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Laparoscopic Port Site Infection: A Review of Its Management of 100 Cases Studies

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Abstract | **Original Research Article**

Introduction: The advent of laparoscopic surgery has transformed the landscape of surgical interventions, providing patients with the benefits of reduced trauma, shorter recovery times, and improved cosmetic outcomes. As this minimally invasive approach continues to gain popularity across various surgical disciplines, it is essential to address the associated challenges and complications that may arise. ***Aim of the Study:*** The aim of this study was to analyze the microbial distribution and antibiotic sensitivity patterns in laparoscopic port site infections. ***Methods:*** A prospective observational study was conducted on a cohort of 100 patients who underwent laparoscopic procedures at MH Samorita Medical College & Hospital, Hi Tech Surgicare Hospital & piles Centre, Savar Specialized Hospital, Lab Zone Hospital Savar, Dhaka, Bangladesh from Jan 2016 to Dec 2023. The study focused on identifying cases with culture-positive laparoscopic port site infections. ***Result:*** The Laparoscopic cholecystectomy being analyzed by Cholelithiasis, Acute cholecystitis, Ch. Cal. Cholecystitis, Empyema GB, and GB polyp. For Cholelithiasis, 33.3% of males and 40.5% of females had this condition. Regarding Acute cholecystitis, it was found in 20.0% of males and 16.7% of females. Majority 36.7% were 40 – 50 years in age group for male and 30.9% were in 40 – 50 years in age group for female respectively. Out of the total 100 patients in the study, 71% patients tested positive for port site infection. ***Conclusion:*** In conclusion, the insights gained from our study provide a foundation for advancing the management of laparoscopic port site infections.

Keywords: Laparoscopic surgery, Port site infections, Microbial dynamics, Antibiotic sensitivity, Staphylococcus aureus.

INTRODUCTION

The advent of laparoscopic surgery has transformed the landscape of surgical interventions, providing patients with the benefits of reduced trauma, shorter recovery times, and improved cosmetic outcomes [1]. As this minimally invasive approach continues to gain popularity across various surgical disciplines, it is essential to address the associated challenges and complications that may arise [2,3]. Among these challenges, laparoscopic port site infections (PSIs) stand out as a pertinent concern, impacting postoperative morbidity and necessitating a thorough understanding for effective prevention and management [4]. Laparoscopic surgery, also known as minimally invasive surgery, marked a paradigm shift in the field of surgical practice [5]. The technique, introduced in the late 20th century, involves the use of small incisions through which a camera and specialized instruments are inserted, enabling surgeons to perform intricate procedures with enhanced precision [6]. This departure from traditional open surgery promised benefits such as reduced blood loss, shorter hospital stays, and quicker recovery, making it an appealing option for both surgeons and patients. While laparoscopic surgery has indeed revolutionized the approach to numerous medical conditions, it is not devoid of complications [7,8]. These infections occur at the entry points of trocars or cannulas used during laparoscopic procedures [9]. Despite the overall low incidence compared to the benefits of laparoscopy, port site infections can lead to considerable patient discomfort, prolonged recovery times, and, in severe cases, may result in systemic complications [10]. Understanding the epidemiology of laparoscopic port site infections is crucial for developing targeted preventive strategies [11]. Such demographic considerations can offer valuable insights into the predisposing factors and aid in tailoring preventive measures [12]. Laparoscopic port site infections are polymicrobial in nature, involving a spectrum of microorganisms. Common culprits include Staphylococcus aureus, Pseudomonas aeruginosa, and Enterococcus faecalis. The microbial landscape may vary based on the type of surgery, patient factors, and geographical location [13]. Identifying the risk factors associated with laparoscopic port site infections is essential for risk stratification and targeted preventive interventions [14]. Factors such as obesity, diabetes, and immunosuppression may contribute to an increased susceptibility to infections [11]. Furthermore, variations in the surgical technique, including the number of port sites and the duration of surgery, can influence the likelihood of infection [15]. Accurate and timely diagnosis of laparoscopic port site infections is pivotal for effective management [16]. Diagnosis poses challenges due to the variable clinical presentation and the potential overlap with other postoperative complications [17]. Recent advances in imaging modalities, including ultrasonography and computed tomography, have enhanced the diagnostic precision, allowing clinicians to delineate the extent of infection and guide appropriate therapeutic interventions [18]. The management of laparoscopic port site infections encompasses a multifaceted approach involving antimicrobial therapy, wound care, and, in some cases, surgical interventions [19, 20]. Early recognition of infections and prompt initiation of targeted antibiotic therapy based on culture and sensitivity results are paramount [21]. Meticulous wound care, including dressing changes and local wound care, plays a pivotal role in preventing the progression of superficial infections [21]. Understanding the antibiotic sensitivity patterns of the microorganisms implicated in laparoscopic port site infections is crucial for optimizing therapeutic outcomes [22]. Staphylococcus aureus, a frequent offender, may exhibit varying sensitivity to antibiotics such as cephalosporins, penicillins, and quinolones. Similarly, Pseudomonas aeruginosa and Enterococcus faecalis may present distinct sensitivity patterns, guiding clinicians in the selection of appropriate antibiotic regimens [23].

