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Original Research Article

A comparative study between single antibiotic prophylaxis and double antibiotic prophylaxis for reduction in incidence of surgical site infection in patients undergoing mesh hernioplasty

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ABSTRACT

Background: This study aims to evaluate and compare the effect of single antibiotic prophylaxis and double antibiotic prophylaxis for reducing incidence of surgical site infection (SSI) in patients undergoing mesh hernioplasty.
Methods: It is a prospective study conducted at general surgery inpatient department, Rama medical college hospital and research centre, Hapur, U.P. from December 2022-March 2024. Intervention was surgery mesh hernioplasty. Injection ceftriaxone 1 gm (third generation cephalosporin) in single antibiotic group and injection ceftriaxone 1 gm (third generation cephalosporin) + injection amikacin 500 mg (Aminoglycoside) in double antibiotic group were given. Patients of either gender between 14-80 years of age with primary, unilateral or bilateral inguinal hernia, femoral hernia, umbilical hernia, ventral hernia or incisional hernia who are planned to undergo mesh hernioplasty were included and patients with diabetes mellitus, on steroid therapy, cigarette smokers, immunocompromised status like HIV, malignancy and abnormal KFT/RFT were excluded. Single and double antibiotic group were divided.
Results: The incidence of SSI in both groups was noted. The incidence of SSI in single antibiotic group (28%) was higher than the incidence of SSI in double antibiotic group (12%). No patient underwent mesh removal and no significant difference in terms of post-operative complications was observed in the results of both groups.
Conclusions: Double antibiotic prophylaxis was more effective than single antibiotic prophylaxis in decreasing the incidence of SSI in patients who undergo mesh hernioplasty by 16% as per the study.

Keywords: Surgical site infection, Hernioplasty, Antibiotics, Prophylaxis

INTRODUCTION

Surgery that involves an incision in the skin can lead to a postoperative wound infection, which is also known as SSI. The SSI occurs within 30 days after the operative procedure if no implant is left in place, or within 1 year if implant is in place, and the infection appears to be related to the operative procedure.[1]

SSIs account for 20% of health care–acquired infections and result in significant morbidity and hospital costs and are associated with increased length of stay and a two-fold to eleven-fold increase in the risk of mortality.[2]

Hernia repair surgery is the most commonly performed surgery worldwide. Several surgical techniques have been described, with access to anterior or posterior spermatic cord, by the open or laparoscopic approaches, and with or without prosthetic materials. Since 1975, Lichtenstein tension free repair using polypropylene mesh is the gold standard procedure for inguinal hernioplasty.

Mesh reinforcement allowed tension-free repairs, improved perioperative pain and shortened hospital stay, and was associated with decreased long-term hernia recurrence rates.[3]

Mesh infection is a highly morbid complication after hernia surgery. It is associated with hospital re-admission, increased healthcare costs, re-operation, hernia recurrence, impaired quality of life and plaintiff litigation. The overall rate of hernia mesh infection ranges from 1 to 8% in various series. This is related to pre-existing patient comorbidities, surgical technique, mesh selection and infection risk prevention strategies in individual institutions. The onset of mesh infection is associated with a contaminated surgical field, a prolonged operation time or early wound complications. Open ventral hernia mesh repairs have higher reported mesh infection rates (6-10%) than laparoscopic hernia repairs (0-3.6%).[4]

The onset of mesh infection is associated with a contaminated surgical field, a prolonged operation time or early wound complications. Open ventral hernia mesh repairs have higher reported mesh infection rates (6-10%) than laparoscopic hernia repairs (0-3.6%). Patients with large, complex ventral or inguinal hernia requiring open surgery who have multiple comorbidities (advanced age, American society of anaesthesiologists (ASA) score ≥3, malnutrition, diabetes, immunosuppression, tobacco smoking or obesity (BMI ≥35 kg/m^2) are particularly at risk. Despite the published rates of SSI in clean surgery being historically <2%, the SSI rate in clean open inguinal hernia surgery varies from 2.4 to 4.9%.[5,6]

The most common bacteria associated with prosthetic mesh infection are *S. aureus* (57.7%), of which up to half are methicillin-resistant *S. aureus* (MRSA). Other bacterial species include *S. epidermidis, Enterococcus faecalis*, Gram-negative bacteria (26.1%) (*E. coli, Klebsiella* spp., *P. aeruginosa*, *Enterobacter cloacae*) and Gram-positive anaerobic cocci (*Peptostreptococcus*, *Finegoldia* spp.). One study found in 63% of postoperative incisional hernia mesh repair infections, the causative organism was MRSA.[6]

The global estimates of SSI have varied from 0.5% to 15%, studies in India have consistently shown higher rates ranging from 23% to 38%.[7]

According to a study conducted at tertiary care hospital, Gujarat the pathogens isolated from SSI culture were *E. coli* (35.7%), *Klebsiella* spp. (21.4%), Coagulase negative *Staphylococci* (14.3%), *P. aeruginosa* (14.3%), *S. aureus* (7.1%) and *Proteus mirabilis* (7.1%).[8]

Research done by Hallander et al in national bacteriological laboratory, Sweden has showed synergism between aminoglycosides and cephalosporins against pseudomonas.[9]

This study aims to evaluate and compare the effect of single antibiotic prophylaxis and double antibiotic prophylaxis for reducing the incidence of SSI in patients undergoing mesh hernioplasty.

