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Port Site Infection in Laparoscopic Surgery

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Abstract: ***Background: Laparoscopic surgery (LS), also termed minimal access surgery, has brought a paradigm shift in the approach to modern surgical care. Early postoperative recovery, less pain, improved aesthesis and early returns to work have led to its popularity both amongst surgeons and patients. Its application has progressed from cholecystectomies and appendectomies to various other fields including gastrointestinal surgery, urology, gynecology and oncosurgery. However, LS has its own package of complications. Port site infection (PSI), although infrequent, is one of the bothersome complications which undermine the benefits of minimal invasive surgery. Not only does it add to the morbidity of the patient but also spoils the reputation of the surgeon. Despite the advances in the field of antimicrobial agents, sterilization techniques, surgical techniques, operating room ventilation, PSIs still prevail. The emergence of rapid growing atypical mycobacteria with multidrug resistance, which are the causative organism in most of the cases, has further compounded the problem. PSIs are preventable if appropriate measures are taken preoperatively, intraoperatively and postoperatively. PSIs can often be treated non-surgically, with early identification and appropriate management. Macrolides, quinolones and aminoglycosides antibiotics do show promising activity against the atypical mycobacteria. This review article highlights the clinical burden, presentations and management of PSIs in LS as shared by various authors in the literature. We have given emphasis to atypical mycobacteria, which are emerging as a common etiological agent for PSIs in LS. Although the existing literature lacks consensus regarding PSI management, the complication can be best avoided by strictly abiding by the commandments of sterilization techniques of the laparoscopic instruments with appropriate sterilizing agent.***

Keywords: Laparoscopic surgery, Port site infection

1. Introduction

Rapid growths in health care technology have given the surgeon the power of not only treating diseases surgically but also limiting surgical invasiveness. The greatest example is minimal access surgery (MAS) also commonly termed laparoscopic surgery (LS) or keyhole surgery, which has caused a paradigm shift in the approach to modern surgery, by limiting the access related morbidities. LS involves the use of reusable metallic or disposable plastic trocars inserted through small skin incisions or ports made on the skin away from the site of surgery. This ports form the portal of entry to perform the surgical procedure by means of specially devised instruments and telescope. It has gained popularity due to better aesthesis, lesser pain, early ambulation and discharge from the hospital with early return to work, minimizing the financial burden to the patient. Ever since Philips Mouret reported the first laparoscopic cholecystectomy in 1987, the approach has been adopted for many other surgical procedures including appendectomy, herniorrhaphy, colonic surgery, gastric surgery, urological and gynaecological surgery [1-4]. This is because of the combination of advancement in technology with the increasing acceptance of MAS by patients, which has led to the expansion of the horizon of LS. LS, however, has its package of unique complications. One such complication, which is preventable although, is the port site infection (PSI). PSI soon erodes the advantages of LS, with the patient becoming worried with the indolent and nagging infection and losing confidence on the operating surgeon. occurs a significant increase in the morbidity, hospital stay and financial loss to the patient. The whole purposeof MAS to achieve utmost cosmesis is turned into anunsightly wound, and the quality of life of patients isseriously affected.In this article we review the current literature regarding the incidence, clinical presentation, etiopathogenesis, management and methods of prevention of PSI in LS. We emphasize on the management of PSI due to the emerging rapid growing atypical mycobacteria that do not respond to the standard anti-tubercular drugs.

Incidence of PSIs

No surgical wound is completely immune to infections. Despite the advances in the fields of antimicrobial agents, sterilization techniques, surgical techniques, and operating room ventilation, PSIs still prevail. Incidence of SSI after elective laparoscopic cholecystectomy is less than that after open elective cholecystectomy due to shorter length of incision [5]. The technique of primary port entry to the peritoneum does not show any difference in umbilical PSIs in patients undergoing laparoscopic cholecystectomy [6]. The umbilical PSI rate in LS has been reported to be 8% with 89% of the infections occurring after laparoscopic cholecystectomy, whereas 11% after laparoscopic appendectomy [7]. Francis *et al* [8] studied the factors predicting 30-day readmission after laparoscopic colorectal cancer surgery. Out of 268 patients in their study who underwent laparoscopic colorectal surgery, 48 (18%) were readmitted with surgical site infection (SSI) [9]. Several other authors have found that SSI rate is much higher in conventional surgical procedures than in MAS. The immune functions are less affected in LS as compared to open surgery. The incidences of PSI in laparoscopic cholecystectomy as per various studies are illustrated in Table 1.