Objective

The general objective is to analyze the microbial distribution and antibiotic sensitivity patterns in laparoscopic port site infections.

Material and Method

A prospective observational study was conducted on a cohort of 100 patients who underwent laparoscopic procedures at MH Samorita Medical College & Hospital, Hi Tech Surgicare Hospital & piles Centre, Savar Specialized Hospital, Lab Zone Hospital Savar, Dhaka, Bangladesh from Jan 2016 to Dec 2023. The study focused on identifying cases with culture-positive laparoscopic port site infections.

Inclusion Criteria

- Underwent laparoscopic procedures during the specified time frame.
- Diagnosed with laparoscopic port site infections based on clinical and microbiological evidence.

Exclusion Criteria

- Cases with incomplete or insufficient medical records, hindering the ability to assess relevant demographic and clinical information.
- Patients who underwent open surgical procedures instead of laparoscopic surgery during the specified time frame.
- Cases with incomplete or insufficient medical records, hindering the ability to assess relevant demographic and clinical information.

Ethical Considerations

This study was conducted in compliance with ethical guidelines, and approval was obtained from the Institutional Review Board (IRB) of MH Samorita Hospital & Medical College, Dhaka, Bangladesh.

Statistical Analysis of Data

After collection of data, all data were compiled in a master table first. Data was processed and analyzed using SPSS (13) for windows software. Qualitative data presented on categorical scale was expressed as frequency and corresponding percentage. Quantitative data was presented as mean and standard deviation (SD). P value was measured by paired t test (one tailed) and less than 0.05 is taken as significant.

Result

Table 1: Laparoscopic cholecystectomy of our study patients

Variable	Male (n=30)	Female (n=42)	p Value
Cholelithiasis	10 (33.3%)	17 (40.5%)	0.519
Acute Cholecystitis	6 (20.0%)	7 (16.7%)	0.721

Ch. Cal. Cholecystitis	11 (36.7%)	12 (28.6%)	0.471
Empyema GB	2 (6.7%)	4 (9.5%)	0.673
GB polyp	1 (3.3%)	2 (4.8%)	0.755

Table 1 displays the frequency and percentage of laparoscopic cholecystectomy in a sample of males and females. The variables being analyzed are Cholelithiasis, Acute cholecystitis, Ch. Cal. Cholecystitis, Empyema GB, and GB polyp. For Cholelithiasis, 33.3% of males and 40.5% of females had this condition. The p-value for this difference is 0.519, indicating that it is not statistically significant. Regarding Acute cholecystitis, it was found in 20.0% of males and 16.7% of females. The p-value of 0.721 suggests that there is no significant difference between the two groups. For Ch. Cal. Cholecystitis, 36.7% of males and 28.6% of females had this condition. The p-value of 0.471 indicates that there is no significant difference between the two groups. Empyema GB was observed in 6.7% of males and 9.5% of females. The p-value of 0.673 suggests that the difference is not statistically significant. Finally, for GB polyp, 3.3% of males and 4.8% of females had this condition. The p-value of 0.755 indicates that the difference is not statistically significant. Majority 36.7% were 40 – 50 years in age group for male and 30.9% were in 40 – 50 years in age group for female respectively. In summary, based on the p-values for all variables, there is no statistically significant difference in the prevalence of these conditions between males and females.

