

Original Research Article

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A study on comparison of short term three dose antibiotic prophylaxis with conventional prolonged postoperative antibiotic coverage in development of surgical site infections

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ABSTRACT

Background: Surgical site infections are still an increasing threat to the surgeons despite advances in techniques of surgery, patient care and sterilization practices. Most of the studies state that pre-operative antibiotic prophylaxis is effective in reducing the risk of wound infection in surgical procedures and has been a standard practice followed in many surgeries. Prolonged administration of prophylactic antibiotic has been associated with development of resistant bacterial strains and predisposes the patient in development of wound infection. The aim of the present study is to study the effectiveness of short term antibiotic coverage during decisive period in prevention of post-operative infection in surgical procedures.

Methods: A prospective randomized and comparative study was done for one year with 100 cases divided into two groups A and B. Group A received prophylactic Ceftriaxone three doses intravenously, 12 h before surgery 1st dose, 1h before surgery 2nd dose and third 10h after surgery. Group B received Ceftriaxone twice daily for 5 days after surgery. The two groups were compared for development of SSI and associated risk factors.

Results: The mean age of the total study group was 37.11 ± 12.12 years with 60% of males and 40% females. Overall incidence of SSI in study was 24% with Group A 10% and 14% in group B. Anemia, associated drain, increased BMI and undernourishment was associated risk factors and a statistically significant association was found with these risk factors in present study. *Pseudomonas* and *Methicillin* resistant *staphylococcus aureus* were the isolates in the study.

Conclusions: Present study strongly recommends the use of antibiotics during surgery than administration after surgery. More care and proper management of the cases are required with associated risk factors like increased BMI, presence of drain and low Hb%. Large multicentric studies are further required to establish further associated risk factors and to identify the local pathogens and their resistance pattern. Appropriate use of antibiotics can substantially reduce the emergence of resistant pathogens and limit the cost of treatment.

Keywords: Antibiotics, Ceftriaxone, *Methicillin* resistant *staphylococcus aureus*, *Pseudomonas*, Surgical site infections

INTRODUCTION

Surgical site infections are still an increasing threat to the surgeons despite advances in techniques of surgery, patient care and sterilization practices. They are the most

common health care associated infections as reported globally.¹ They are associated with prolonged hospital stay, increased economic loss, additional surgical procedures and increase chances of mortality. Multiple risk factors are involved in development of SSI ranging

from general health of the patients to type of surgery, wound and procedure employed. Few of the risk factors are modifiable eg: conditions of the operating room whereas few factors like diabetes mellitus, patient's immune status are non-modifiable.² Most of the studies state that pre-operative antibiotic prophylaxis is effective in reducing the risk of wound infection in surgical procedures and has been a standard practice followed in many surgeries.

However different studies propose administration of antibiotic at different timings of surgery and timing of first dose is considered as a crucial factor in reduction of SSI. Most of the studies suggest that there is no benefit in administration of antibiotic after wound closure and when compared to single dose and multiple dose administration revealed no benefit than single dose in reduction of SSI after procedure. Prolonged administration of prophylactic antibiotic has been associated with development of resistant bacterial strains and predisposes the patient in development of wound infection.^{3,4}

The basic surgical skills of post-operative precaution, pre-operative preparation, excellent surgical technique, fastidious wound care and post-operative management are corner stone's in prevention of SSI and infection prophylaxis. In case of elective and clean surgeries where respiratory, genital and alimentary canal is not involved the decisive period of administration of antibiotic is crucial and operations begin and end within this period. So it is always wise to administer prophylactic antibiotic during this period and to maintain the levels of antibiotics in tissues above the level of minimum inhibitory concentrations.⁵

The aim of the present study is to study the effectiveness of short term antibiotic coverage during decisive period in prevention of post-operative infection in surgical procedures.

METHODS

A prospective randomized and comparative study was conducted for a period of six months from July 2017 to December 2017 at a tertiary care hospital. The study was approved by the institutional ethical committee and the study protocol was followed as per the guidelines of the committee.