SSIs and PSIs

SSIs are infections consequent to the surgery that are present within a month of the operative procedure. Surveillance in surgeries, such as breast, cardiac, cranial, spinal and bone

surgeries, with use of prosthetic material, extends to 90 d after surgery. PSI is a type of SSI but limited to LS. The same criteria for SSIs are applicable to PSIs, but the infections are limited to superficial and deep surgical sites only as detailed below. According to the definitions developed by the United States Centre for Disease Control (CDC), SSIs were categorized into: (1) Superficial SSIs which involve skin and subcutaneous tissue; (2) Deep SSIs which involve fascia and muscle layers; and (3) Organ/Space SSIs. Wounds are classified as (as per CDC criteria for SSI 2015) (1) Clean: A surgical wound that is neither exposed to any inflamed tissue nor has breached the gastrointestinal, respiratory, genital, or uninfected urinary tract; (2) Clean-Contaminated: Surgical wounds where there is controlled entry into the gastrointestinal, respiratory, genital, or uninfected urinary tract with minimal contamination; (3) Contaminated: Fresh wounds related to trauma, surgical wounds with major breach in sterile technique or gross contamination from the gastrointestinal tract, and incisions through nonpurulent inflammatory tissues; and (4) Dirty or Infected: Old wounds following trauma having devitalized tissue and surgical procedure performed in the presence of active infection or visceral perforation.

2. Materials & Methods

This prospective and retrospective study. All patients who underwent laparoscopic surgeries, between December 2017 and December 2019, at our institute in the Department of General Surgery were included and port sites were monitored for complications prospectively. A total of 100 cases were operated. All patients received antibiotics preoperatively. Reusable ports were used in 100 cases. they were reused in two cases after sterilization with ethylene oxide (ETO). Once the surgery was finished, all the instruments were removed carefully under vision. Fascia of ports ≥10 mm was closed. PSI was defined according to the National Nosocomial Infections Surveillance (NNIS) system. Centers for Disease Control and Prevention (CDC). Wounds were assessed clinically after surgery and in case of infection, were treated with regular cleaning and dressing, with empirical oral antibiotics. PSI was studied in relation to frequency, type of surgery, and port position. Similarly, port site bleeding, was studied in relation to frequency, site, type of ports, and size of ports. Omentum-related complications were studied in relation to frequency, type of surgery, number of ports, and the port site involved. Further port site complications were studied in relation to age, sex, body mass index (BMI), total number of ports used, technique of port closure, and procedure performed.

3. Result

Among the 100 cases of laparoscopic surgery, females (85%) predominated over the males (15%). Mean age was 42.71 years with a standard deviation of 13.79 years. The youngest patient was 19 years old while oldest one was 85 years of age. PSI was found in 4/100 patients (4%). Regarding gender, in 3/85 female patients, percentage of the PSI was 4% and in 1/15 male patients the percentage was 6.6.%. There is an association between male gender and infection, p-value 0.03. as in Table 1.

Table 1

Gender	Infected/total	Percentage%	P value
Male	1/15	6%	0.03
Female	3/85	4%	0.03
Total	4/100		

Table 2: Incidence of PSI in relation to the clinical diagnosis of the gallbladder pre-operatively

Condition	Infected/Total	Percentage (%)	P Value
Chronic cholecystitis	1/20	5	0.01
acute cholecystitis	1/30	3.3	0.01
Acute appendicitis	1/22	4.2	0.01
Chronic appendicitis	1/28	3.5	0.01

Concerning spillage of bile, stones, or pus, 9/30 patients (30%) developed infection while spillage occurred during their operations and 2/70 patients (2.8%) developed infection despite no spillage occurred. P value was 0.0001 i.e., the spillage can be regarded as a risk factor in the development of PSI (Table 3).