METHODS

Study design

It was a prospective study.

Study area

Study conducted at general surgery inpatient department, Rama medical college hospital and research centre, Hapur, U. P., India.

Study period

Study carried out from December 2022 to March 2024.

Intervention

Surgery-mesh hernioplasty was performed.

Medication

Injection ceftriaxone 1 gm (third generation cephalosporin) in single antibiotic group and injection ceftriaxone 1g (third generation cephalosporin) + injection amikacin 500 mg (Aminoglycoside) in double antibiotic group were given.

Inclusion criteria

Patients of either gender between 14-80 years of age with primary, unilateral or bilateral inguinal hernia, femoral hernia, umbilical hernia, ventral hernia or incisional hernia who are planned to undergo mesh hernioplasty were included.

Exclusion criteria

Patients with diabetes mellitus, on steroid therapy, cigarette smokers, immunocompromised status like HIV, malignancy and abnormal KFT/RFT were excluded.

Groups

There were two groups-Single antibiotic group and double antibiotic group.

Patients of either gender between 14-80 years of age with primary, unilateral or bilateral inguinal hernia, femoral hernia, umbilical hernia, ventral hernia/incisional hernia who are planned to undergo mesh hernioplasty in the general surgery IPD from December 2022 to March 2024 will be enrolled in this prospective study after obtaining a written or verbal informed consent, and a full detailed medical and surgical history of patient will be recorded.

Medication consisting either injection ceftriaxone 1 gm in single antibiotic prophylaxis group, or injection ceftriaxone 1 gm + injection amikacin 500 mg in double

antibiotic prophylaxis group, will be given in such a manner, that the optical difference is excluded and the patient or the operating surgeon will not be aware of the group to which the patient is belonging to.

In short, the surgical site (part) of the patient will be prepared by trimming of the hair in the previous night. Then the surgical site will be cleaned with betadine scrub for 3-5 minutes before the surgery. After anaesthetizing the patient, the trial medication will be given. Then the incision site will be painted at least four times with 5% betadine solution for 3-5 minutes.

The operation will be performed by faculty or by resident assisted by a senior surgeon. A monofilament polypropylene flat mesh will be sutured in place using monofilament polypropylene (prolene). Types of anesthesia and skin closure will not be not standardised.

All the collected data will be recruited using a predesigned pro-forma. Data will be entered in the Microsoft excel sheet. Statistical analysis will be done. Patients will be first examined on second post-operative day for SSI. Then patients will be reviewed after one week, two weeks and four weeks. Thorough clinical examination will be done to rule out SSI. Wound infection is defined by the centres for disease control and prevention criteria. If the patient develops SSI, he will be initially managed with dressing alone. If required even a suture will be removed to let out the discharge. If there is no response or infection is progressing, antibiotics will be started.

RESULTS

The present study was conducted in the department of general surgery Rama medical college hospital and research centre, Hapur, U.P. from the period of December 2022 to March 2024. Proper institutional ethical committee clearance was obtained.

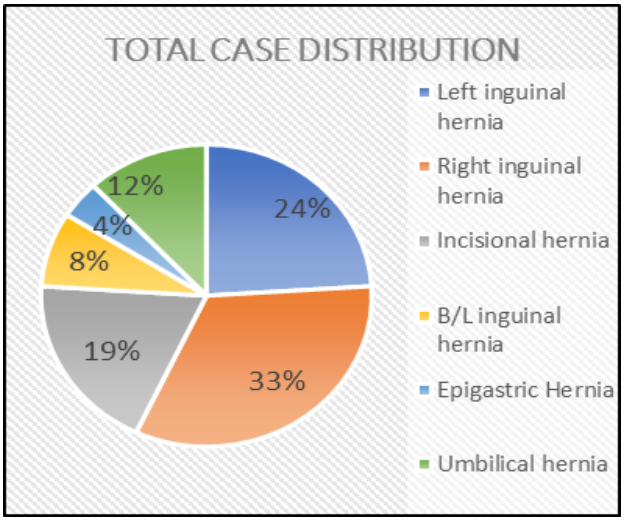

Figure 1: Total case distribution.

