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Original Research Article

Assessment of bacteriological profile and wound infection in open and laparoscopic gall bladder surgery

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ABSTRACT

Background: Cholecystectomy is one of the most frequent types of abdominal surgery performed in the world. Generally, there is minimal risk of serious postoperative complications. One of the complications is Surgical Site Infection, which can be caused by bile leakage and intraoperative contamination.
Methods: This prospective study was conducted in department of General Surgery, SKIMS medical college Srinagar, from June 2020 to July 2023 comprising of 100 patients. All patients undergoing the procedure were observed for wound infection.
Results: A total of 100 patients were studied with female to male ratio of 2:3. The mean age was 50.24±12.25 with 54% elderly patients. The average hospital stay was 4.02±07. 88% subjects belonged to ASA II Category with Hypertension and hyperthyroidism as common comorbidity. 11 patients got wound infection including 9 from open cholecystectomy and 02 from laparoscopic cholecystectomy with most patients belonging to elderly age group. Wound culture was positive in 9 out of 11 subjects of open cholecystectomy. E. coli was seen to be a major causal bacterial agent. Bile culture was positive in 8 patients. Both genders were almost equally affected by wound infection. Meropenem, Ceftriaxone, Gentamicin and Amikacin showed the highest number of antibiotic sensitivities tested in case of wound cultures.
Conclusions: The prevalence of positive wound culture in uncomplicated laparoscopic cholecystectomy is low as compared to open procedure. Elderly age, co-morbid patients, patients who had history of jaundice, recent history of cholecystitis were at higher risk of wound infections.

Keywords: Laparoscopic, Surgical site infection, Cholecystectomy

INTRODUCTION

Carl Langenbuch of Berlin performed the first open cholecystectomy in 1882, four years after Kocher and Sims performed the first cholecystostomies, with the stated goal of preventing future episodes of biliary colic by eliminating the source of gallstones.[1,2] The first laparoscopic cholecystectomy was performed in 1985 Erich Muhe of Germany. [2] Over time, these operations became more successful as they remained focused at better understanding of the modified surgical techniques to address the minor post-operative complications. Cholecystectomy is one of the most frequent types of abdominal surgery performed in the world. Generally, there is minimal risk of serious postoperative complications. One of the complications is surgical site infection (SSI), which can be caused by bile leakage and intraoperative contamination.

Laparoscopic cholecystectomy is associated with fewer SSI than open cholecystectomy.[3] However, with the increasing number of laparoscopic cholecystectomies performed, there is an increasing number of port site infections. Although this occurs infrequently, it has a significant impact on the overall outcomes of laparoscopic cholecystectomy and its final results such as delayed return to work, increased cost and poor cosmetic results, which are disappointing for both the patient and the surgeon. Usually, cholecystectomy entails removal of a non-inflamed gallbladder and is associated with a low postoperative infection rate. Postoperative infection rates are higher in patients with certain risk factors of which there are many described in the literature.[4,5] According to a meta-analysis of studies on the use of perioperative antibiotics during laparoscopic cholecystectomy, the incidence of SSI following cholecystectomy was 2.4%.[6] It is not advised to routinely administer antibiotic prophylaxis (AP) during elective cholecystectomy due to the low incidence of postoperative infection.[7-9] However, the risk is significantly higher after cholecystectomy for acute cholecystitis.[10] Attempts to reduce postoperative wound infections are therefore very important. Postoperative wound infections in biliary tract surgery are largely due to endogenous contamination produced by opening the biliary tract in patients with bacteria in the bile, which is present in 15-50% of high- risk patients.[11,12] There are well-known and well-researched risks associated with the procedure itself.[13,14] A number of general risk factors are frequently quoted as being associated with an increased risk of postoperative wound infection. These include age, diabetes, concurrent disease, emergency procedure, duration of operation and obesity. The relative importance of these risk factors in laparoscopy is unclear. Each may render the patient more susceptible to a wound infection, but their influence may still be dependent upon the degree of endogenous contamination during surgery. Postoperative wound infection and the need for antibiotic prophylaxis are well documented in open biliary surgery.[15] Specific risk factors for the development of wound infection are jaundice at operation, recent rigors, emergency operation or one within 4 weeks of an emergency admission, age over 70 years, previous biliary operation, common duct obstruction and stones in the bile duct.[16] The aim of our study was to determine the incidence of postoperative infections, especially wound infection, after laparoscopic and open cholecystectomy, and to assess the bacteriological profile of these patients.

