study was 1 in 500 (0.20%),[19] 3 in 1983 (0.15%),[20] and 1 in 800 (0.13%),[21] respectively. This equates to an overall incidence of 0.18%, which is considerably lower than that reported above in more recent studies. In one report, the study period was 9 months,[19] and in the other 2, the study period was 15 months.[20,21] Follow-up was not reported beyond the study period; therefore, only early hernias were identified through this means. There may also have been a lack of awareness of the complication, because these articles reported the initial experience with LC.

Location of Hernias

The umbilicus was by far the most common port to be associated with incisional hernia, being affected in 88 of 99 cases. However, hernias were observed at all other sites including the epigastrium (8 cases),[10,14,22,23] the right hypochondrium (2 cases),[10,11] and left hypochondrium (1 case).[10]

Classification

A classification of PSH into early (dehiscence of fascial planes and peritoneum), late (dehiscence of fascial plane with intact peritoneal hernia sac), and special (dehiscence of whole abdominal wall) types has been described[2] but not widely used. No other article has attempted to classify PSH in any way.

Clinical Presentation/Management

In the majority of cases, PSH is not associated with any strangulation or bowel obstruction. In cases of strangulation, the hernia is typically of a Richter's type.[10,17,24] Where omentum rather than bowel is the herniating tissue, patients tend to present later and with minimal symptoms.[2,10] Details of treatment were available in 38 of 99 hernias presented in **Table 1**. Of these, 22 (58%) were operatively repaired. Two patients presented with small bowel strangulation (one with obstruction), one patient presented with a jejunal perforation associated with a strangulated hernia, and one patient had acute intestinal small bowel obstruction without strangulation.

Time to Diagnosis

The interval between operation and diagnosis of PSH varies between studies and depends on follow-up regimes. When associated with few symptoms, they often present late, and where data were available, time to diag-

Table 1.
Large Studies Presenting Port-site Hernias Following Laparoscopic Cholecystectomy

Author	No. of Patients	No. of Hernias	Incidence (%)	Hernia Port Site	Number Repaired	Follow up	Entry Type (closed/ open)	Port Fascial Closure
Ahmad[21] (1997)	1300	11	0.85	11 umbilical	unknown	at least one post-operative visit	300 closed 1000 open	Figure of 8 suture to all umbilical ports
Balakrishnan[22] (2008)	1332	5	0.38	5 epigastric	unknown	all reviewed within 6 weeks	all closed	Polydioxanone suture to all ports ≥10mm
Coda[10] (2000)	1210	16	1.3	13 umbilical 1 epigastric 1 right upper quadrant 1 left upper quadrant	9 of 16	unknown	most closed	Suture repair to all umbilical ports if extended
Nassar[11] (1997)	870	16	1.8	15 umbilicus 1 right lower lateral	9 of 16	3 months and 6 months	most closed	Polyglycolic acid suture in most 11 nonabsorbable suture 7 formal hernia repair
Mayol[18] (1997)	373	6	1.6	6 umbilicus	4 of 6	Minimum 3 months range 3-51 months	188 closed 185 open	Umbilicus sutured for all open access ports, for closed access only when incision was enlarged and in all other ports >10mm
Sanz-Lopez[23] (1999)	123	3	2.4	2 umbilical 1 epigastric	unknown	Range 1 to 5 years mean 3 years	unknown	Interrupted sutures to all umbilical ports
Uslu[13] (2007)	776	42	5.4	41 umbilical 1 epigastric	unknown	1 week and 1 month	751 closed 25 open	None closed
Totals	5984	99	1.7	-	-	-	-	-

nosis ranged from 5 days to 3 years with an average of 9.2 months.[10]

Predisposing Factors

Very few prospective studies have aimed at identifying the risk factors for PSH. No randomized studies have been performed to date. The factors predisposing to PSH can be divided into patient factors and operative factors.

Patient Factors

The presence of a preexisting umbilical/paraumbilical hernia has been identified in several reports as a risk factor for PSH.[2,5,11,17,18,25,26] Azurin et al[17] retrospectively reviewed 1300 patients who underwent LC. Postoperative PSH developed in 10 patients, 9 of these occurred in patients who were found at operation to have incidental ventral midline hernias. These patients had umbilical closure with figure-of-eight polyglycolic acid sutures. When a hernia was symptomatic or identified preoperatively, it was repaired at the time of surgery with nonabsorbable, interrupted sutures. None of these patients developed postoperative hernias.

Nassar et al[11] found that 12% of patients undergoing LC had preexisting umbilical or paraumbilical defects, of which 83.7% were asymptomatic. Defects were closed at the end of the procedure with a polyglycolic acid suture repair in 90% of patients, the remainder having nonabsorbable suture or formal hernia repair. Incisional PSH developed in 1.8% of patients, 25% of whom had a preexisting hernia with fascial closure at the time of surgery.

