RESEARCH ARTICLE

Prevalence of Surgical Site Infections and Antimicrobial Prophylaxis in Major Abdominal Surgeries

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Abstract

Introduction: Surgical site infections (SSIs) after major abdominal surgeries are the major causes of morbidity and mortality in our country. SSIs can be prevented by usage of antimicrobial prophylaxis. The appropriate administration of antimicrobial prophylaxis, with respect to choice and timing, is crucial to yield better results and reduce the prevalence of SSIs.

Aims: To analyze the time, duration, route, and choice of antimicrobial prophylaxis in major abdominal surgeries at a tertiary care hospital and to assess the prevalence of surgical site wound infections.

Methodology: We conducted a descriptive, observational, and cross-sectional study on 100 patients who were administered antimicrobial prophylaxis preoperatively before undergoing major abdominal surgeries. The time, duration, route, and choice of antimicrobial prophylaxis for 18 different types of abdominal surgeries, which included gastroduodenal and gynecological cases, were recorded. These patients were followed up postoperatively for 30 days following the surgery. Incidence of SSIs was also recorded.

Results: The prevalence of SSIs in major abdominal surgeries in this study was found to be 7%, which is on the lower limit when compared to similar studies involving major abdominal surgeries conducted in India. This is attributed to proper administration of antimicrobial prophylaxis, with respect to their choice, dosage, and time of administration. The prevalence of SSIs was predominantly seen in elderly groups of patients of advancing age, patients with higher American Society of Anesthesiology (ASA) score, patients undergoing open surgeries, and in prolonged surgical procedures that exceeded their usual duration.

Conclusion: This study of antimicrobial prophylaxis for major abdominal surgeries conducted at tertiary care hospitals has shown the prevalence of SSIs as 7%. The prevalence of SSIs is low due to the appropriate choice and timing of administration of antimicrobial prophylaxis.

Keywords: Abdominal surgeries, Antibiotic prophylaxis, Surgical site infections.

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Introduction

Infection at the surgical site can occur up to 30 days after surgery and may affect either surgical incision or deeper tissues at the site of surgery.[1]

Surgical site infections after major abdominal surgeries are the major causes of morbidity and mortality in our country. The incidence of SSI rate ranges from 6.09 to 38.7% and may be due to differences in the characteristics of the hospital population, differences in the type of clinical procedures, differences in infection control measures, and the hospital environment.[2]

Increased incidence of SSI after major abdominal surgeries may be due to increased duration of hospital stay, differences in surgical techniques, and different infection control policies and procedures. Quality indicators like increased hospital readmission rate, improper administration of timely prophylactic antibiotics, and increased repeat operation rates will all lead to a significant increase in morbidity and mortality. Hence, the prevention of SSI is very crucial and involves prophylactic measures preoperatively, intraoperatively, and also postoperatively.[2,3]

Proper usage of antibiotics prophylactically is one of the measures in preventing SSI, which when properly administered can decrease the incidence up to four times. We should aim to achieve adequate serum and tissue levels of the drug at the time of surgical incision and for the duration of surgery. Hospital antibiotic policies should ensure safety, they should not be expensive, define the time to administer the antibiotic, and they must be appropriate as per the antibiogram of the hospital.[4–8] Improper usage and defective policy can lead to emergence of resistant microorganisms. Hence, observation of the administration of antimicrobial prophylaxis, as done in this study, is of utmost importance.[9]

The guidelines for administration of antibiotic prophylaxis are formulated by the American Society of Health-System Pharmacists (ASHP) to provide safe and effective use of antibiotics for the prevention of SSIs.[4–6] These guidelines are practiced as per the

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prevalent infections and their microbial sensitivity in tertiary care hospitals by using an antibiogram. The updated guidelines recommended by the hospital infection control committee are being considered in this study.

The objectives are as follows:

- To analyze the time, duration, route, and choice of antimicrobial prophylaxis in major abdominal surgeries at a tertiary care hospital.
- To assess the prevalence of surgical site wound infections.

Methodology

This is a descriptive, observational, and cross-sectional study conducted on 100 patients administered with antibiotic prophylaxis preoperatively before undergoing major abdominal surgeries. These patients were followed up postoperatively for SSIs for 30 days.

The ethical clearance was obtained on 6th September 2021 from the Institutional Ethics Committee (number: RRMCH-IEC/74/2021), after which the study was conducted. The study took place at the preoperative and postoperative wards of surgery and gynecology in RajaRajeswari Medical College & Hospital, Bengaluru from 1st June 2022 to 31st July 2022, for a period of 2 months.