METHODS

This study was conducted in department of General Surgery SKIMS medical college Srinagar, tertiary care hospitals in Jammu & Kashmir, India from June 2020 to July 2023. It was a prospective study which comprised of 100 patients having symptomatic gallstone disease. All the complications which were encountered in post-operative period in both open as well as laparoscopic cholecystectomy were taken into account. Patients having symptomatic gallstones underwent abdominal ultrasound and liver function tests before operation. From all patient's informed consent was obtained. In case of open cholecystectomy bile was obtained by fine needle aspiration of intact gall bladder and sent for culture and sensitivity. In case of laparoscopic cholecystectomy, all operations were performed with reusable instruments.

Inclusion and exclusion criteria

All patients undergoing a cholecystectomy, elective as well as non-elective, were eligible. Excluded patients with the following conditions: age below 18 years, hypersensitivity to penicillin/cephalosporins, pregnant ladies, impaired renal function, the presence of an underlying disease or concomitant infection which would interfere with the evaluation of response.

All patients undergoing the procedure were observed for wound infections. Data regarding etiological factors was collected from each patient; These include age, sex, duration of surgery, wound class, use of general anesthesia, the ASA class, whether the operation was an emergency or elective. Infection rates were calculated for each type of denominator data collected (e.g., operative procedure and wound class), as well as for combinations of denominator data (e.g., operative procedure by wound class). The data was finally collected and analyzed using appropriate statistical tests and final inferences were drawn.

RESULTS

A total of 100 patients who full filled the inclusion and exclusion criteria were studied. The samples were heterogeneous in terms of gender, as female showed a maximum representation 60% (60 out of 100) as compared to 40 males. The mean age was 50.24±12.25 with a range of 18 to 78 years old. Elderly patients were comparatively in higher numbers with the total percentage of 54%. Both open and laparoscopic cholecystectomies were performed in equal numbers of 50 each. The average hospital stay of the patients was 4.02±07 with the range of 3-7 days. The applied ASA classification of patients showed that 88% of the subjects present in ASA II while as ASA I and ASA III presented with 05% and 07% respectively, thus majority of the subjects' mild systemic disease (Table 1). Majority of the subjects was having presented with Hypertension and hyperthyroidism individually or in combination. An ample number of patients also presented with Hypertension (HTN) and chronic obstructive pulmonary disease (COPD) in combination. Among the 100 subjects only 11% of patients were without any co-morbidities, 27% presented with HTN+hypothyroidism, 23% with HTN, 20 % with Hypothyroidism, 13% presented with HTN+COPD (Figure 1). Jaundice was seen only in 10 patients, rigor in 45 patients and cystic duct obstruction was present in 14 patients. All the patients presented with

100% efficacy towards antibiotics, as antibiotic prophylaxis was given in all the recruited subjects.

Table 1: General characteristic of patient underwent laparoscopic and open cholecystectomy (n=100).

Variable	N (%)
Age years (mean±SD)	50.24±12.25
Age group (years)	
≤50	46 (46.0)
>50	54 (54.0)
Gender	
Male	40 (40.0)
Female	60 (60.0)
Procedure type	
Lap cholecystectomy	50 (50.0)
Open cholecystectomy	50 (50.0)
Hospital stays (days)	4.02±07 (3 -7)
ASA classification	
ASA I	05 (5.0)
ASA II	88 (88.0)
ASA III	07 (7.0)

Table 2: Wound infection and culture sensitivity.

