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Original Article

# Prophylactic Single-dose Antibiotics to Prevent Surgical Site Infection

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## Abstract

**Introduction:** Surgical site infections (SSIs) are associated with multiple hospital visits and incur additional costs. The infection can be translocated to a sterile site through the endogenous flora. Seeding of the surgical site from a prosthesis or implant can also occur. The reasons for SSI include virulent bacterial inoculums, host defense, and poor intraoperative/post-operative care. This study was conducted to investigate the prevention of SSI in patients who receive a single dose of prophylactic antibiotic before surgery.

**Aim:** This study aims to evaluate the effect of prophylactic single-dose antibiotic in surgical wound site to prevent surgical site infection and assess the outcome.

**Materials and Methods:** Fifty patients posted for elective surgery were selected for the study and informed consent was obtained. Patients with comorbid conditions were excluded from the study. Surgeries were performed following NICE guidelines and the study was conducted after approval from the Institutional Ethics Committee.

**Results:** The mean age of the patients was 46 years and most of the study patients were of the age group 41–50. Majority of the patients underwent hernioplasty (32%). SSI was noted in 3 patients (6%), and *Staph. aureus* was the predominant bacteria found in the infected site.

**Conclusion:** A single prophylactic dose of antibiotic is effective in preventing SSI, provided the surgical procedure is uncomplicated.

**Key words:** Antibiotic prophylaxis, Single-dose antibiotic, Surgical site infection, hernioplasty, Surgical wound infection

## INTRODUCTION

Surgical site infection (SSI) is the leading cause of nosocomial infection that occurs at or near the surgical incision within 30 days of the operation.[1] In the United States, approximately 500,000 surgical site infections occur annually as estimated by the Centers for Disease Control and Prevention (CDC).[2] The economic burden of patients with surgical site infections is much higher than that for surgical patients without the infections. SSIs reduce patients' quality of life and also account for prolonged hospital stays and an annual cost of more than $1.6 billion.[3] Furthermore, SSI is also associated with an increased mortality rate and the chances of being readmitted to the hospital are above 60%. Methicillin-resistant *Staphylococcus aureus* (MRSA)-related SSIs have a relatively high mortality rate than those of the other organisms.[4]

The efficacy of single-dose antibiotic prophylaxis in clean surgery has been well established over the past 20 years. Antibiotics augment the natural immune defense mechanisms in the host and kill bacteria that are inoculated into the wound. This is the guiding principle behind antibiotic prophylaxis and it should be ensured that the systemic antibiotic levels are maintained above the minimum inhibitory concentration (MIC) of the pathogen of concern throughout the surgery.[5] Studies report that the incidence of post-operative SSI without an antibiotic prophylaxis is around 30–40%

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and a single-dose (SD) administration is as effective as multiple dose (MD) antibiotic prophylaxis. A recent randomized control study even proved that a SD of the 2nd generation cephalosporin was equally effective as MD antibiotics.[6,7]

The use of the less expensive appropriate antimicrobial agents for the prevention of SSI has also been demonstrated in many published studies. This study was conducted to evaluate the effectiveness of a prophylactic single-dose antibiotic in elective surgery to reduce surgical site infection in clean and contaminated wounds.

### Aim

This study aims to evaluate the effect of prophylactic single-dose antibiotic in surgical wound site to prevent surgical site infection and assess the outcome.

## MATERIALS AND METHODS

The study was conducted in the surgery Department of General Surgery at Government Headquarters Hospital, Dindigul. Among 50 patients posted for elective surgery during the period February 2019–December were included 2019. All patients above 18 years of age and who had no signs of infections, with a normal renal and coagulation profile and with no comorbid conditions such as HT, diabetes, asthma, and bleeding disorders were included in the study. No patient received any antibiotics 14 days before the surgery and informed consent was taken from all the study participants. Patients under 18 years of age, who had comorbidities, those who were on antiretroviral drugs, steroids, and other immunosuppressants, those with signs of infection, and those not willing to participate in the study were excluded from the study. The study was duly approved by the Institutional Ethics Committee and all pre-operative tests (hemoglobin, RFT, coagulation profile, chest X-ray, ECG, blood sugar, and BP) were performed on all the study patients.