Table 2: Laparoscopic appendectomy of our study patients

Variable	Male (n=13)	Female (n=09)	p Value
Acute Appendicitis	10 (76.9%)	8 (88.9%)	0.483
Ree. Appendicitis	3 (23.1%)	1 (11.1%)	

Table 2 presents the data on laparoscopic appendectomy of the study patients, categorized by gender. The variables include acute appendicitis and recurrent appendicitis. For acute appendicitis, out of the male patients 10 (76.9%) had acute appendicitis, while out of the female patients 8 (88.9%) had acute appendicitis. The p-value for this comparison is 0.483, indicating no statistically significant difference between males and females with regard to acute appendicitis. For recurrent appendicitis, out of the male patients 3 (23.1%) had recurrent appendicitis, whereas out of the female patients only 1 (11.1%) had recurrent appendicitis. Similar to acute appendicitis, the p-value for this comparison is 0.483, suggesting no statistically significant difference between males and females in terms of recurrent appendicitis. In summary, based on the given data in Table 2, there are no significant gender differences observed in the occurrence of either acute or recurrent appendicitis among the study patients who underwent laparoscopic appendectomy.

Table 3: Laparoscopic hernia of our study patients

Variable	Male	Female
Laparoscopic umbilical hernia mesh repair	1 (100%)	2 (100%)
Laparoscopic incisional hernia	0	2 (100%)
Diagnostic laparoscopy	0	1 (100%)

From Table 3, we analyzed the laparoscopic hernia procedures performed on the study patients. For Laparoscopic umbilical hernia mesh repair, one male patient underwent this procedure, accounting for 100% of the male patients. Additionally, two female patients underwent the same procedure, making up 100% of the female patients. Regarding Laparoscopic incisional hernia, no male patients had this procedure, while two female patients (100%) received it. Finally, no male patients underwent diagnostic laparoscopy, but one female patient (100%) had this procedure.

Table 4: Port site infection (culture) of our study patients (n = 100)

Culture	n	%
Positive	71	71
Negative	29	29

Based on table 4, we have analyzed the port site infections of our study patients. Out of the total 100 patients in the study, 71% patients tested positive for port site infection. On the other hand, 29% patients tested negative for port site infection. This information suggests that a significant majority of the study patients had a positive culture for port site infection.

Table 5: Port site infection (culture positive) of our study patients (n = 100)

Variable	n	%
Staphylococcus aureus	37	37
Pseudomonas aeruginosa	21	21
Klebsiella pneumoniae spp	3	3
Proteus spp	3	3
E. Coli	4	4
Enterococcus faecalis	2	2

Bacteroid	1	1

From the table 5, we analyzed the port site infection (culture positive) data of the study patients. The table presents the number and percentage of infections caused by different bacteria. A total of 100 patients were included in the study. Among them, Staphylococcus aureus was identified as the cause of infection in 37 patients, constituting 37% of the total infections. Pseudomonas aeruginosa was responsible for infections in 21 patients, which accounts for 21% of the infections. Klebsiella pneumoniae spp, on the other hand, caused infection in only 3 patients, representing 3% of the total infections. This table provides an overview of the prevalence of different bacterial pathogens causing port site infections among the study patients.

Table 6: Biopsy of our study patients (n = 100)

Variable	n	%
Non specific	87	87
M. TB	7	7
Atypical mycobacteria	6	6

According to the table 6, out of the 100 study patients, the following biopsy results were observed. Non-specific biopsies were found in 87 patients, accounting for 87% of the cases. Mycobacterium tuberculosis (M. TB) was detected in 7 patients, making up 7% of the cases. Atypical mycobacteria were identified in 6 patients, constituting 6% of the cases. This table highlights the distribution of biopsy findings among the study patients, indicating the prevalence of non-specific results, M. TB, and atypical mycobacteria.

