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Comparative study of elective cholecystectomy with and without antimicrobial prophylaxis: A prospective randomized study

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ABSTRACT

Background: Cholecystectomy is one of the most common, clean, and contaminated surgery operations performed by surgeons worldwide. Antibiotic prophylaxis in elective cholecystectomy is a controversial issue and our study was undertaken to evaluate the rate of infection and the usefulness and efficacy of antibiotic prophylaxis in elective cholecystectomies. **Aims and Objectives:** The aims and objectives are to study antimicrobial prophylaxis on elective laparoscopic cholecystectomy and to compare surgical site infections (SSI) between the two groups after laparoscopic cholecystectomy with respect to (a) duration of surgery, (b) post-operative pain, (c) complications encountered, and (d) post-operative hospital stay. **Materials and Methods:** Patients were randomly divided into the study group (Group A) and the control group (Group B). Antibiotic dose of ceftriaxone + sulbactam 1.5 g will be administered intravenously 2 h before induction of anesthesia for the patients in the study Group A (n = 30), and no antibiotic will be administered prophylactically to the control Group B (n = 30). **Results:** In the study group, one patient developed fever, and in the control Group, 4 patients developed fever. In this study, SSIs were considered. In the study group, two patients (6.67%) developed pus discharge from the port site which was considered superficial infection, and in the control group, five patients (16.67%) developed pus discharge. **Conclusion:** Based on our study, in elective cholecystectomy, a single dose of intravenous ceftriaxone + salbactam 1.5 g given before the operative procedure does not lead to a higher SSI rate as compared to the conventionally given antibiotics which are continued postoperatively for a variable length of time.

Key words: Prophylactic antibiotic; Laparoscopic cholecystectomy; Surgical port sites infections

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INTRODUCTION

Gallstones are the most common biliary pathology. The incidence of biliary calculus disease varies widely throughout the world. By the age of 75, about 35% of women and 20% of men would have developed gallstones. Cholesterol gallstones are increasing in Asia for reasons that may be related to environmental and dietary considerations. Most patients with gallstones are asymptomatic and only about 10% will have developed symptoms 5 years after discovery. In a functioning gall bladder, most of the gallstones are cholesterol stones. Gallstone disease is a relatively common problem in our country, particularly in North India. It is estimated that more than 60% of these patients have cholesterol stones. Recent studies from south India have highlighted pigment and a mixed variety of gall stones to be more common (>90%) in contrast to cholesterol stones. Laparoscopic cholecystectomy is the gold standard procedure due to its advantages to the patient such as reduced pain, reduced hospital stay, lesser analgesics required, earlier returns to work, and better cosmesis. Asymptomatic gallstones represented 14% of all patients. In literature, 10–15% of all gallstone patients develop complications so that a prophylactic cholecystectomy is advisable as acute cholecystitis as well as common bile duct stones occur significantly more often with increasing

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duration of the gallstone disease.[1] Surgical antimicrobial prophylaxis refers to a very brief course of antimicrobial agents initiated 1–2 h before an operation begins. A lower incidence of complication and a better postoperative outcome have been observed with laparoscopic surgery compared with conventional open operation. The infective complications following laparoscopic cholecystectomy are low, which was further supported by a study analysis of 1702 patients undergoing laparoscopic cholecystectomy and revealed an overall infection rate of 2.3% and surgical site infection rate of 0.4%.[2] Observing the low incidence of infections following laparoscopic cholecystectomy, the need for prophylactic antibiotics is now frequently questioned. The overuse of antibiotics can result in a rising frequency of adverse effects, the emergence of drug-resistant organisms, as well as excessive costs. A number of studies and meta-analysis show different results in the context of surgical site infection in elective laparoscopic cholecystectomy and it ranges from 0.4% to 7.9%. Antibiotic prophylaxis includes the pre-operative administration of a wide spectrum antibiotic against the most frequent bacteria involved in surgical site infections (SSIs), trying to get high tissue levels of the antibiotic at the surgical wound to avoid colonization and the growing of microorganisms.[3] It is advisable to use prophylactic antibiotics to reduce the incidence of wound infection in laparoscopic cholecystectomy. Antibiotic prophylaxis can prevent infection in contaminated wounds but is not indicated for most patients undergoing straight forward clean surgical operations in which no obvious bacterial contamination or insertion of a foreign body has occurred.[4] The infective complications of open cholecystectomy are well known, and prophylactic antibiotics are a routine practice. However, the wounds created after open cholecystectomy behave differently as compared to laparoscopic cholecystectomy.[5] First, the wounds created are smaller as compared to the open surgery. Second, it has been proved that the immune system is better preserved in laparoscopic surgery since the tissue trauma is less. Laparoscopic cholecystectomy *per se* does not violate the mucosal defense barrier of the respiratory, gastrointestinal, or genital epithelium. It is not clear whether antibiotic prophylaxis in laparoscopic cholecystectomy is of any advantage to the patient in terms of preventing infection.[6] Hence, we conducted a randomized prospective study, to analyze the effect of antibiotic prophylaxis in laparoscopic cholecystectomy with respect to duration post-operative pain, duration of surgery, complications encountered, and other hospital stays.[7]

Aims and objectives

The aims and objectives are to study antimicrobial prophylaxis on elective laparoscopic cholecystectomy and to compare surgical site infections (SSI) between the two groups after laparoscopic cholecystectomy with respect to (a) duration of surgery, (b) post-operative pain, (c) complications encountered, and (d) post-operative hospital stay.