Patients between 18 and 70 years of age who were undergoing major abdominal surgeries, including lower segment cesarean section (LSCS) were included in the study. Patients already on antibiotics for other conditions unspecified, pediatric and geriatric (>70 years) patients were excluded from the study.

Data Collection

Consent forms from the patients were obtained prior to the collection of data. The data collected were completely confidential and the patient's details remained anonymous throughout.

- The case sheets of the patients undergoing major abdominal surgeries were collected and analyzed for details regarding the administration of antimicrobial prophylaxis. The data collected were both qualitative and quantitative in nature. All data were collected from the postoperative wards of surgery and gynecology and the surgical site infections, if present, were noted: the demographic details of the patient such as name, age, gender, address, and occupation were obtained as per standard procedure. It was used to ascertain any relationship between the age and gender of the patient and the incidence of early SSI. Details of chief complaints, history of comorbidities, and provisional diagnosis were also obtained.
- The type of surgery to be performed on the patient was obtained. The surgeries, once performed, were classified as clean, clean-contaminated, contaminated, and dirty. It was used to analyze if there exists any relationship between the type of surgery/the organ operated upon and the incidence of early SSI.
- The ASA score of each patient was obtained as given by the physician.
- The time of administration of antibiotic prophylaxis was obtained from the anesthesiologist and the following details of antibiotics were also collected.

Drug of choice

According to the ASHP guidelines, an antimicrobial agent should be safe for the patient, should not be expensive, and reduce the treatment period. For most patients undergoing clean-contaminated surgeries (e.g., gastrointestinal), cephalosporin is the recommended prophylactic antibiotic.

Dosage administered

As per the choice of drug, standardized dosage based on body weight and type of surgery was administered to the patients.

Route and site of administration

It depends upon the choice, dosage, and pharmacokinetics of the drug. It may also vary based on the surgical site operated upon.

Time of administration

Preoperatively, the antibiotic has to be administered within 60 minutes before the surgical incision. Fluoroquinolones, vancomycin, and other agents should be administered within 120 minutes as they require administration over 1–2 hours.

Duration of prophylaxis of drug

In adults, a single dose was usually administered. If the prophylaxis was continued postoperatively, the duration should be less than 24 hours.

Duration of surgery

Prolonged duration of the surgery (>2 hours) was related to an increased risk of SSI.

- Presence or absence of SSI for 30 days postoperatively was noted.
- The common clinical features of SSIs include:

(1) Spreading erythema, (2) localized pain, (3) pus or discharge from the wound, and (4) persistent pyrexia.

Statistics

Yamane's formula was used to calculate the sample size of the population. The formula is as follows:

$$n = \frac{N}{1 + N(e)^2}$$

where:

N = population size, n = corrected sample size, e = margin of error = 0.05.

The formula was used to obtain a sample size of 100.

Once the data were collected, statistical analysis was done by using descriptive and inferential statistics. Software used for statistical analysis were SPSS version 20 and MS Excel.

Results

We recruited a total of 100 patients undergoing major abdominal surgeries in our study. The patients were followed postoperatively for the incidence of SSI over a period of 30 days. A total of seven patients out of 100 developed SSI.

Demographic details such as the age of the patient, the gender of the patient, and the ASA score were studied. Table 1 shows the demographic details of the patients in the study and the number of patients who developed SSI under each category.

The choice of antimicrobial prophylaxis administered to the patients was studied. The antimicrobials were administered preoperatively, and when the surgery exceeded the said duration,

Table 1: Demographic details of the patients in the study. It also shows the number and percentage of patients who developed SSI under each category

Demographic details	*Total no. of patients in the study (100 patients)*	*No. of patients who developed SSI*	*Percentage of patients who developed SSI*
Age			
18–20 years	2	0	0%
21–30 years	21	1	4.76%
31–40 years	23	1	4.34%
41–50 years	27	0	0
51–60 years	14	1	7.14%
61–70 years	13	4	30.77%
>71 years	0	–	–
Gender			
Male	47	3	6.38%
Female	53	4	7.55%
ASA score			
Grade I	39	–	–
Grade II	46	4	8.69%
Grade III	15	3	20%
Grade IV	0	–	–
Grade V	0	–	–

the antimicrobials were administered perioperatively. The antimicrobials used in this study were inj. cefoperazone (1000 mg) + sulbactam (500 mg), inj. ceftriaxone (1000 mg) + sulbactam (500 mg), inj. cefotaxime (1000 mg) and inj. metronidazole (500 mg), inj. ceftriaxone (1000 mg), inj. ceftolozane (1000 mg) + tazobactam (500 mg), inj. piperacillin (4000 mg) + tazobactam (500 mg) and inj. ciprofloxacin (500 mg) (Fig. 1).