The study involved 100 cases of clean and clean contaminated cases (Figure 1) randomized to 2 groups of 50 each i.e. 50 cases in single antibiotic group and 50 cases in double antibiotic group.

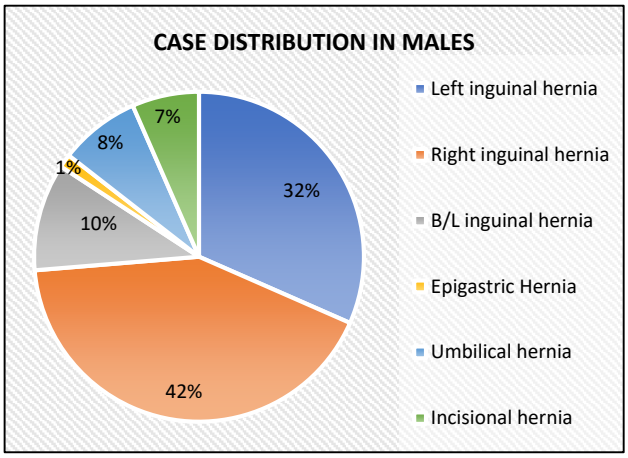

Figure 2: Case distribution in males.

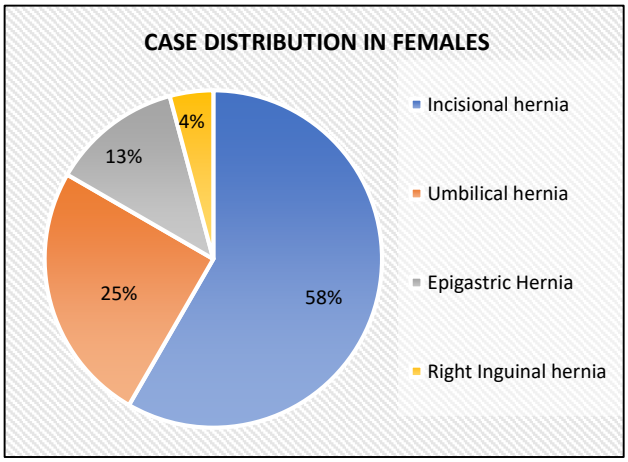

Figure 3: Case distribution in females.

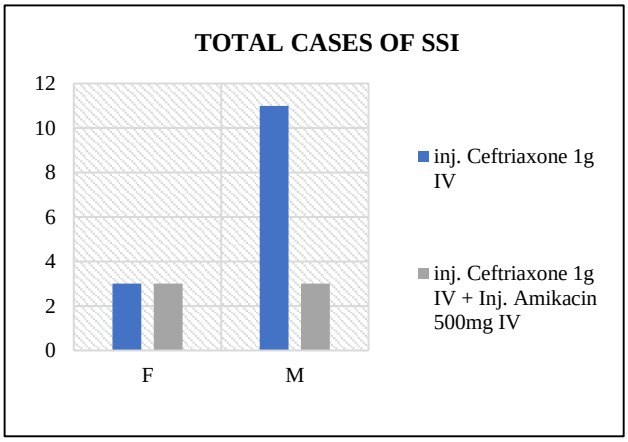

Figure 4: Total cases of SSI.

Cases in single antibiotic group received a single dose of injection ceftriaxone 1 gm IV given at the time of

induction and cases in double antibiotic group received a single dose of inj. ceftriaxone 1 gm + inj. amikacin 500 mg IV given at the time of induction.

Neither of groups received any further antibiotics IV or oral.

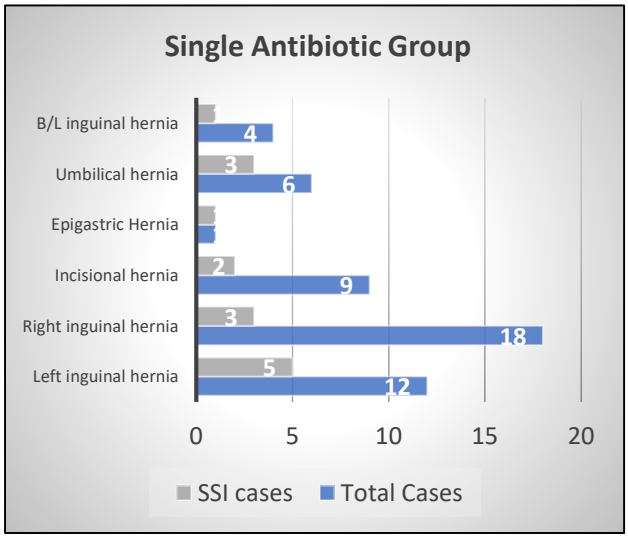

Figure 5: Single antibiotic group.