MATERIALS AND METHODS

Patients undergoing elective laparoscopic cholecystectomy were selected as suitable subjects for the study protocol. All the patients were examined clinically and investigated accordingly. Informed and written consent was taken from all the patients participating in the study. Patients were randomly divided into the study group (Group A) and the control group (Group B). Antibiotic dose of ceftriaxone + sulbactam 1.5 g was administered intravenously 2 h before induction of anesthesia for the patients in the study group – Group A (n=30). No antibiotic was administered prophylactically to the control group of patients – Group B (n=30) after induction of anesthesia skin was disinfected with betadine. Laparoscopic cholecystectomy was performed in all patients. The post-operative course was monitored and any incidents, such as fever, infection of the trocar site, or intra-abdominal collection of pus, and superficial or deep incisional soft-tissue surgical site infection will be noted. The method of data collection was based on direct observation of the study population in the post-operative period. All patients were followed up daily till discharge, then after a few days (during stitch removal) and then 30 days following surgery to evaluate the surgical wound and to look for signs and symptoms suggestive of any infection. The study subject consists of the patients admitted to the surgery wards of GSVM Medical College, Kanpur (UP), with a diagnosis of cholelithiasis, duration of study: 2 years (2020–2022).

Exclusion criteria

Antibiotic intake within 7 days before surgery, acute cholecystitis within 6 months before surgery, evidence of cholangitis and/or obstructive jaundice and biliary pancreatitis, conversion to open cholecystectomy, and age more than 60 years.

Inclusion criteria

Patients with radiologically diagnosed case of cholelithiasis, patients more than 15 years of age, patients with no previous abdominal surgery, patients with body mass index <40, and patients with normal leukocyte count.

OBSERVATIONS

A total of 60 patients eligible for the study were selected. All the patients who had undergone elective laparoscopic cholecystectomy were categorized into a study group and a control group. Study Group A received prophylactic intravenous antibiotic (1.5 g ceftriaxone + sulbactam) 2 h

before induction of anesthesia alone. Control Group B received intravenous antibiotics after the post-operative period till discharge. Patients were followed in the post-operative period regarding SSI.

Mean age in the study group was 30 years and in the control group was 33 years. The age group of patients ranges from 15 to 60 years. In study Group A, 46.67% of patients range between 20 and 29 years of age. In control Group B, 40% of patients range from 20 to 29 years of age.

In the study group, 10 cases (33.33%) were male and 20 cases (66.67%) were female. In the control group, 14 cases (46.67%) were male and 16 cases (53.33%) were female.

In the study group, one patient developed a fever, and in the control group, four patients developed a fever. In this study, SSIs were considered. In the study group, two patients (6.67%) developed pus discharge from the port site which was considered superficial infection, and in the control group, 5 patients (16.67%) developed pus discharge. In all cases, deep infections were ruled out by ultrasonography. There was no seroma formation in both the study and control groups. I concluded that surgical site infection in the single IV antibiotic group is 6.67% whereas in the control group, in which IV antibiotics were continued in the post-operative period till discharge is 16.67%. Significant association was found by Chi-square t-test with mean and standard deviation.

In the study group, four patients developed pain, and in the control group, 12 patients developed pain, showing the significance of prophylactic antibiotics. Significance was shown by Chi-square t-test with means and standard deviation of values.

In the study group, one patient's hospital stay was more than 2 days, and in the control group, six patients' hospital stay was more than 2 days. In this study, SSIs were considered. In this study, there is a significance of prophylactic antibiotics.

RESULTS

The mean age of the study was 30 years in the study group and 33 years in the control group (Table 1). Symptomatic cholelithiasis was found most commonly present in the fourth decade with significant female preponderance (Table 2). Pain abdomen was the most common presenting symptom which occurred 56.67% in the study group and 50% in the control group (Table 3). In my study, 13.33% of patients in the study group and 20% of patients in the control group were diabetic and 13.33% of patients in the study group and 20% of patients in the control group were hypertensive. In our study, out of 60 patients in study Group A, two of them developed pus discharge from the port site with an incidence of about 6.67%, and in the control group, five patients out of 30 patients developed pus discharge from the port site with an incidence of about 16.67% (Table 4). All others had completely healed wounds. Post-operative pain and hospital stay appear to be more in Group B (Table 5). These differences yielded a $P<0.05$ which is statistically significant, thereby illustrating that the rates of wound infection in patients given shots of IV antibiotics, and in patients given continuous post-operative IV antibiotics are statistically significant.