Table 2 shows the choice of antimicrobial prophylaxis administered and the number of patients under each group.

A total of 100 abdominal surgeries were conducted in this study. The prevalence of SSIs varied with the type of surgery performed. A total of 18 types of surgeries were performed where 71% were made up by laparoscopic cholecystectomy, open hernia mesh repair, open appendicectomy, total abdominal hysterectomy, diagnostic laparoscopy, LSCS, and laparoscopic appendicectomy.

Table 3 shows the types of surgeries performed and the number of surgical site infections that have developed under each type.

Table 2: Choice of antimicrobial prophylaxis given. The antimicrobials were administered preoperatively, and when the surgery exceeded the said duration, the antimicrobials were administered perioperatively

Sl. no.	*Choice of antimicrobial prophylaxis (with standard dosage)*	*No. of patients*
1.	Inj. cefoperazone (1000 mg) + sulbactam (500 mg)	41 (41%)
2.	Inj. ceftriaxone (1000 mg) + sulbactam (500 mg)	21 (21%)
3.	Inj. cefotaxime (1000 mg) Inj. metronidazole (500 mg)	18 (18%)
4.	Inj. ceftriaxone (1000 mg)	8 (8%)
5.	Inj. ceftolozane (1000 mg) + tazobactam (500 mg)	7 (7%)
6.	Inj. piperacillin (4000 mg) + tazobactam (500 mg)	3 (3%)
7.	Inj. ciprofloxacin (500 mg)	2 (2%)

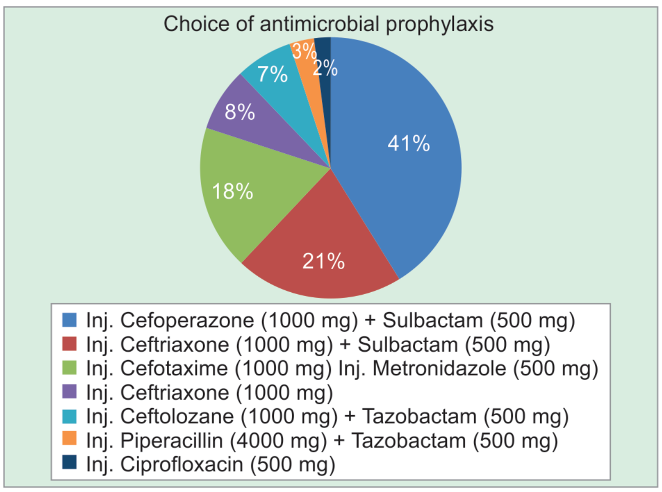

Fig. 1: Pie chart depicting the choice of antimicrobial prophylaxis in this study

Discussion

A total of seven patients out of 100 developed SSI, hence the prevalence of SSIs in major abdominal surgeries under this study is 7%. This result is on the lower side, where SSIs in India range from 6.09 to 38.7%.[2]

The infection rate in Indian hospitals is much higher than that in other countries; for instance, in the USA, it is 2.8% and it is 2–5% in European countries.[10] The prevalence of SSIs in this study is comparatively high when compared to the international standards, at 7%. Here the prevalence of SSIs could have been reduced by taking up stringent aseptic measures preoperatively and postoperatively.

The demographic details of the patients and the prevalence of SSI under each category are given in Table 1.

The prevalence of SSIs was 30.77% in elderly patients of 61–70 years of age and 7.14% in 51–60 years of age. This was significantly higher than the other groups, which presented with

Table 3: Types of surgeries performed and the number of surgical site infections that have developed under each type.