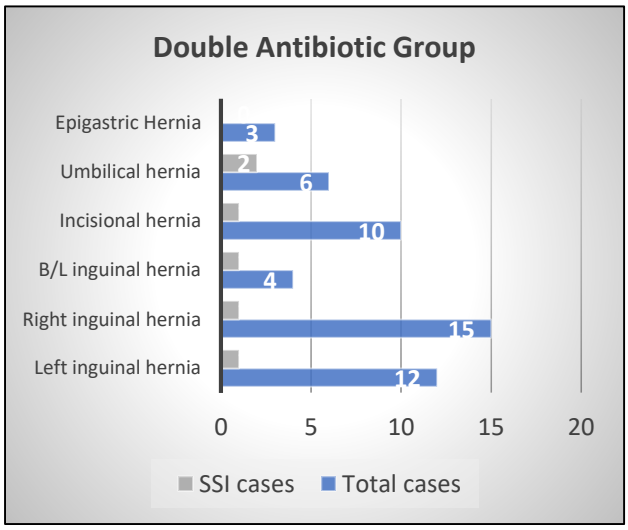

Figure 5: Double antibiotic group.

In my research, the occurrence of SSI was recorded at 28% in the single antibiotic group (Figure 5). Among these cases, 7 patients exhibited SSI symptoms on POD2, while another 7 patients manifested SSI symptoms 1 week after surgery.

The double antibiotic group demonstrated a lower incidence of SSI at 12% (Figure 6). Among these cases, only 2 patients displayed signs of SSI on POD2, 3 patients exhibited SSI symptoms 1 week after surgery and 1 patient showed signs of SSI 2 weeks after the surgery.

DISCUSSION

In all 20 SSI cases (Figure 4) culture and sensitivity of discharge was done. Results are as follows: 9 were infected by *S. aureus*, sensitive to linezolid, gentamicin and ciprofloxacin; 5 by *E. coli*, sensitive to imipenem, ciprofloxacin and nitrofurantoin; 4 by methicillin-resistant *S. aureus*, sensitive to vancomycin and linezolid; and 2 by *P. aeruginosa*, sensitive to piperacillin-tazobactam, ceftazidime and gentamicin

In our study, it became evident that the predominant causative agent of SSI was *S. aureus*, with a breakdown of 45% for SA and 20% for MRSA, collectively contributing to 65% of all SSIs. Following closely were cases attributed to *E. coli* (25%) and *P. aeruginosa* (10%).

Every patient diagnosed with SSIs received standardized treatment as per the protocol, initially receiving empirical therapy with inj. amoxicillin (1000 mg) and clavulanic acid (200 mg) IV. Subsequently, definitive antibiotic courses were administered based on individual culture and sensitivity reports. Notably, none of the patients underwent mesh removal, and the analysis revealed no significant disparity in post-operative complications between the two groups.

In a meta-analysis done by Sanabria et al showed 50% protective effect of prophylactic antibiotics on decreasing the SSI rate in patients submitted to mesh inguinal hernioplasty.[10]

In an RCT done by Igwemadu et al named “single-dose versus multiple-dose antibiotics prophylaxis for preventing caesarean section postpartum infections” concluded that single-dose ceftriaxone and metronidazole is as effective as multiple-dose antibiotic prophylaxis to prevent post-caesarean section infectious morbidity.[11]

No prior studies have been published evaluating the comparative prophylactic efficacy of single antibiotic (cephalosporin) and double antibiotics (cephalosprin + aminoglycoside).

In our research, the occurrence of SSI was recorded at 28% in the single antibiotic group. Among these cases, 7 patients exhibited SSI symptoms on POD2, while another 7 patients manifested SSI symptoms 1 week after surgery.

The double antibiotic group demonstrated a lower incidence of SSI at 12%. Among these cases, only 2 patients displayed signs of SSI on POD2, 3 patients exhibited SSI symptoms 1 week after surgery and 1 patient showed signs of SSI 2 weeks after the surgery.

The findings from this study indicated a notable reduction in the incidence of SSI among patients undergoing mesh

hernioplasty who received a double antibiotic regimen compared to those in the single antibiotic group.

Limitations

Small sample size: A limited number of subjects may reduce the statistical power of the study, making it difficult to generalize the findings to a larger population. A more extensive dataset is needed to validate the effectiveness of double antibiotic prophylaxis.

Lack of multicentre data: Conducting the study at a single institution or region may introduce selection bias and limit the generalizability of results. A multicentre approach with diverse patient populations would provide stronger evidence.

CONCLUSION

The study provides clear evidence indicating that patients who received double antibiotic prophylaxis have a lower likelihood of developing surgical site infections compared to those who received single antibiotic prophylaxis. According to the study, double antibiotic prophylaxis was found to be more effective than single antibiotic prophylaxis in reducing the incidence of surgical site infections in patients undergoing mesh hernioplasty by 16%.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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