Table 7: Antibiotic Sensitivity of our study patients (n = 100)

Antibiotic	n	%
Macrobid	26	26
Quinolones	29	29
Amino glycoside	14	14
Anti TB	31	31

In this table, we have the results of the antibiotic sensitivity testing for a study population of 100 patients. The table displays the number (n) and percentage (%) of patients who showed sensitivity to each antibiotic. Out of the 100 patients, 26 (26%) showed sensitivity to Macrobid. 29 patients (29%) were sensitive to Quinolones. 14 patients (14%) showed sensitivity to Amino glycoside. 31 patients (31%) had sensitivity to Anti TB antibiotics. These figures indicate the percentage of patients in the study population who responded positively to each specific antibiotic.

DISCUSSION

The findings of our prospective analysis shed light on the microbial landscape and antibiotic sensitivity patterns in laparoscopic port site infections, contributing to a deeper understanding of the complexities surrounding these infections. In this discussion, we delve into the key insights derived from our study, implications for clinical practice, and avenues for future research.

The microbial distribution revealed in our study underscores the polymicrobial nature of laparoscopic port site infections. Staphylococcus aureus emerged as the most prevalent pathogen, constituting 71% of the culture-positive cases. This dominance aligns with existing literature highlighting Staphylococcus aureus as a common culprit in postoperative infections, emphasizing the need for vigilant preventive measures, particularly in procedures prone to skin contamination [24]. Pseudomonas aeruginosa, identified in 21% of cases, adds another layer of concern. Known for its resistance mechanisms and potential to cause severe infections, the prevalence of Pseudomonas aeruginosa warrants attention in the context of laparoscopic surgeries [25]. The presence of Enterococcus faecalis, Proteus spp, and Klebsiella pneumoniae spp further enriches the microbial landscape, requiring a multifaceted approach to treatment. The identification of Bacteroid, though in a single case (1%), raises questions about its potential role in laparoscopic port site infections. Further research is needed to elucidate the significance of Bacteroid in the context of surgical site infections and whether this represents a sporadic finding or a potential emerging concern.

Our analysis of antibiotic sensitivity patterns provides crucial insights for optimizing treatment strategies in laparoscopic port site infections. The frequent use of Macrobid (26%) suggests its efficacy in managing the identified microorganisms. Macrobid, a nitrofuran antibiotic, is commonly employed for urinary tract infections, pointing to a potential urogenital source of infection or its broad-spectrum utility against gram-positive bacteria [26]. Quinolones, utilized in 29% of cases, emerge as a cornerstone in empirical treatment. Their broad-spectrum coverage against both gram-negative and some gram-positive bacteria aligns with their common use in postoperative infections [27]. However, the increasing concern of resistance to quinolones necessitates ongoing surveillance and judicious use to prevent the emergence of resistant strains [28].

Aminoglycosides, prescribed in 14% of cases, are reserved for situations requiring potent antibacterial action. Their use suggests a consideration for severe or resistant infections, although the potential nephrotoxicity and ototoxicity associated with aminoglycosides warrant careful monitoring [29]. Understanding the microbial dynamics and antibiotic sensitivity patterns has direct implications for evidence-based clinical practices. The prevalence of specific pathogens allows clinicians to tailor prophylactic measures, such as targeted antibiotic prophylaxis, and informs postoperative management strategies. The dominance of Staphylococcus aureus, for instance, may prompt reconsideration of preoperative decolonization protocols to reduce the risk of infection [30].

LIMITATION AND RECOMMENDATION

Some medical records may have lacked detailed information, potentially impacting the completeness and accuracy of certain variables. Efforts were made to mitigate this limitation, but data completeness remains subject to the quality of record-keeping. The study focused on data from a single institution, potentially limiting the generalizability of findings to broader patient populations. Multicenter studies are recommended to validate the observed patterns across diverse healthcare settings. The study relied on recorded antibiotic prescriptions, and the absence of data on actual patient response to treatment limits a comprehensive assessment of antibiotic effectiveness. Future research should include treatment outcomes to better evaluate the clinical impact of antibiotic choices. Conducting prospective multicenter studies would provide a more robust understanding of laparoscopic port site infections, allowing for the validation of findings across diverse patient populations and healthcare settings. Future research should prioritize comprehensive data collection, ensuring detailed information on patient demographics, surgical procedures, and postoperative outcomes. This includes incorporating standardized reporting mechanisms to minimize incomplete data.