Table 3: Incidence of PSI in relation to spillage of bile, stones, or pus during operation

PSI	Infected/total	Percentage (%)	P value
With spillage	9/30	30	0.0001
Without spillage	2/70	2.8	0.0001
Total	11/100		

According to the site of port infection, 2 patients (50 %) developed an infection at the epigastric port, 1 patient (25%) developed an infection at the umbilical port and only 1 patient (25%) developed an infection at the lateral ports. P value was 0.0001, which is highly significant and site of gallbladder appendix extraction could be a cause of PSI (Table 4).

Table 4: Incidence of PSI in different port sites

Port site	No.	Percentage (%)	P value
Umbilical port	2	50	0.0001
Epigastric por	1	25	0.0001
Lateral port	1	25	0.0001
Total	4		

Regarding the type of port site infection, 3/4 patients (75%) developed a superficial infection and 1/4 patient (25%) developed deep site infection as in Table 5.

Table 5: Types of PSI

PSI	Number	Percentage (%)
Superficial infection	3	75
Deep site infection	1	25
Total	4	

About results of swabs culture and PCR of tissue samples, 2 patients (50%) were infected by Gram –ve bacteria, 1 patients (25%) were infected by Gram +ve bacteria, 1 patients (25%) were infected by mycobacterium species, Table 6.

Table 6: Type of microorganism associated with post laparoscopic cholecystectomy and appendectomy

Type of Infection	Microorganism	Microorganism	No. of cases
Non-specific infection 34	Gram -ve 2 (50%) Gram +ve 1 (25%)	*Enterobacter spp* *E. coli* *Staphylococcus auras spp*	3
Specific infection *(Mycobacterium tuberculosis*	Atypical 1 (25%) Typical		1

