Research Article

Bacteriological Profile of Patients Suffering from Acute Versus Chronic Port Site Infection at a Tertiary Care Hospital

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Abstract

Background: Surgical (port) site infections can complicate the course of recovery in a surgical patient. It is important to know the spectrum of organisms and their antibiotic sensitivity pattern for targeted treatment of SSI.

Objective: To determine bacteriological profile of patients suffering from acute and chronic surgical (port) site infection (SSI).

Methods: This descriptive cross-sectional study was held at CMH, Rawalpindi from May-Dec 2022 which included the patients who had elective laparoscopic surgery and eventually developed acute or chronic surgical-site infection. Bacteriologic profile of both acute and chronic surgical-site infections was assessed along with their sensitivity to various commonly used antibiotics. Data was analyzed by statistical package for social sciences 21.

Results: A total of 526 patients had elective laparoscopic surgical procedures during study period amongst which 60 patients (11.40%) developed SSI which were included in the study. Amongst these 60 patients, 39 (65.00%) were male and 21 (35.00%) were females with a mean age of 34.31 ± 8.93years. Acute SSI occurred in 38 (63.30%) while 22 (36.70%) were found to have chronic SSI. In cases of acute SSI, Staphylococcus aureus while in chronic SSI cases, Mycobacterium fortuitum was common. Pseudomonas aeruginosa was found in both types of SSI.

Conclusion: Overall frequency of SSI was 11.40%. In acute SSI, Staphylococcus aureus was the main culprit while in chronic SSI, Mycobacterium fortuitum was found to be the major pathogen.

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Introduction

Surgical procedures have been undergoing a continuous process of evolution and advancements, and it is critical that this innovation continues to proceed.[1] Open surgical approach with high degree of exploration have been shifted from open to laparoscopic approach with time and this continuous progress is highly dictated by the skills of the operating surgeon.[2] Biggest advantage that is offered by laparoscopy lies in its very basic principle that is its nature of being "minimally invasive". During laparoscopic surgeries, small incisions are made

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in order to gain access into the desired body cavity, "pneumoperitoneum is created first followed by insertion of ports and telescope (for visualization).[3]

Although laparoscopic surgeries have far less rate of complications as compared to the exploratory open procedures, yet, there are certain complications associated with it one of which is "surgical-site infection" which is an infection at the incision site from where laparoscopic ports are inserted.[4] It can be acute that occurs soon after surgery and chronic or delayed which occurs after four weeks or more after surgery.[4] It is a fact that not a single type of incision is free from the risk of getting infection but it has been observed that the infection rate of surgical site from where port is inserted is not that high which may be due to smaller extent of the incised area used for the laparoscopic procedures.[5] Frequency of surgical site infection has been observed to be variable in the population and is found to be associated with type of surgery performed and the technique of entry and exit.[6]

Surgical site infections, like other surgical wound infections can be caused by a wide variety of organisms including gram positive organisms (like Staphylococcus aureus, Enterococcus spp.) and gram negative organisms (like Enterobacter spp., Escherichia coli), mainly in acute settings.[7] Additionally, mycobacteria, especially atypical mycobacteria have also been found associated with chronic surgical-site infections that occur beyond one month of the surgery.[8] There are several factors that have been found associated with occurrence of surgical-site infection after laparoscopic surgery. These factors include age of the patient, gender, duration for which patient has the condition for which laparoscopic surgery is indicated, total operating time and use of protective maneuvers (like use of retrieval bag).[9] Another important factor that influences the frequency of surgical site infection after laparoscopic surgery (especially laparoscopic cholecystectomy) is the retrieval route (through epigastric port or umbilical port) of the operated diseased organ.[1]

Knowing the bacteriological profile of the patients suffering from either acute surgical-site infection or chronic surgical-site infection is essential because microbial pattern and subsequent antimicrobial sensitivity continues to evolve and at times varies between different locations and healthcare setups. Therefore, this study was conducted to find out bacteriological profile of the patients suffering from acute or chronic surgical-site infection.

