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Original Article

Clinical Evaluation of Role of Antibiotic Prophylaxis in Elective Surgical Cases

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Abstract

Background and Objectives: The prevention of surgical site infection (SSI) remains a focus of attention because wound infections continue to be a major source of expense, morbidity, and even mortality. Prolonged use of prophylactic antibiotics is associated with emergence of resistant bacterial strains. The objective of the study was to obtain precise information on the optimal time window for surgical antimicrobial prophylaxis and to compare single-dose intravenous (iv) ceftriaxone pre-operatively versus 5 days ceftriaxone iv for prophylaxis post-operatively.

Methods: A prospective study was carried out on 100 admitted patients and was evaluated clinically. Patients were divided into Protocol 1 and Protocol 2. Protocol 1 patients received pre-operative single dose of 1 g ceftriaxone iv no post-operative antibiotics. Protocol 2 patients did not receive any antibiotics pre-operatively but post-operatively were given 1 g ceftriaxone iv at 12th hourly intervals after surgery for a minimum of 5 days. Results in the two groups were compared and interpreted.

Results: In this study, Protocol 1 showed 8% infection rates, whereas Protocol 2 showed 12% infection rates ($P > 0.05$). There was increase infection rate in Protocol 2 patients. There was increase in duration of stay in infected patients (mean 8.8 days) compared to non-infected patients (mean 3.35 days). Out of 50 cases of Protocol 1, 25 cases received antibiotic prophylaxis half an hour before incision accounting for 1 (4%) infected case, and 25 cases received antibiotic prophylaxis 1 h before incision accounting for 3 (12%) infected cases ($P > 0.05$).

Conclusion: In our study, we have seen the importance of timing of the dose to be administered and that following closure, the administration of the antibiotics is not effective and not necessary. Single dose of 1 g injection ceftriaxone intravenously given within an hour before incision is sufficient to prevent SSIs, provided extra dose has to be given if the surgery has passed more than 3 h.

Keywords: Antibiotic prophylaxis, Ceftriaxone, Surgical site infection

INTRODUCTION

The emergence of prophylactic antibiotics has made a huge contribution toward extending the range and complexity of surgical procedures. Since then, the use of prophylactic antibiotics has exploded and constitutes 30% of antibiotic use in general hospitals.[1] In the 1940's and 1950's, experiments with sporadic prophylactic administration of antibiotics such as sulfonamides and penicillin did not yield encouraging results, until in the 1960's, when the importance of the timing of administration of dose emerged. The concept of single-dose pre-operative antibiotic administration was mooted by Strachan *et al.*,[2] in 1977, when they compared a single pre-operative dose of cefazolin with a regimen of cefazolin given for 5 days post-operatively. The present study is undertaken to compare a pre-operative single-dose protocol with a multiple post-operative doses in prevention of post-operative wound infections. As prolonged antibiotic use is associated with microbial resistance, we took a prospective study to obtain precise information on the optimal time window for surgical antimicrobial prophylaxis (AMP) and to compare single-dose intravenous (iv) ceftriaxone pre-operatively versus 5 days' ceftriaxone iv for prophylaxis post-operatively. The aim of our study was to obtain precise information on the optimal time window for surgical AMP and compare results of single-dose iv

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ceftriaxone pre-operatively versus 5 days ceftriaxone iv post-operatively.

MATERIALS AND METHODS

A prospective study was conducted on patients admitted in the Department of General Surgery from November 2012 to April 2015. The institute ethical committee clearance was taken and written informed consent was obtained from patients treated in general surgical ward of our hospital. The study involved 100 patients who underwent elective surgery procedure with normal workup investigations. Inclusion criteria included elective surgical procedures in clean and clean-contaminated cases of both sexes between the age group of 12 and 60 years. Exclusion criteria excluded immunocompromised patients, surgeries exceeding 3 h of duration, presence of any comorbid conditions such as diabetes mellitus, hypertension tuberculosis, or other chronic illness use of prosthetic materials. Patients were divided into Protocol 1 and Protocol 2. Protocol 1 patients received pre-operative single dose of 1 g ceftriaxone iv and no iv antibiotics was given for 24 h after surgery. Half of these patients received antibiotic half an hour before incision and the other half 1 h before incision. Protocol 2 patients did not receive any antibiotics pre-operatively but post-operatively were given 1 g ceftriaxone iv at 12th hourly intervals after surgery for a minimum of 5 days. Culture swabs were taken on the 3rd, 5th, and 7th post-operative days, if the wound was showing discharge or any other signs of infection. Antibiotics were changed according to culture sensitivity report, and the patients were studied from the time of their admission till they were discharged and followed up to 3 weeks postoperatively. Details of the individual cases were maintained in the pro forma.