4. Discussion

The rate of PSI after laparoscopic cholecystectomy is lower than that of open cholecystectomy because laparoscopic procedures are minimally invasive technique and have less impact on the immune system than an open one. The incidence of port site infection in our sample is about 4% (4 patients from 100) which was lower than results of study done by Khurshid, et al. in Indian hospital of Kashmir in 2012, their results was 6.7% and higher than results of study done by Jasim Saud, et al. which performed in AL Basrah general hospital 2010, their result was lower than our (2.4%) [9]. The differences among the three studies may be due to differences in environment, population and sterilization technique which could be different from hospital to another and there may be rapid turnover on the expense of adequate sterilization. In our study, we found the majority of patients underwent laparoscopic cholecystectomy were females (85 patients 85%) from 100, also most of our port site infection patients were females 3 patients from 4 patients. If we compare with another study that was done in Al-Basrah hospital which included 369 patients, 301 (81.57%) of them were females and 68 (18.43%) were males and PSI occur in 11 patients (2.98%), 7 females (63.63%) and 4 males (36.36%). In both studies, although number of female is higher than males but after statistical analysis we found the p-value of male gender is significant (0.03) i.e. associated with higher incidence PSI. Also, perforation of gallbladder during operation more in males than in females [10]. The explanation of this is not so clear but we can say that male gender tolerates more pain than female (by questioner). From a total number of 100 patients, we found 20 patients had chronic cholecystitis before operation and 30 were operated during the acute phase, Acute appendicitis 22, chronic appendicitis 28. 1/20 patients (5%) were operated during the chronic phase of cholecystitis and developed PSI and 1/30 patients (3.3%) were operated during acute inflammation and got infected. In comparing with other study done in DHQ (Divisional Headquarters Teaching Hospital) Mirpur-Kashmir show 7.1% PSI in their sample, 65% of cases were during the acute phase and 35% were in chronic cases. Both studies show the significance of acute phase with PSI. This is due to increased probability of perforation of gallbladder and spillage of bile, stones, or pus as a result of difficult manipulation, tensely distended gallbladder with thickened oedematous wall. As long as the inflammation is limited to gallbladder, laparoscopic cholecystectomy is usually feasible. However, the inflammation extends to the porta-hepatis, great care must be taken in proceeding with operations, as normally thin minimally adhesive tissue that invest cystic duct and artery is markedly thickened and oedematous and may not readily separated by usual blind dissection. Laparoscopic cholecystectomy is associated with spillage of gallstones in 5% to 40% of procedures and perforation of gallbladder during surgery occur frequently at a rate of 10% to 40% and may occur secondary to traction applied by grasping forceps or because of electro-surgical thermal injury during removal of the gallbladder from its bed. Escaped stones composed primarily of cholesterol that pose little threat of infection, however, pigment stones frequently harbour viable bacteria and may potentially lead to subsequent infections if allowed to remain in the peritoneal cavity. In our study spillage occur in 30 operations which represent 30% from the total sample (100). 9 patients with spillage presented with port site infection (30%) and only 2 patients (2.8%) develop PSI from 70 cases without spillage. Spillage of bile, pus or stones which can be retained inside the abdomen or in the wound is highly associated with port site infection and abscess formation, which was statistically significant (p=0.0001). Foreign body retained could be stones, clips, or parts of plastic sheath. Another study done in Taj surgery hospital in Pakistan for three years 2009-2012 show relation between port site infection and intraoperative spillage during laparoscopic cholecystectomy in 5.3% of perforated cases. In our study, the percentage was higher maybe due to lack of usage of retrieval bag which prevent direct contact of port wound with the content of infected gallbladder and appendicitis. Port site infection was noticed in 1 patient (25%) in epigastric port and 2 patients (50%) in umbilical port and one patients (25%) at the lateral port (p=0.0001), which is statistically significant for the association between umbilical port and SSI. This may be due to the fact that the umbilical port is the site of gallbladder extraction therefore this port will be in direct contact with inflamed gallbladder and appendix. Study was done in governmental medical college in India which also shows high association between umbilical port and infection (88.2%) and in another study, shows surgical site infection in umbilical port more than epigastric port and this related to umbilical flora and gall bladder extraction through umbilicus in single port surgery which indicates that site of gall bladder and appendix extraction was the most common site of PSI. Most of the patients presented with PSI in our study were superficial infection 3/4 patients (75%) compared with 1/4 patients (25%) presented with deep site infection. Also, superficial infection is more common than deep infection as reported by study done by Mir, et al. at tertiary care hospital of Kashmir 2012 (87.7% for superficial infection compared with 13.3% for deep infection). one patient (25%) who presented with deep infection in our study as recurrent discharging single or multiple sinuses. one of these were infected with atypical mycobacterium species, By taking detailed history, one of the patient infected with mycobacterium species has close relative (her husband who was changing her dressing) working in hospital of infectious disease. There is another explanation for the source of mycobacterium is the use of tap water for rinsing laparoscopic instruments after complete sterilization to rinse glutaraldehyde may re-introduce mycobacterium, to the instrument and then to the wound.

Also sharing of laparoscopic instruments with other department like urology has observed as another source of infection sometimes. The instruments itself covered by plastic insulation and presence of joints make its sterilization insufficient. Also, the rapid turnover between operations is at the expense of optimum sterilization time. In advanced centres, the golden standard is to use a disposable laparoscopic instrument, use of advanced sterilization methods such as (STERRAD) "which is a trademark for low-temperature sterilization system, using gas plasma technology, quick, safe and efficient elimination of toxic residue from devices" or use ethylene oxide. Another technique is to keep instruments 24 hours in formalin gas chamber.

5. Conclusion

There is a significant association of PSI with spillage of bile, stones, or pus, with the port of gallbladder and appendix extraction and with acute cholecystitis acute appendicitis. Special consideration should be taken in chronic deep surgical site infection as mycobacterium tuberculosis could be the cause. Most of the PSIs are superficial and more common in males.

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