NICE guideline for patients as well as medical professionals was followed. The patients were asked to bath using a non-medicated soap 1 day before the surgery and the specific surgical theaters were washed and dried. The operating team washed the hands (following NICE guideline) before the surgery and sterile gowns and two pairs of operating gloves were used. Single dose of parenteral ciprofloxacin 400mg IV antibiotic prophylaxis injection was administered intravenously 30 min before the incision. Intraoperative homeostasis was achieved following NICE guideline and a sterile dressing was given to the surgical incision at the end of the surgery. The surgical site was regularly assessed until suture removal and proper follow-up visit was scheduled. The patients were examined for fever or deep SSI. In the case of fever/signs of pus or infection, CBC was done, and pus sample was collected for culture sensitivity. Regular wound dressing was done and it was allowed to heal with secondary intention. The patients were followed up for a period of 1 month. Broad-spectrum antibiotics were prescribed to patients with surgical site infection and switched to specific antibiotics after pus culture sensitivity reports. The data were properly analyzed based on distribution of age and surgery.

## RESULTS

A total of 50 patients ($n$ = 50) posted for elective surgery were included in the study. The duration of the surgery in majority of the patients was <2 h. Out of the 50 study participants, 32 were male and 18 patients were female. Most of the patients belonged to the age group of 41–50 years (52%) and the mean age was 46 years. About 26% of the study patients were >51 years of age, Figure 1.

Appendicectomy was planned in 4% of the patients, cholecystectomy in 16%, hernia mesh repair in 10%, hydrocele in 8%, cystolithotomy in 2%, and other surgical excisions in 28% of the patients. Majority of the patients underwent hernioplasty (32%) [Figure 2].

Three cases, one each in appendicectomy, cholecystectomy, and hernioplasty, had evidence of pus and sample was sent for pus culture and sensitivity. Figure 3 depicts the distribution of SSI in the patients. All the patients were discharged on the 4th–9th post-operative day. Regular follow-up was done in patients who had surgical site infection, wound dressing was done, and oral antibiotics were started. As a consequence of surgical site infection, patients suffered a longer recovery time and incurred additional cost. Patients even needed multiple visits to the hospital. The pus sample was collected and sent to the laboratory for sensitivity testing. *Staphylococcus aureus* was the predominant bacteria in the pus samples responsible for SSI.