RESULTS

Among 100 patients, majority of the cases fall into age group of 21-30 years. About 65% of the cases fall between 21 and 40 years. The most common procedure done was herniorrhaphy. Various surgical procedures done are depicted in Figure 1. There were 10 infected cases post-operatively (04 males and 06 females) with surgical site infection (SSI) rate was 10% (Table 1). The organisms encountered were *Escherichia coli* (4 cases), *Staphylococcus aureus* (3 cases), *Pseudomonas* (2 cases), and *Klebsiella* (1 case). The 2nd swab was taken following regular dressing on the 5th day from the wound. These cases required further antibiotic coverage and follow-up. The subsequent 3rd swab showed no growth.

Twenty-five cases were given injection half an hour before incision, and 25 cases were given injection 1 h before incision, accounting for 1 and 3 SSI cases, respectively. The overall wound infection rate in Protocol I group was 8%. Protocol 1 group showed 4 SSI cases (8%), and Protocol 2 group showed 6 SSI cases (12%). Out of 10 infected cases, 9 belonged to the age group of 21-40 years. Out of 55 male patients, 4 patients were showing wound infection. Out of 45 female patients, 6 patients were showing wound infection. Although no much statistical significance was observed in the study, female showed increased incidence of SSIs.

There was increase in duration of stay in the wound infected cases. The maximum duration of stay was 14 days and a minimum of 6 days was noted in this study with average number of days was 8.8 days for wound infected cases, whereas it was 3.35 days for non-infected cases (Table 2). SSIs lead to significant prolongation of hospital stay. Among the infected cases, majority were herniorrhaphy (4 cases), followed by appendicectomy (2 cases), cholecystectomy (2 cases), and anatomical repair (2 cases) as shown in Figure 2. All the infected wounds were followed up, and swabs were taken on post-operative day 3. Out of the two infected appendicectomy cases, one received antibiotic 1 h before surgery, whereas the other after the surgery. Out of the two infected cholecystectomy cases, one received antibiotic half an hour before while the other after the surgery. Out of the four infected cholecystectomy cases, one received antibiotic 1 h before surgery while the rest after the surgery. Out of the two infected anatomical repair cases, one received antibiotic 1 h before surgery while the other after the surgery. As shown in Figure 3, the most common isolate from the SSI site was *E. coli* (4 cases), then followed by *S. aureus* (3 cases), *Pseudomonas* (2 case), and *Klebsiella* (1 case). All these were sensitive to the prophylactic antibiotic that was used.

DISCUSSION

The scientific use of prophylactic antibiotic was laid by Hsu P *et al.*[3] in the late 1950s when they were

Table 1: Infection rates

Parameters	Number of infected wounds	Total number of patients (%)
Protocol 1	4	50 (8)
Protocol 2	6	50 (12)
Total	10	100 (10)

Table 2: Duration of stay in hospital

Parameters	Maximum stay (days)	Minimum stay (days)	Average (days)
Infected cases	14	6	8.8
Non-infected cases	7	1	3.35
Total cases	14	1	3.9