Male gender seemed to be associated with a higher incidence of hernia in one report, without statistical analysis.[11] In another study, the incidence was higher in women on univariate analysis but not in the multivariate analysis.[13]

Obesity has been suggested as a predisposing factor in some studies,[2,5,13,17] with one study reaching significance in multivariable analysis,[13] but no statistical difference in others.[2,11,18] The majority of studies did not assess the effect of body mass index (BMI) on the incidence of PSH. One study suggested that there may be a correlation with sudden weight gain and hernia development following surgery rather than obesity itself.[10] Examination of incisional hernias can be more difficult in the obese patient,[27] which can give rise to late presentation and diagnosis.

In the study by Coda et al,[10] large-diameter gallstones have been proposed as a predisposing factor with 5 of 13 cases of PSH being associated with gallstones ranging from 2cm to 5cm in size. All these were removed via the umbilical port and would have required extension of the port-site incision, which has been identified as a risk factor in many other reports identified below.

A variety of medical comorbidities have been linked to hernias, including diabetes mellitus,[11,17] chronic obstructive pulmonary disease,[10] renal failure,[17] and acquired immune deficiency syndrome.[17] In one report, 9 of 10 PSH were associated with comorbidities, although without statistical significance.[17] The presence of cholecystitis or recent malnutrition has been proposed as a possible causal factor in some studies without statistical testing.[10,11]

Operative Factors

Trocar diameter has been widely reported as a factor in development of PSH.[2,5,10,17,23,25,28] Of the 99 cases identified in **Table 1**, only 2 hernias were through ports 5mm in diameter, the remainder occurring in port sites ≥10mm in diameter. However, there are many other reports in the literature of herniation through 5-mm ports,[10–12,29–32] particularly in children[29,30,33] and indeed a single report of herniation through a 3-mm port site.[26]

Primary port insertion is either by a closed or open technique. The closed technique usually involves Veress needle insufflation followed by blind insertion of a trocar. In the open technique (Hasson or similar), the abdominal wall is opened, and the port inserted under direct vision. In a report on 373 patients, PSH only occurred in the closed insertion group.[18] However, these patients only had closure of the fascia when the incision had to be extended whilst all patients in their "open" group had suture closure of the fascia. It has been suggested that in the case of closed insertion, even when the fascia is sutured, the incidence of PSH is higher. Fascial closure can be more difficult when the closed technique has been used, particularly in obese patients. However, in a nonrandomized study of 1300 patients, the incidence of postoperative hernia was no different in the closed group (0.8%) compared with the open group (0.7%).[17] Fascial closure was performed in all cases. None of the other studies was of a suitable methodology to compare the 2 insertion techniques.

Secondary ports are less often the site of hernia development, but hernias do occur at secondary port sites. The type of trocar used is thought to be a determining factor.[5,28] Broadly, they can be divided into 2 types: cutting trocars and dilating trocars. The most common cutting trocars in use are reusable metal pyramidal trocars and disposable metal bladed trocars with or without a sprung

protective sleeve. They generally require less force to use but have a higher incidence of complications, such as bleeding, pain, and hernias. Dilating or "radially expanding" trocars bluntly separate abdominal wall tissues.[9] They are thought to be associated with less bleeding and pain, although they require greater application of force to insert which could increase internal organ injury. Newer hybrid designs have also been developed in an effort to minimize these problems.[28] Shafer et al[28] measured the size of the tissue defect created by a range of different trocar types in a porcine model. The functional and measured tissue defect was smallest for the hybrid and radially dilating trocars compared with cutting or plastic bladed trocars, suggesting that the former may be associated with fewer PSH.

No controlled trials have been conducted that use different trocar designs in a clinical setting. Most series either use the same trocar design throughout or chose the type based on other patient/operative factors. In one study on 747 patients, 3735 port sites were created using a dilating trocar (VersaStep) without any occurrences of hernia.[9] Investigators encountered 9 PSH at Hasson ports used for induction of pneumoperitoneum. In another study, a bladeless, 12-mm visual entry trocar was used to gain access to the peritoneum and establish pneumoperitoneum in 849 gastric bypasses.[34] The rate of PSH after 10 months was 0.2%. It must be remembered however that no specimens were extracted via the port sites.

Antoniou et al[35] recently published online their review of single-incision laparoscopic cholecystectomy (print journal in press). They identified 29 large studies and found a single PSH in 1166 patients (0.09%). Three further recent studies are identified in the literature with no incidence of incisional hernia in 30, 80, and 29 patients.[36–38] The technique is relatively new but rapidly increasing in popularity, demonstrated by the fact that of the 32 studies cited above, 27 were published in 2009 or 2010. Long-term follow-up was not reported in these studies.