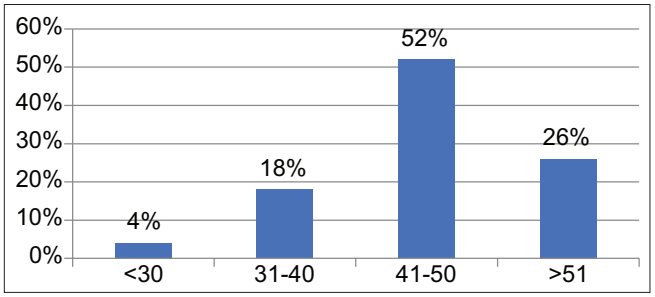


**Figure 1: Distribution of age group**

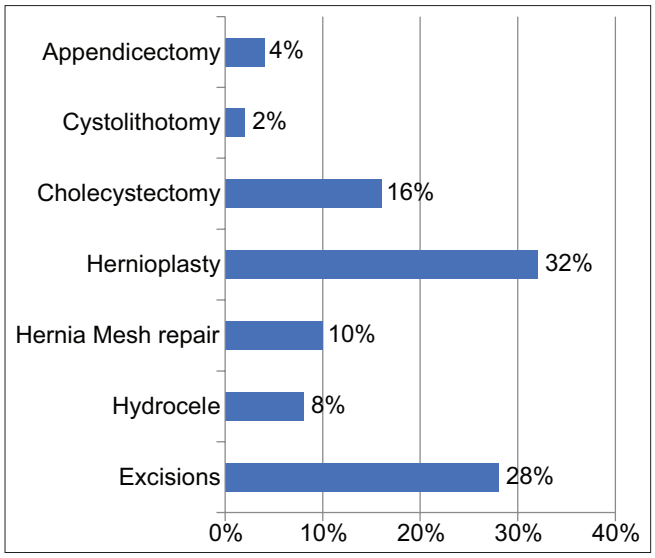


**Figure 2: Distribution of surgery**

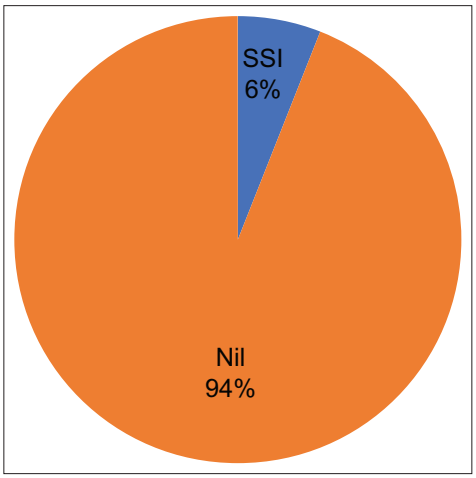


**Figure 3: Distribution of SSI**

## DISCUSSION

Post-operative infections, wound drainage, and sepsis were very common until the mid-19th century until the principles of antisepsis were implemented by Joseph Lister in the late 1860s. This fundamental work changed the infections and deaths associated with an operation to reduced suffering and extended life.[8] The "window" of prophylactic effectiveness was shown by Miles and his colleagues and Bruke, while working with the guinea pig wound infection model. They found that antibiotics administered shortly before or at the time of bacterial inoculation of the guinea pig caused a significant decrease in the size of wound indurations relative to lesions in animals that did not receive any antibiotic prophylaxis.[1]

Prophylactic antibiotics, administered at an optimal time before the surgery, can minimize the risk of SSI. Many studies have been conducted in this regard that prove the effectiveness of a properly administered SD antibiotic in preventing post-operative infections. A double-blind RCT by Thakur and his associates in the year 2010 among 55 patients of inguinal hernia showed that a single dose of cefuroxime sodium had beneficial effects in reducing the incidence of SSI. The percentage of SSI in his study was 10.3% in the prophylactic group in superficial SSI (11.5% in control group) and 0% in deep SSIs (3.8% in control group).[9]

In our study, a low incidence (6%) of post-operative surgical site infection was observed. The infection rates were 2% in appendicectomy, 2% in cholecystectomy, and 2% in hernioplasty. Out of the 32% of the patients who underwent hernioplasty, only 2% incidence of SSI was observed. The association between comorbid conditions and the risk of occurrence of SSI could not be demonstrated in this study. All the surgeries were performed within 2 h and NICE guidelines were followed. Out of the 4% of the appendicectomy patients, 2% had post-operative wound infection which is significant. *Staphylococcus aureus* was the most commonly found organism in the infected sites in our study, and a similar pattern of microflora was demonstrated by Anvikar *et al.* and Olson and Lee in his study.[10,11]

In a trial by Hughes *et al.*, where penicillin was given intravenously in a single prophylactic dose, the post-operative infection rates were significantly reduced when compared to the rate when no prophylactic dose was administered.[12] Age > 46, immunosuppression, poor nutrition, and obesity are all risk factors for SSI. A thorough knowledge in these regards can help the surgeon and the medical staff to effectively prevent SSIs and also reduce the cost burden on the patient. The appropriate time of administration of the prophylactic dose, additional care to contaminated, long and complicated surgical procedures, the half-life of the administered antibiotic, the duration of the surgery, and following proper asepsis measures can play a strong role in reducing post-operative SSI.

## CONCLUSION

A single-dose prophylactic antibiotic is very efficient in reducing the risk of post-operative wound infection. Prophylactic antibiotics can be administered within 30 min before incision and have a desired safety from surgical site infection. Complicated, contaminated, or dirty procedures should receive additional post-operative coverage.

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