Sl. no.	*Type of surgery*	*Total no. of patients*	*No. of patients who developed SSI*	*Percentage of patients who developed SSI*
1.	Laparoscopic cholecystectomy	18	–	–
2.	Open hernia mesh repair/hernioplasty	11	3	27%
3.	Open appendicectomy	10	1	10%
4.	Total abdominal hysterectomy	9	–	–
5.	Diagnostic laparoscopy	8	–	–
6.	Lower segment cesarean section	8	–	–
7.	Laparoscopic appendicectomy	7	–	–
8.	Endoscopic retrograde cholangiopancreatography + stenting	5	–	–
9.	Cystogastrostomy	4	–	–
10.	Incisional hernia repair	4	–	–
11.	Gastrojejunostomy	3	–	–
12.	Open cholecystectomy	3	1	33%
13.	Bowel resection	3	–	–
14.	Resection and anastomosis of intestinal strictures	2	–	–
15.	Exploratory laparotomy	2	–	–
16.	Intramuscular abdominal wall hematoma exploration and evacuation	1	1	100%*
17.	Open appendicectomy + umbilical hernia repair	1	1	100%*
18.	Laparoscopic cystectomy	1	–	–

*High prevalence is seen due to small subgroup in the sample

lower values of 4.76% (21–30 years) and 4.34% (31–40 years). Hence, this indicates that the prevalence of SSIs increases with age.

There was not much of a difference in the gender of the patients. The preponderance of female patients to develop SSI was 7.55%, compared to 6.38% in male patients.

The prevalence of SSIs was 20% in patients with an ASA score of grade III, as compared to grade II, where the prevalence was 8.69%, indicating that the prevalence of SSIs increases with an increase in the ASA score.

The choice of antimicrobial prophylaxis mainly depended upon the type of surgery performed (Table 2).

Gastroduodenal procedures were mainly administered a combination of inj. cefoperazone (1000 mg) + sulbactam (500 mg) or a combination of inj. ceftriaxone (1000 mg) + sulbactam (500 mg) administered to 41 and 21% of the patients, respectively. Meanwhile, gynecological procedures associated with the abdomen (LSCS and total abdominal hysterectomy) were administered inj. cefotaxime (1000 mg) and inj. metronidazole (500 mg), administered to 18% of the patients. The remaining antimicrobial prophylaxis was prescribed based on the type of surgery and patient parameters such as age, ASA score, duration of surgery, and other significant factors.

The prevalence of SSIs was seen predominantly in open surgeries as compared to laparoscopic surgeries (Table 3). The prevalence of SSIs was found to be 27% in open hernia mesh repair, 10% in open appendicectomy, and 33% in open cholecystectomy. In special surgeries such as intramuscular abdominal wall hematoma exploration and evacuation and open appendicectomy with umbilical hernia repair, the prevalence of SSIs was found to be 100%. This higher SSI rate may be due to a small subgroup in the sample.

The SSIs developed between a period of 5–21 days in this study. The types of wounds were noted as clean (42.85%), clean-contaminated (42.85%), and contaminated (14.28%). Patients presented with symptoms such as wound discharge (85.71%), tenderness (42.85%), redness (28.57%), and fever (14.28%).

The most common cause was attributed to sterility not being maintained, followed by presence of comorbidities like uncontrolled type 2 diabetes mellitus. Other causes include bacterial contamination, hospital-acquired infections, and types of wounds. The patients were promptly treated with proper antibiotics for the same.

Conclusion

This study of antimicrobial prophylaxis for major abdominal surgeries conducted in tertiary care hospitals has shown the prevalence of SSIs as 7%. The prevalence of SSIs in our study is low as compared to other similar studies conducted at tertiary care hospitals in India (6.09–38.7%). This may be due to the strict adherence of antibiotic policy of the hospital which usually sets the choice, correct timing of administration, and the duration of antimicrobial prophylaxis.

In this study, the antimicrobial prophylaxis administered in majority of cases (41%) was a combination of inj. cefoperazone (1000 mg) with sulbactam (500 mg). In some studies, the prevalence of SSIs is increased due to the inclusion of high-risk cases (ASA score of grade IV and above and presence of comorbidities). Whereas, in this study, it is low and it may be due to a small sample size, patients with an ASA score not exceeding grade III, exclusion of patients <18 years or >70 years, and appropriate administration of antimicrobial prophylaxis, with respect to their choice, dosage, timing and duration of action.

When compared to international standards, where the incidence of SSIs was found to be between 2 and 5%,[10] the prevalence of SSIs in this study is higher. We should also adopt prophylactic measures before, during, and after surgery. Here the prevalence of SSIs could have been reduced by taking up stringent sterile measures, preoperatively and postoperatively, by making the surgical procedures less invasive and of a shorter duration.

Although SSIs cannot be eliminated, a decrease in the rate of infection to a minimum has significant benefits, not only by reducing surgical morbidity and mortality but also being cost-effective and conservation of healthcare resources.

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