Parameters	N (%)
Wound infection	
Yes	11 (11.0)
No	89 (89.0)
Wound culture sensitivity	
Positive	11 (11.0)
Sterile	0 (0.0)
Wound scoring	
Minor	10 (10.0)
Major	01 (1.0)
Bile culture sensitivity	
Positive	08 (16)
Sterile	42 (84)

The cystic obstruction was present in only 14% of our patients. It was observed that out of 100 patients only 11 patients got wound infections which include 9 from open cholecystectomy while as 02 wound infections were from Laparoscopic cholecystectomy. On wound scoring basis, majority (10 out of 11) of the presenting wounds were of minor category. The majority of the wound culture positivity was shown among subjects of open cholecystectomy (09 out of 11). On further assessment, it was observed that *E. coli* was seen to be a major causal bacterial agent for wound infections followed by *Klebsiella pneumonia*. Similar to the wound infections, bile culture positivity in case of open type cholecystectomy was 16% (8 out of 50) and in majority of cases the bile culture was positive for *E. coli* (Table 2). It was seen that both genders were almost equally affected after procedures by wound infection and bile culture positivity. Maximum wound type infections and bile culture positivity was found in case of elderly patients (age >50 years). Maximum co-morbidities like HTN, hypothyroidism and COPD were presented by patients who were operated by open type cholecystectomy (Table 3). Following laboratory culture, the prevalence of bacteria cultured in the bile as well as from wound site were monomicrobial.

Table 3: Characteristic of patient on the basis of wound and bile culture result.

Parameters	N (%)
Wound culture	
Gender	
Female	06 (54.5)
Males	05 (45.5)
Age group (years)	
≤50	02 (18.2)
>50	09 (81.8)
Co-morbidities	
Yes	10 (90.1)
No	01 (9.1)
Bile culture	
Gender	
Female	04 (50.0)
Males	04 (50.0)
Age group (years)	
≤50	03 (37.5)
>50	05 (62.5)
Co-morbidities	
Yes	07 (87.5)
No	01 (12.5)

Table 4: Wound Infections, wound scoring, culture positivity and bacteriological assessment infection.

Parameters	Frequency (%)
Wound infection (N=11)	
Open cholecystectomy	9 (81.8)
Laproscopic cholecystectomy	2 (18.18)
Wound scoring (N=11)	
Minor	10 (90.9)
Major	1 (9.09)
Wound culture positivity (N=11)	
Open cholecystectomy	9 (81.8)
Laproscopic cholecystectomy	2 (18.18)
Wound culture bacteriological assessment (N=11)	
Pseudomonas aeruginosa	1 (9.1)
Klebsiella pneumonia	3 (27.3)
E. coli	7 (63.6)
Bile culture positivity (N=50)	
Open cholecystectomy	8 (16)
Bile culture bacteriological assessment (N=8)	
Pseudomonas aeruginosa	2 (25)
Klebsiella pneumonia	2 (25)
E. coli	4 (50)

Culture cultivated includes; *Escherichia coli* (07 out of 11 samples), *Klebsiella pneumonia* (3 out of 11 samples) and *Pseudomonas aeruginosa* (1 out of 11 samples). The

bacteriological analysis of each patient is shown in (Table 4). From the antibiogram (Table 5), it shows meropenem, imipenem, gentamicin and amikacin has the highest number of antibiotic sensitivities tested in case of wound cultures against all microbes found in the culture.

Table 5: Antibiogram of each sample of positive wound culture.