Methods

This descriptive cross-sectional study was conducted at "Combined Military Hospital (CMH), Rawalpindi" from May 2022 to December 2022 after obtaining approval from the ethical committee of the "Combined Military Hospital (CMH), Rawalpindi". Sample size of 60 was calculated using WHO sample size calculator by assuming confidence level of 95%, absolute precision of 10% and anticipated frequency of surgical site infection of 19.1% 11, using formula 12:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

All the patients who underwent elective laparoscopic surgery under general anesthesia who had either male or female gender having the age ranging from 20 to 65 years who developed acute or chronic surgical-site infection were included in the study. Surgical-site infection was labelled as "acute" if it occurred within first four weeks of surgery while it was labeled "chronic" if it was reported after four weeks of surgery[13]. Laparoscopic surgeries that were included in this study were elective laparoscopic cholecystectomy, elective laparoscopic hernia repair and elective laparoscopic appendectomy (in patients who had failed the initial conservative management, those who had chronic complaint of right iliac fossa pain and those who had appendicial carcinoid).

All the patients who were not fit enough to receive general anesthesia, who had co-morbidities like diabetes, asthma, hypertension and smoking, patients who had history of illicit drug abuse, patients who had immunodeficiency syndromes/conditions, patients with thyroid disease and patients in which laparoscopic procedure was converted to open procedure were excluded from the study.

All the patients, before their inclusion in the study, signed a written informed consent. After inclusion, baseline demographics of the included patients were documented including age (in years), gender (male/female), type of surgical-site infection (acute/chronic), type of surgery (elective laparoscopic cholecystectomy,

elective laparoscopic hernia repair and elective laparoscopic appendectomy), number of ports (single or multiple) infected and type of port (supra-umbilical, lateral, sub-xyphoid and medial) infected. Surgical-site infection was defined as "presence of pus or any discharge at the surgical wound site which is accompanied by pain, fever, raised white blood cell count (> 11000), swelling and erythema"[14]. Pus/discharge from the infected surgical-site was swabbed and sent for culture and sensitivity to the hospital pathology laboratory to assess the bacteriological profile and their antimicrobial sensitivity pattern. For the growth of organism agars that were used included blood agar, chocolate agar, AN1, "MacConkey" agar and "Mueller-Hinton" agar. Sensitivity of various antibiotics wasalso checked that are commonly used for these organisms.

"The statistical package for social sciences (SPSS) version 21.00 software was used forstatistical analysis of the data. Normality of test will be checked using Shapiro-Wilk test 15. For qualitative variables (gender, type of surgical-site infection, type of surgery, type of port infected, number of ports infected, bacteriologic profile, drug sensitivity), frequency and percentages were used, whereas for quantitative data (age), mean with standard deviation and median (IQR) were used. Qualitative variables were analyzed using chi-square test. Quantitative variables were analyzed using Student t-test. Significant level was set at p-value of ≤0.05".

Results

A total of 526 patients had elective laparoscopic surgical procedures during study period amongst which 60 patients (11.40%) developed surgical site infection (SSI) which were included in the study. Mean age of the included patients was 34.31 ± 8.93 years amongst which 39(65.00%) of the patients were male while remaining 21 (35.00%) of the study participants were female. In current study, patients who were found to have acute surgical-site infection (SSI) were 38 (63.30%) while 22 (36.70%) were found to have chronic surgical-site infection (Figure 1).

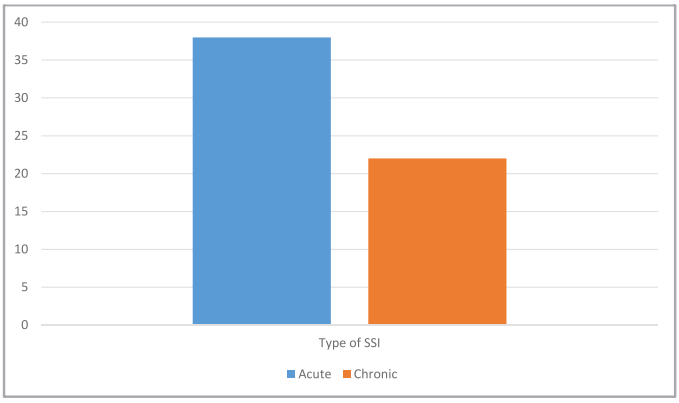

Figure 1: *Comparison of type of Surgical Site Infection (SSI); (n = 60)*

Various surgical variables were compared between patients who were found to have acute surgical-site infection and those who were found to have chronic surgical-site infection. These features include type of surgery they had, number of ports that got infected and port site that got infected (Table 1).

Overall SSI rate was 60/526 (11.40%). In terms of bacterial growth it was found that the most common organism in acute surgical-site infection cases was Staphylococcus aureus while in chronic surgical-site infection cases, Mycobacterium fortuitum was common. Pseudomonas aeruginosa was found as a common organism in both types of surgical-site infections. Bacteriologic profile of both acute surgical-site infections and chronic surgical site infections is demonstrated in detail below in Table 2.