There are anecdotal reports that prolonged manipulation and reinsertion of ports are associated with a greater risk of herniation.[10,11] In the multivariate analysis by Uslu et al,[13] increased duration of surgery was associated with an increased incidence of PSH.

Many reports identify extension of the port incision to facilitate extraction of the gallbladder as a risk factor for PSH.[2,10,11,18] However, in one study, none of the 10 patients with PSH had extension of the incision.[17]

Some studies suggest there may be a greater incidence of herniation in the midline ports rather than off-midline ports[5,8,39]; however, others suggest this is not the case but rather larger diameter ports and extraction of the gallbladder are more likely to occur at the midline ports.[2,12]

Not closing the fascial defect is thought to be implicated in PSH formation,[2,11] although closing the fascia is certainly not preventative. This is demonstrated by the fact that in some studies, hernias were identified despite fascial closure in all cases.[11,17,23] Mayol[18] found a trend towards a slightly higher incidence of hernia in those who had ports closed; however, they were only closed when the port had to be extended for gallbladder removal. Unlike in most studies, Uslu et al[13] did not perform fascial closure in their series of 776 patients. In comparison, they identified a very high incidence of PSH at 5.4%. Whilst care has to be taken in drawing conclusions from this, it would suggest that not closing the fascia is at least partly responsible for their results.

One randomized trial involving 100 patients compared the use of a Berci fascial closure instrument (suture retrieval needle) with standard suture closure of the umbilical fascia.[40] With 50 patients in each group, the study was too small to be of clinical relevance, and no patient in either group developed PSH.

In the absence of any preexisting hernia, there are no reports suggesting any method of suture closure is superior to another, although a poor closure technique has been identified as contributory factor in individual cases.[10]

One institution has been using a Deschamps ligature needle for fascial closure of trocar sites. This hand operated, reusable, blunt-tipped device can be used to close all post sites, including 5-mm ports and the final port. In their series of 1400 laparoscopic procedures, they report no incidents of PSH.[41]

Wound infection has been implicated in the pathogenesis of umbilical incisional hernia in some reports.[2,10,11,16,42] One randomized study investigating the effect of prophylactic topical rifamycin showed a reduction in incisional hernias with 2 of 24 patients in the control arm developing PSH (8%).[42] This incidence is very high; therefore, this work would need to be repeated before any conclusions are drawn.

The use of a drain placed through a port site has been suggested as a risk factor for PSH in 2 studies, although this has not been fully evaluated.[5,31]

DISCUSSION

Patients with PSH following LC may have minimal symptoms, particularly in the late onset type. Together with a lack of long-term follow-up, this may give rise to an underreporting in the literature, and the true incidence of PSH may be considerably higher than measured.[12,23]

There is some statistical evidence to suggest that age, body mass index, and duration of surgery increase the risk of PSH. It is likely that extending the port incision, preexisting fascial defects, nonclosure of ports, and trocar diameter are also important factors.

Data would suggest that there has been no decrease in the incidence of PSH since 1995, although there is a lack of sufficient evidence to draw a formal conclusion.

Early reports suggest the risk of PSH associated with single-incision laparoscopy is low. Caution must be used in interpreting these initial reports without long-term follow-up data. Larger studies with longer follow-up will be available in time to better assess the safety of this new but increasingly popular technique.

An effort should be made to identify any previously undetected hernia by digital examination of the fascia through the port site at the time of surgery. The fascia of the umbilical port should always be closed carefully with sutures and where there is a preexisting hernia, formal repair should be undertaken including defining borders of the defect and closing with interrupted nonabsorbable sutures.

We suggest always using the umbilical port as the extraction site to minimize the number of sites at increased risk of herniation. If the epigastrium is used for gallbladder extraction, this should be closed in a similar manner.

When the epigastrium is not used for gallbladder extraction, the incidence of hernia is low; however, we would suggest the use of a dilating trocar if the fascial defect is not to be closed.

If a port is extended for extraction of the gallbladder, the entire resulting defect should be closed under direct vision.

Secondary ports should be kept to as small a diameter as possible with the use of 5-mm camera and instruments where possible. Dilating or hybrid ports should be used in preference to cutting ports, but the experience of the operating surgeon and other risks such as trocar injury need to be considered. All secondary ports ≥10mm in size should be closed if a cutting trocar has been used.

Surgeons should avoid reinsertion of ports and unnecessary torsion as well as keeping overall operating times low.

In single-incision LC, the fascia is routinely closed. Awareness of the predisposing factors and the principles above should be kept in mind.

In subsequent studies, multivariate analysis needs to include whether the fascia was closed, whether preexisting hernias were present, and whether port incisions were extended. Controlled trials aimed at comparing different techniques would add significantly to the current literature. It is realized that surgeons' preference will always lead to a variation in techniques used.

Further evaluation of specialist closure devices including disposable suture retrieval needles and reusable blunt ligature guides would be required to prove their effectiveness and feasibility.

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