Sample No	1	2	3	4	5	6	7	8	9	10	11
Organism isolated	*Escherichia coli*	*Escherichia coli*	*Klebsiella pneumonia*	*Klebsiella pneumonia*	*Escherichia coli*	*Klebsiella pneumonia*	*Escherichia coli*	*Escherichia coli*	*Pseudomonas aeruginosa*	*Escherichia coli*	*Escherichia coli*
Amikacin	S	S	S	S	S	S	S	S	S	S	S
Gentamycin	R	S	S	S	S	S	S	S	S	S	S
Imipenem	S	S	S	S	S	-	S	-	-	S	S
Meropenem	S	S	-	-	S	S	S	S	-	S	S
Piperacillin-tazobactam	R	-	-	-	S	S	S	S	S	S	S
Tigecycline	S	-	-	-	S	-	S	S	-	-	S
Cefepime	R	-	-	-	R	-	R	-	-	-	-
Ceftriaxone	R	-	S	S	R	S	R	R	R	R	R
Ciprofloxacin	R	-	-	-	R	-	R	R	-	-	R
Polymyxin B	-	S	S	S	-	S	-	-	-	S	-
Ampicillin+salbactum	-	-	-	-	-	R	-	R	R	R	R
Ceftazidime	-	-	R	-	R	R	-	R	S	R	
Levofloxacin	-	-	R	-	-	-	-	S	S	-	-
Ticarcillin+ clavulanic acid	-	-	R	R	-	R	-	-	-	-	-
Co trimoxazole	-	-	S	S	-	-	-	-	R	-	-

Table 6: Antibiogram of each case of positive bile culture in open cholecystectomy.

Number of samples	1 sample	2 samples	4 samples	1 sample
Organism Isolated	*Pseudomonas aeruginosa*	*Klebsiella pneumonia*	*Escherichia coli*	*Pseudomonas aeruginosa*
Amikacin	S	S	S	S
Imipenem	S	S	S	R
Gentamycin	-	S	S	S
Polymyxin B	-	S	S	S
Ceftriaxone	-	S	S	-
Co trimoxazole	-	S	S	-
Meropenem	-	-	-	S
Cefepime	S	-	-	-
Ciprofloxacin	S	-	-	-
Aztreonam	S	-	-	-
Tobramycin	S	-	-	-
Cefoperazone	S	-	-	-
Ceftazidime	R	R	R	S
Ticarcillin	S	R	R	R
Ampicillin+salbactum	-	R	R	-
Levofloxacin	S	-	-	R
Piperacillin-tazobactam	R	-	-	S

There were 05 samples with ampicillin alone or in combination with sulbactam resistance shown against the cultured bacteria. The (Table 6) represent the bile culture sensitivity and resistance against the cultured bacteria. It was found that all 08 (100.0%) samples were sensitive to Amikacin, 07 out of 08 were sensitive to gentamycin followed by ceftriaxone in 06 out of 08 samples.

The maximum resistance was seen against ceftazidime and ticarcillin (07 out of 08 samples both) followed by the Ampicillin Sulbactam (06 out of 08).

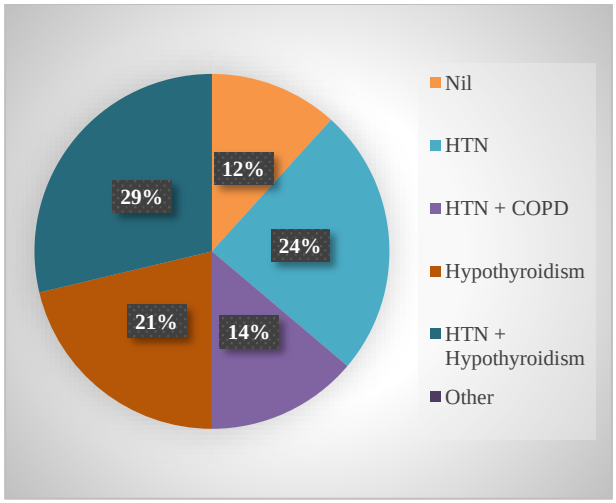

Figure 1: Associated comorbidities of patients undergoing cholecystectomy.

DISCUSSION

The goal of both laparoscopic and open techniques is to safely remove the gall bladder with low mortality, little morbidity, and early recovery.[17] Laparoscopic cholecystectomy (LC) has complications, just like open cholecystectomy. Postoperative complications or access-related complications have been reported in patients of all ages and genders. Several studies have reported lower infection rates for laparoscopic cholecystectomy compared to open cholecystectomy.[18-20]