Table 1: *Comparison of Surgical Variables between Acute and Chronic Surgical Site Infection (n = 60)*

Parameter	Acute Surgical Site Infection (n = 38)		Chronic Surgical Site Infection (n = 22)		p-value
Type of surgery	Cholecystectomy	21 (55.26%)	Cholecystectomy	11 (50.00%)	0.798
	Appendectomy	11 (28.95%)	Appendectomy	6 (27.27%)	
	Hernia Repair	6 (15.79%)	Hernia Repair	5 (22.73%)	
Number of ports	Single	21 (55.26%)	Single	16 (72.73%)	0.180
	Multiple	17 (44.74%)	Multiple	6 (27.27%)	
Port site being infected	Supra-umbilical	21 (55.26%)	Supra-umbilical	12 (54.54%)	0.245
	Sub-xyphoid	6 (15.78%)	Sub-xyphoid	7 (31.82%)	
	Latral	7 (18.42%)	Lateral	3 (13.64%)	
	Medial	4 (10.54%)	Medial	0(0.00%)	

Table 2: *Bacteriologic profile of acute and chronic SSI*

Organism	Value
Acute	**(n = 38)**
Staphylococcus aureus	13 (34.21%)
Pseudomonas aeruginosa	6 (15.79%)
Klebsiella pneumonia	5 (13.16%)
Acinetobacter baumanii	4 (10.53%)
Proteus mirabilis	4 (10.53%)
Escherichia coli	3 (7.89%)
Burkhulderia cepacia complex	3 (7.89%)
Chronic	**(n = 22)**
Mycobacterium fortuitum	9 (40.91%)
Mycobacterium abscessus	5 (22.73%)
Mycobacterium chelonae	4 (18.18%)
Pseudomonas aeruginosa	4 (18.18%)

Patients were also checked for antibiotic sensitivity patterns of all these organisms against some antibiotics that are commonly used in the research setting for the management of post-surgical patients with surgical-site infections. Sensitivity percentages of these organisms to various antibiotics is demonstrated below in Table 3.

Discussion

There are several complications that have been reported being associated with laparoscopic surgery. Surgical-site infection is one of the complication associated with laparoscopic surgery that is caused by a wide variety of organisms[16]. In present study, it was found that there was no significant difference of type of port being infected[17]. This was not consistent with the findings of a study in which this difference was statistically significant. In current study, most commonly infected port type was supra-umbilical which was in line with the findings of Ghosh et al.[18] in which similar trend was observed. In present study, frequency of single surgical port infection was much common which was different from findings of Ghosh et al.[18] in which multiple surgical port infection was common.

In current study, most common organism that was isolated in patients who had acute surgical-site infection was Staphylococcus aureus. This was similar to the observation made by Negiet al.[19] Contrary to this, Hasan et al.[20] reported that most common organism that was

Table 3: *Antibiotic Sensitivity Pattern*

	Co-amoxiclav	Piperacillin / tazobactam	Ceftriaxone	Clarithro-mycin	Moxifloxacin	Vancomycin	Meropenem	Linezolid
Organisms	**Sensitivity %**							
***Staphylococcus aureus* (n = 13)**	0 (0.00%)	6 (46.15%)	0 (0.00%)	2 (15.38%)	2 (15.38%)	8 (61.53%)	7 (53.84%)	3 (23.07%)
***Pseudomonas aeruginosa* (n = 10)**	3 (30.00%)	3 (30.00%)	0 (0.00%)	0 (0.00%)	3 (30.00%)	8 (80.00%)	8 (80.00%)	2 (20.00%)
***Klebsiella pneumonia* (n = 5)**	0 (0.00%)	2 (40.00%)	0 (0.00%)	0 (0.00%)	2 (40.00%)	2 (40.00%)	3 (60.00%)	0 (0.00%)
***Acinetobacter baumanii* (n = 4)**	0 (0.00%)	2 (50.00%)	0 (0.00%)	0 (0.00%)	2 (50.00%)	2 (50.00%)	2 (50.00%)	0 (0.00%)
***Proteus mirabilis* (n = 4)**	0 (0.00%)	3 (75.00%)	0 (0.00%)	0 (0.00%)	2 (50.00%)	1 (25.00%)	3 (75.00%)	2 (50.00%)
***Escherichia coli* (n = 3)**	1 (33.33%)	1 (33.33%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	3 (100%)	0 (0.00%)
***Burkhulderia cepacia complex* (n = 3)**	1 (33.33%)	1 (33.33%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
***Mycobacterium fortuitum* (n = 9)**	1 (11.11%)	5 (55.56%)	0 (0.00%)	2 (22.22%)	2 (22.22%)	3 (33.33%)	7 (77.78%)	2 (22.22%)
***Mycobacterium abscessus* (n = 5)**	0 (0.00%)	3 (60.00%)	0 (0.00%)	1 (20.00%)	0 (0.00%)	1 (20.00%)	3 (60.00%)	1 (20.00%)
***Mycobacterium chelonae* (n = 4)**	2 (50.00%)	4 (100%)	0 (0.00%)	1 (25.00%)	0 (0.00%)	2 (50.00%)	2 (50.00%)	2 (50.00%)