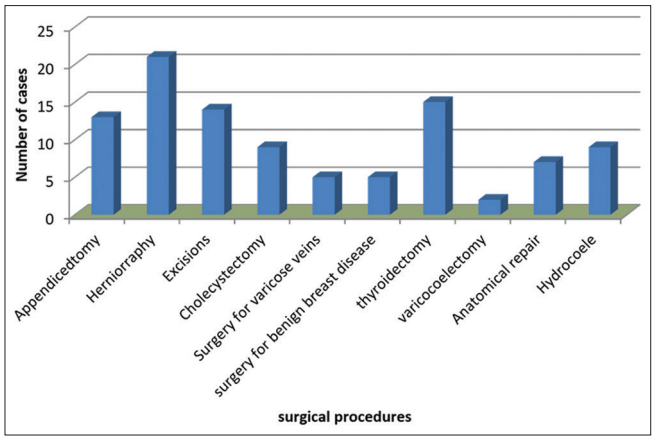

Figure 1: Surgical procedures done

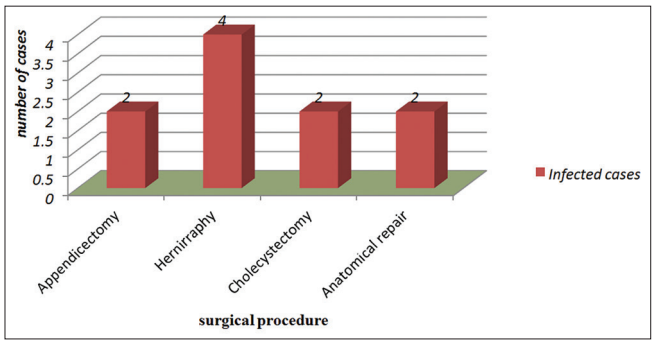

Figure 2: Infected cases in various surgical procedures

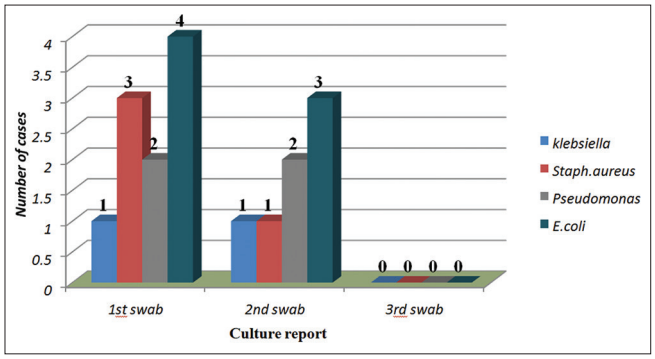

Figure 3: Culture report

able to show that infection could be prevented only when antibiotics were given prior or at the time of infectious challenge. SSI is worldwide problem, and many studies have reported varied infection rate. In our study, 10 cases had SSIs with an overall incidence of 10% infection rate similar to the one reported by Mead *et al.*,[4] Kumar and Mittal,[5] Devenish and Miles,[6] Agarwal *et al.*,[7] America University Center (8.4%),[8] and British Public Health Services (13.2%),[9] but differs from Mead *et al.*[4] and Kumar and Mittal.[5] which is less that of 3% and 6%, respectively. All SSIs were of superficial and deep incisional type. None of them developed organ/space SSIs.

Following incision, the normally sterile tissue is exposed to a non-sterile environment, and if the bacterial load exceeds the host defense capacity, the infection ensues. This bacterial load can be reduced by techniques of asepsis. Following closure of the wound, its environment is sealed by local intravascular coagulation and the events of early inflammation which initiate wound healing. This may explain the ineffectiveness of the post-operative antibiotic administration to prevent wound infection. Antibiotic administered pre-operatively diffuse into the peripheral compartment (wound fluid). This prevents the contamination with invading bacteria on exposure to the environment and surgical instrumentation.[8,9] Successful prophylaxis requires the tissue concentrations of antibiotics to be at peak levels at the time of incision and the effective concentrations to be maintained till closure.[10-12]

This study conducted with 100 patients has shown comparable infection rates in both the groups receiving antibiotic before and after the surgery. Within the group comparison in pre-operative group, with antibiotic given half an hour, and 1 h before surgery, showed no significant difference in infection rate. From this study, it can be concluded that following closure of clean and clean contaminated surgical wounds, the administration of the antibiotics is not very effective and not necessary. Single dose of 1 g injection ceftriaxone iv given half an hour before incision is sufficient to prevent SSIs, provided, an extra dose has to be given if the duration of the surgery has passed more than 3 h.

SSIs lead to significant prolongation of hospital stay. Patients who received or commenced AMP preoperatively did significantly better than those who received or commenced prophylaxis following surgery. Females had marginally increased risk of SSIs in comparison to males. The SSI rates increased with the increasing age. The most common isolate obtained in this study was *E. coli* and was sensitive to the AMP used. No resistant strains were seen. All SSIs responded well to regular dressing and antibiotics.

A pre-operatively given dose of antibiotic (within 2 h of incision) ensures peak tissue concentration when the incision exposes the normally sterile tissue to the bacterial challenge of a non-sterile environment and the surgical instrumentation. It is seen that antibiotic given 3 h following an infective bacterial challenge (surgery) is ineffective in preventing infection, as the bacteria may start multiplying before host defenses are activated, and if its concentration reaches to 100,000 organisms/gram of tissue, it may exceed host defense capacity.

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