From all patients of open cholecystectomy, gallbladder bile cultures were obtained intraoperatively. Postoperative wound cultures were also obtained. In open cholecystectomy, overall bile cultures were positive in 16% and wound infection was present in 18%. In case of lap cholecystectomy wound infection was present in 4% of individuals. The organisms isolated from positive cultures in bile and wound culture are listed in (Table 5-6). There were 08 patients (16%) in open cholecystectomy group with positive bile cultures. The predominant microorganisms from bile were *Escherichia coli* followed by *Klebsiella spp*. and *Pseudomonas aeruginosa*. 11 patients showed positive wound cultures. The predominant microorganisms from wound cultures were *Escherichia coli* (7 isolates), *Klebsiella pneumonia* (3 isolates) and *Pseudomonas aeruginosa* (01 isolate). In 7 of the positive bile cultures, resistance to Ceftazidime was found. 6 of the bile cultures were sensitive towards Ceftriaxone, Co-Trimoxazole, Amikacin, Gentamycin, Imipenem, Polymyxin B and resistant to Ceftazidime, Ampicillin Sulbactam, Ticarcillin, Clavulanic Acid. In 11 samples of the positive wound cultures, 8 samples were resistant towards Ceftriaxone, 5 towards Ciprofloxacin, 4 towards ampicillin+ Sulbactam and others were towards Cefepime, Ticarcillin Clavulanic Acid, Gentamycin etc. The wound cultures were sensitive towards Meropenem, polymyxin B, Imipenem, Amikacin, Gentamicin, Piperacillin+Tazobactam etc. The samples were not homogenous in term of gender, as female patients were predominantly higher in number as compared male patients. There is interesting fact that age group in positive bile culture group was greater than 50 years compared with lower age group in negative bile culture group. Though, the plausible reason for this difference cannot be explained, however, the more co-morbid patients in higher age group could be one of the reasons. In a study done by Faraz et al from India in 2013, the prevalence of positive bile culture was 58.58% with 268 bile samples.[21] In other study by Moazeni et al from Iran in 2010, the prevalence was 37.87% with 132 bile samples.[22] In another study from United Kingdom by Morris et al in 2007, the prevalence was 15.6% out of 128 patients.[23] In comparison to our study, the prevalence was varied. If we compare with the two Asian studies, the prevalence of those studies was high because the study samples include patient with active cholecystitis and patients who underwent open cholecystectomy. However, in one study done in India by Manoj et al in 2016, the prevalence of positive bile culture was 4.67% with 257 bile samples.[24] In our study, there was no anaerobic bacteria detected, and all culture isolates were monomicrobial in nature. Comparing with other study by Moazeni et al, anaerobic bacteria were detected in 8 samples (16%), monomicrobial isolation in 47 (94%) and polymicrobial isolation in 3 (6%) samples.[22] In another study by Manoj et al the polymicrobial isolation was 16.67% compared with monomicrobial isolation which was 83.33%.[24] In our study *Escherichia coli* was the commonest organism isolated in wound cultures which were 7 out of 11 samples (63.6 %), compared to, *Klebsiella pneumonia* which were 3 out of 11 samples (27.27%) and *Pseudomonas aeruginosa* which was 1 out of 11(9.09%). The results were comparable to other 3 studies (Manoj et al, Moazeni et al and Faraz et al). Based on our study, the antibiogram showed sensitivity towards second generation of cephalosporin, fluoroquinolones and aminoglycoside. All the positive culture cultivated had sensitivity towards amikacin, gentamicin and ciprofloxacin. The resistant pattern towards ampicillin was high in our study. Out of 11 positive culture samples, 6 samples had resistance towards ampicillin.

Limitations

There may be differences in bacteriology between our study and other studies because of different sample size and our study included only uncomplicated symptomatic cholelithiasis patients who underwent cholecystectomy, compared to other studies, which would have included patients of acute cholecystitis, gall bladder empyema and cholangitis.

CONCLUSION

The prevalence of positive wound culture in uncomplicated laparoscopic cholecystectomy is low as compared to open procedure. Elderly age, co-morbid

patients, patients who had history of jaundice, recent history of cholecystitis were at higher risk of wound infections. The antibiotic treatment practice needs to be improvised as the data shows that a number of drugs showed resistance towards different antibiotics.

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