CONCLUSION

In conclusion, the insights gained from our study provide a foundation for advancing the management of laparoscopic port site infections. By translating these findings into evidence-based practices, we aim to enhance patient outcomes, reduce the incidence of infections, and contribute to the ongoing evolution of best practices in laparoscopic surgery. As we navigate the dynamic landscape of surgical site infections, this study serves as a catalyst for continued inquiry and innovation in the pursuit of optimal patient care.

REFERENCES

1. Fischer, C. P., Castaneda, A., & Moore, F. (2002, March). Laparoscopic appendectomy: indications and controversies. In *Seminars in Laparoscopic Surgery* (Vol. 9, No. 1, pp. 32-39). Sage CA: Thousand Oaks, CA: Sage Publications.
2. Brockmann, J. G., Kocher, T., Senninger, N. J., & Schürmann, G. M. (2002). Complications due to gallstones lost during laparoscopic cholecystectomy. *Surgical Endoscopy and Other Interventional Techniques*, *16*, 1226-1232.
3. Den Hoed, P. T., Boelhouwer, R. U., Veen, H. F., Hop, W. C. J., & Bruining, H. A. (1998). Infections and bacteriological data after laparoscopic and open gallbladder surgery. *journal of Hospital Infection*, *39*(1), 27-37.
4. Azurin, D. J., Go, L. S., Arroyo, L. R., & Kirkland, M. L. (1995). Trocar site herniation following laparoscopic cholecystectomy and the significance of an incidental preexisting umbilical hernia. *The American Surgeon*, *61*(8), 718-720.
5. Montz, F. J., Holschneider, C. H., & Munro, M. G. (1994). Incisional hernia following laparoscopy: a survey of the American Association of Gynecologic Laparoscopists. *OBSTETRICS AND GYNECOLOGY-NEW YORK-*, *84*, 881-881.
6. Jansen, F. W., Kapiteyn, K., Trimbos-Kemper, T., Hermans, J., & Trimbos, J. B. (1997). Complications of laparoscopy: a prospective multicentre observational study. *BJOG: An International Journal of Obstetrics & Gynaecology*, *104*(5), 595-600.
7. Kadar, N., Reich, H., Liu, C. Y., Manko, G. F., & Gimpelson, R. (1993). Incisional hernias after major laparoscopic gynecologic procedures. *American journal of obstetrics and gynecology*, *168*(5), 1493-1495.
8. Mettler, & Semm. (1999). Optical trocar systems: laparoscopic entry and its complications (a study of cases in Germany). *Gynaecological Endoscopy*, *8*(6), 383-389.
9. Wexner, S. D., & Cohen, S. M. (1995). Port site metastases after laparoscopic colorectal surgery for cure of malignancy. *British journal of surgery*, *82*(3), 295-298.
10. Cirocco, W. C., Schwartzman, A., & Golub, R. W. (1994). Abdominal wall recurrence after laparoscopic colectomy for colon cancer. *Surgery*, *116*(5), 842-846.
11. Shindholimath, V. V., Seenu, V., Parshad, R., Chaudhry, R., & Kumar, A. (2003). Factors influencing wound infection following laparoscopic cholecystectomy. *Tropical gastroenterology: official journal of the Digestive Diseases Foundation*, *24*(2), 90-92.
12. Basse, L., Jakobsen, D. H., Bardram, L., Billesbølle, P., Lund, C., Mogensen, T., ... & Kehlet, H. (2005). Functional recovery after open versus laparoscopic colonic resection: a randomized, blinded study. *Annals of surgery*, *241*(3), 416.
13. MacKay, G., Ihedioha, U., McConnachie, A., Serpell, M., Molloy, R. G., & O'Dwyer, P. J. (2007). Laparoscopic colonic resection in fast-track patients does not enhance short-term recovery after elective surgery. *Colorectal Disease*, *9*(4), 368-372.
14. Vlug, M. S., Wind, J., Zaag, E. V. D., Ubbink, D. T., Cense, H. A., & Bemelman, W. A. (2009).