found in the wound culture of patients with surgical site infection was Acinetobacter baumannii and E. coli. Similarly, Misha et al.[21] and Abayneh et al.[22] reported that the two most common organisms that were isolated on the culture of sample obtained from wound of acute surgical site infection were Escherichia coli, Staphylococcus aureus and Pseudomonas aeruginosa. In our study, patients who had chronic surgical-site infection, we found that most common organism was an atypical mycobacterium which was Mycobacterium fortuitum. This was consistent with the findings of studies conducted by Ghosh et al.[18] Similar, trend is stated in a study conducted by Piyumal Samaranayakeet al.[23] in which they reported that atypical mycobacteria are frequently isolated in cases of chronic surgical-site infections.

One of the alarming observation that was made during present study was that there was a very lowsensitivities of various antimicrobials observed in the wound site samples on culture and sensitivity. This was especially the case for ceftriaxone, moxifloxacin, co-amoxiclav and linezolid. This shows that anti-microbial sensitivities against micro-pathogens is continuously on the decline and is going to be a major health problem in the coming future for which essential measures should be taken as soon as possible.

Conclusion

SSI can occur acutely as well as chronically. Acute and chronic surgical-site infections are caused by different anti-microbial species. It is important to keep track of the bacteriological profile for the surgical-site infection. In acute settings Staphylococcus aureus, while in chronic SSI, Mycobacterium fortuitum was the major pathogen. Determining the antimicrobial susceptibilities of these organisms can assist inusingtargeted antibiotic choice that can be highly effective for treating surgical-site infections.

Ethical Approval: The Ethical Committee / Institutional Review Board CMH Rawalpindi approved the study vide Serial No. 335.

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Authors' Contribution:

HQ: Conception and design, data drafting and revising article, final approval of the version

AZ: Data analysis and interpretation, drafting and final approval of the version

WFA: Conception, design, data analysis and interpretation, revision and final approval

MS: Data collection, analysis, interpretation, drafting and final approval

SAM: Conception, data collection and analysis and final approval

ARR: Acquisition, data analysis, drafting of data, final approval

References

1. Mulita F, Verras GI, Anagnostopoulos CN, Kotis K. A smarter health through the internet of surgical things. Sensors (Basel). 2022;22(12):4577. doi: 10.3390/ s22 124577.
2. St John A, Caturegli I, Kubicki NS, Kavic SM. The rise of minimally invasive surgery: 16 year analysis of the progressive replacement of open surgery with laparoscopy. JSLS. 2020;24(4):e2020.00076. doi: 10.4293/ JSLS.2020.00076.
3. Lansdowne JL, Mehler SJ, Bouré LP. Minimally invasive abdominal and thoracic surgery: principles and instrumentation. Compend Contin Educ Vet. 2012; 34 (5):E1.
4. Sasmal PK, Mishra TS, Rath S, Meher S, Mohapatra D. Port site infection in laparoscopic surgery: A review of its management. World J Clin Cases. 2015; 3(10): 864-871. doi: 10.12998/wjcc.v3.i10.864.
5. Kulkarni N, Arulampalam T. Laparoscopic surgery reduces the incidence of surgical site infections compared to the open approach for colorectal procedures: a meta-analysis. Tech Coloproctol. 2020; 24(10): 1017-1024. doi: 10.1007/s10151-020-02293-8.
6. Karthik S, Augustine AJ, Shibumon MM, Pai MV. Analysis of laparoscopic port site complications: A descriptive study. J Minim Access Surg. 2013;9(2):59-64. doi: 10.4103/0972-9941.110964.
7. Ranjan R, Prakash A, Kumar R. A study on port site infections after laproscopic cholecystectomy at a tertiary care centre of Bihar. Eur J Mol Clin Med. 2022; 9(3): 2912-2917.
8. Samaranayake WA, Kesson AM, Karpelowsky JS, Outhred AC, Marais BJ. Port-site infection due to non-tuberculous mycobacteria following laparoscopic surgery. Int J Mycobacteriol 2020;9(3):231-238. doi: 10.4103/ ijmy.ijmy_32_20.
9. Rehman HU, Siddiqa M, Munam AU, Khan S. Frequency of port site wound infection after gall bladder

removal with or without retrieval bag in laparoscopic cholecystectomy. J Pak Med Assoc. 2020; 70(9): 1533-1537. doi: 10.5455/JPMA.300311.