Table 1: Age incidence

Characteristics	Study group (n=30), n (%)	Control group (n=30), n (%)	P-value
Age (years)			
20–29	14 (46.67)	12 (40)	0.67
30–39	9 (30)	10 (33.33)	(>0.05)
40 and above	7 (23.33)	8 (26.67)	

Table 2: Sex incidence

Characteristics	Study (n=30), n (%)	Control (n=30), n (%)	P-value
Sex			
Male	10 (33.33)	14 (46.67)	0.29
Female	20 (66.67)	16 (53.33)	(>0.05)

Table 3: Post-operative pain incidence

Characteristic	Study (n=30), n (%)	Control (n=30), n (%)	P-value
Pain			
Yes	4 (13.3)	12 (40)	0.019
No	26 (86.6)	18 (60)	(<0.05)

Table 4: Post-operative complications

Complications	Study (n=30), n (%)	Control (n=30), n (%)	P-value
Fever	1 (3.33)	4 (13.33)	<0.05
Superficial infection (pus discharge from port site)	2 (6.67)	5 (16.67)	0.025
Deep infection	0	0	
Seroma formation	0	0	
Others	0	0	

Table 5: Post-operative hospital stay incidence

Category	Study (n=30), n (%)	Control (n=30), n (%)	P-value
Hospital stay (days)			
>2	1 (3)	6 (20)	0.04 (<0.05)
<2	29 (96)	24 (80)	

DISCUSSION

It is well documented that prophylactic antibiotic coverage of most "clean contaminated" surgical procedures can significantly prevent infectious complications, including wound infections, thereby affecting overall mortality and morbidity. However, the benefit of antibiotic prophylaxis in other clean surgical procedures, such as laparoscopic cholecystectomy, has been questionable. Antibiotic prophylaxis is indicated clearly for most clean-contaminated and contaminated (or potentially contaminated) operations.[8] The choice of antibiotic should be guided by four principles: Safety, narrow spectrum coverage of relevant pathogens, no general use for treatment of infection, and short-duration administration (ideally, a single dose given 1 to 2 h before surgery; certainly for no more than 24 h). Prolongation of antibiotic prophylaxis beyond 24 h not only provides no benefit but also can be associated with complications, including *Clostridium difficile*-associated colitis, nosocomial infections other than SSI, and the emergence of multi-drug-resistant pathogens.[9] The lowest SSI rate occurred in patients receiving antibiotic prophylaxis 1–2 h before surgery. A statistically significant trend was observed toward higher rates of infection with each successive hour. That antibiotic administration was delayed after the surgical incision.[4] In a randomized controlled trial (RCT) on 417 patients undergoing laparoscopic cholecystectomy, conducted by Gaur and Pujahari, they reported an overall infection rate of 2.2%, which is consistent with the results obtained in our study.[10] In another study conducted by Mahmoud et al., to assess the role of antibiotic prophylaxis in elective laparoscopic cholecystectomy, they stated that antibiotic prophylaxis does not prevent wound infection in elective laparoscopic cholecystectomy. This is probably due to the fact that Mahmoud et al., excluded all patients with associated co-morbidities such as diabetes mellitus and hypertension.[11] In a study conducted by Koc et al., it was stated that the presence of diabetes mellitus is a risk factor for the development of post-operative infective complications in patients undergoing elective laparoscopic cholecystectomy. The presence of diabetes mellitus is a known risk factor for biliary sepsis in patients with diabetes.[12] Shindholimath et al., found that bactibilia was the most important predictor of wound infection in low-risk patients undergoing elective LC. They recommended prophylactic antibiotics to reduce the incidence of wound infection because it might not be possible to determine which patients have bactibilia by routine investigation.[13] Liang et al., conducted a comprehensive literature review of the PubMed, Embase, and Cochrane Library databases for RCTs that compared antibiotic prophylaxis versus placebo or no antibiotics and concluded that two doses of antibiotic and 3–10 doses of antibiotic significantly reduced the incidence of SSI compared with placebo or no antibiotics, while a single dose of antibiotic administration did not.[14] Matsui et al., reviewed seven meta-analyses regarding prophylactic antibiotics for low-risk laparoscopic cholecystectomy. They examined a total of 28 RCTs and concluded that prophylactic antibiotics reduce the incidence of post-operative infections after elective laparoscopic cholecystectomy.[15] In a study conducted by Dr. Ashwani, on 240 patients with low-risk randomized in 2 groups stated that one single dose of prophylactic antibiotic, administered at induction of anesthesia, is sufficient to prevent post-operative infective complications in patients undergoing elective laparoscopic cholecystectomy, showing significant use of prophylactic antibiotic.[16]

Limitations of the study

This study considered post-operative superficial infections only after laparoscopic cholecystectomy in patients of age up to 60 years.

CONCLUSION

Based on our study, in elective cholecystectomy, a single dose of intravenous ceftriaxone + sulbactam 1.5 g given before the operative procedure does not lead to a higher SSI rate as compared to the conventionally given antibiotics which are continued postoperatively for a variable length of time. When factors accounting for antibiotic prophylaxis use were accounted for, either using multivariable adjustment or matched analyses, antibiotic prophylaxis appeared to reduce superficial SSI in clean-contaminated surgery. A single dose of antibiotic can certainly decrease the cost of antibiotic therapy to the patient.

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