Systematic review of laparoscopic vs open colonic surgery within an enhanced recovery programme. *Colorectal Disease*, *11*(4), 335-343.
15. Liu, T., Li, L., Korantzopoulos, P., Goudevenos, J. A., & Li, G. (2008). Meta-analysis of association between C-reactive protein and immediate success of electrical cardioversion in persistent atrial fibrillation. *The American journal of cardiology*, *101*(12), 1749-1752.
16. Wang, G., Jiang, Z., Zhao, K., Li, G., Liu, F., Pan, H., & Li, J. (2012). Immunologic response after laparoscopic colon cancer operation within an enhanced recovery program. *Journal of gastrointestinal surgery*, *16*, 1379-1388.
17. Xie, Z.Y., Cheng, L.Y., Zhang, Y.X., Kang, H.X. & Chen, J.Y. (2012). A prospective randomized controlled comparing laparoscopic and open surgery for colorectal cancer guided by fast-track surgery. *The Journal of Practical Medicine*. 28(1):18-20.
18. Lacy, A. M., García-Valdecasas, J. C., Delgado, S., Castells, A., Taurá, P., Piqué, J. M., & Visa, J. (2002). Laparoscopy-assisted colectomy versus open colectomy for treatment of non-metastatic colon cancer: a randomised trial. *The Lancet*, *359*(9325), 2224-2229.
19. Polle, S. W., Wind, J., Fuhring, J. W., Hofland, J., Gouma, D. J., & Bemelman, W. A. (2008). Implementation of a fast-track perioperative care program: what are the difficulties?. *Digestive surgery*, *24*(6), 441-449.
20. Bardram, L., Funch-Jensen, P., & Kehlet, H. (2000). Rapid rehabilitation in elderly patients after laparoscopic colonic resection. *British journal of surgery*, *87*(11), 1540-1545.
21. Schwenk, W., Haase, O., Neudecker, J. J., & Müller, J. M. (2005). Short term benefits for laparoscopic colorectal resection. *Cochrane database of systematic reviews*, (2).
22. Sekhon, V., Menon, P., Arora, S., & Rao, K. L. N. (2013). Nephrectomy in children: Comparison of stress response to laparoscopic and open methods. *Journal of Indian Association of Pediatric Surgeons*, *18*(2), 53.
23. Raj, P. K., Katris, K., Linderman, C. G., & ReMine, S. G. (1998). An inexpensive laparoscopic specimen retrieval bag. *Surgical endoscopy*, *12*, 83-83.
24. Mangram, A. J., Horan, T. C., Pearson, M. L., Silver, L. C., Jarvis, W. R., & Hospital Infection Control Practices Advisory Committee. (1999). Guideline for prevention of surgical site infection, 1999. *Infection Control & Hospital Epidemiology*, *20*(4), 247-280.
25. Lister, P. D., Wolter, D. J., & Hanson, N. D. (2009). Antibacterial-resistant Pseudomonas aeruginosa: clinical impact and complex regulation of chromosomally encoded resistance mechanisms. *Clinical microbiology reviews*, *22*(4), 582-610.
26. Gupta, K., Hooton, T. M., Naber, K. G., Wullt, B., Colgan, R., Miller, L. G., ... & Soper, D. E. (2011). International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women: a 2010 update by the Infectious Diseases Society of America and the European Society for Microbiology and Infectious Diseases. *Clinical infectious diseases*, *52*(5), e103-e120.
27. Dalhoff, A. (2012). Global fluoroquinolone resistance epidemiology and implictions for clinical use. *Interdisciplinary perspectives on infectious diseases*, *2012*.
28. Neuhauser, M. M., Weinstein, R. A., Rydman, R., Danziger, L. H., Karam, G., & Quinn, J. P. (2003). Antibiotic resistance among gram-negative bacilli in US intensive care units: implications for fluoroquinolone use. *Jama*, *289*(7), 885-888.
29. The Use of Systemic Fluoroquinolones. (2016). American Thoracic Society. Official Statement of the American Thoracic Society.
30. Leong, G., Wilson, J., Charlett, A., & Pearson, A. (2004). Surveillance of Hospital-Acquired Infections in the United Kingdom and Ireland. Journal of Hospital Infection, 56(3), 196–203.