10. Hajong R, Dhal MR, Natung T, Khongwar D, Jyoti AB, Newme K. A comparative study of postoperative port-site pain after gallbladder retrieval from umbilical versus epigastric ports in laparoscopic cholecystectomy. J Family Med Prim Care. 2019;8(5):1617-1620. doi: 10.4103/jfmpc.jfmpc_172_19.
11. Legesse Laloto T, Hiko Gemeda D, Abdella SH. Incidence and predictors of surgical site infection in Ethiopia: prospective cohort. BMC Infect Dis. 2017;17(1):119. doi: 10.1186/s12879-016-2167-x.
12. Pourhoseingholi MA, Vahedi M, Rahimzadeh M. Sample size calculation in medical studies. Gastroenterol Hepatol Bed Bench. 2013;6(1):14-17.
13. Siddiqua SS, Khan MAI, Khan MAU, Sayeed S. Port site infections following laparoscopic cholecystectomy. Bangladesh J Med. 2018;29(2):51-58. doi: 10.3329/bjmed.v29i2.37938
14. Zabaglo M, Sharman T. Postoperative wound infection. In: StatPearls [Internet]. [Cited 2022 Jan 20]. Available from: https://www. ncbi. nlm.nih.gov/books/NBK-560533/
15. Mishra P, Pandey CM, Singh U, Gupta A, Sahu C, Keshri A. Descriptive statistics and normality tests for statistical data. Ann Card Anaesth. 2019;22(1):67-72. doi: 10. 4103/aca.ACA_157_18.
16. Rehman UA, Qadir MR, Hamid T, Ahmed K, Nasar AR. Early port site complication after laparoscopic cholecystectomy. Pak J Med Health Sci. 2021;15(3):524-527.
17. Al-Naser MKH. Port site infections after laparoscopic cholecystectomy. Int J Med Res Health Sci. 2017; 6(6): 132-137.
18. Ghosh R, Das S, De A, Kela H, Saha ML, Maiti PK. Port-site infections by nontuberculous mycobacterium: A retrospectiveclinico-microbiological study. Int J Mycobacteriol. 2017;6(1):34-37.doi: 10.4103/2212-5531.201901.
19. Negi V, Pal S, Juyal D, Sharma MK, Sharma N. Bacteriological profile of surgical site infections and their antibiogram: A study from resource constrained rural setting of Uttarakhand State, India. J ClinDiagn Res. 2015;9(10):DC17-20. doi: 10.7860/ JCDR/ 2015/ 15342.6698.
20. Hasan SS, Islam KMS, Jalil RA. Post-operative surgical site infection following open and laparoscopicsurgery at tertiary care hospitals in Dhaka city. Int J Med Res Prof.2021;7(4);001-05.doi: 10.21276/ ijmrp.2021. 7.4.001.
21. Misha G, Chelkeba L, Melaku T. Bacterial profile and antimicrobial susceptibility patterns of isolates among patients diagnosed with surgical site infection at a tertiary teaching hospital in Ethiopia: a prospective cohort study. Ann ClinMicrobiolAntimicrob. 2021; 20(1): 33. doi: 10.1186/s12941-021-00440-z.
22. Abayneh M, Asnake M, Muleta D, Simieneh A. Assessment of bacterial profiles and antimicrobial susceptibility pattern of isolates among patients diagnosed with surgical site infections at Mizan-Tepi University Teaching Hospital, Southwest Ethiopia: A prospective observational cohort study. Infect Drug Resist. 2022; 15(1): 1807- 1819. doi: 10.2147/IDR.S357704.
23. PiyumalSamaranayake WAM, Kesson AM, Karpelowsky JS, Outhred AC, Marais BJ. Port-site infection due to nontuberculous mycobacteria following laparoscopic surgery. Int J Mycobacteriol. 2020;9(3):231-238. doi: 10.4103/ijmy.ijmy_32_20.