All the patients who were included in the study were clearly explained about the study and written and informed consent was obtained. All the patients who visited the general surgery OPD were considered for the study.

Inclusion criteria

- Patient aged ≥ 18 years who were admitted for elective clean surgeries and willing to consent for study.

Exclusion criteria

- Patients with preexisting contamination at site of surgery, with history of administration of systemic antibiotic one week before surgery, allergic to cephalosporin's, on steroids, surgical procedure that don't involve incision, patient who did not complete the follow up period.

Data collection

The data was collected by the trained physicians who were explained about the study, in a separately designed pre-coded questionnaire form. Data included demographic data; age and sex, other variables included type of surgery, type of anaesthesia used, co-morbidities, body mass index. The participants of the study were divided into two groups Group A and Group B randomly. Group A received prophylactic Ceftriaxone three doses intravenously, 12 hour before surgery 1st dose, 1 hour before surgery 2nd dose and third 10 hour after surgery. Group B received Ceftriaxone twice daily for 5 days after surgery. The postoperative care was similar in both the groups. However, the variables included the type of anesthesia, with or without drain in cases. Follow up was done at same time intervals in both the groups and development of SSI was noted and if occurred were graded as per Southampton Scoring system. 6 Pus samples were sent for isolation of the causative agent and antibiotic sensitivity of the isolate was noted. Predictors of development of wound infection include patient's age, co-morbidities and body mass index, Anemia, type of surgical technique and grading of wound.

Statistical analysis

All the data collected was entered in Microsoft excel spread sheet and corrected initially. The values were expressed as mean \pm standard deviation, percentages. Student t-test was used to compare the means and Chi-Square test to compare the data and 'p' value <0.005 was considered significant.

RESULTS

The present study was conducted at a tertiary care hospital of south India. A total of 100 patients who fulfilled the inclusion criteria were selected for the study. The study was conducted for a period of one year from January 2016 to December 2016. The selected participants were divided into Group A and Group B.

Age and sex distribution of cases: 26 cases in group A and 36 in group B were < 40 years of age. 24 cases in Group A and 14 in Group B were ≥ 40 years. The mean age of the study population in Group A was 37.12 ± 10.21 years and in Group B was 36.12 ± 20 years. The mean age of the total study group was 37.11 ± 12.12 years. The age range was 23-62 years in the study and in group A was 23-61 years and in Group B was 23-62 years.

However, the difference in the age groups in the study was not statistically significant. (P value > 0.05) Majority 60 cases (60%) were males in the study and 40 (40%) were females. In Group A 32 were males and 18 were

females and in Group B 28 were males and 22 were females. The difference in the sex incidence of the two groups was statistically insignificant with P value > 0.05. (Table-1)

Table 1: Factors associated with development of Post-operative wound infection.

Factors	Group A		Group B	
	Number of cases	Infected (%)	Number of cases	Infected (%)
Age				
< 40 years	26	4 (15.39%)	36	8 (22.22%)
≥40 years	24	6 (25%)	14	6 (42.85%)
TOTAL	50	10 (20%)	50	14 (28%)
Sex				
Male	32	5 (15.63)	28	8 (28.57)
Female	18	5 (27.78)	22	6 (27.27)
Hb% (gm)				
<11	16	7 (43.75)	14	7 (50)
>11	34	3 (8.82)	36	7 (19.45)
Nutritional status				
Normal	36	2 (5.56)	30	4 (13.34)
Obese	6	4 (66.67)	12	6 (50)
Undernourished	8	4 (50)	8	4 (50)
Drain				
Present	14	6 (42.86)	18	9 (50)
Absent	36	4 (11.11)	32	5 (15.63)

Incidence of post-operative wound infection in the study

The total number of cases with development of post-operative infection in the study was 24 (24%). In Group A the incidence was 10 (20%) with 4 males (15.39%) and 6 females (25%).

In group B the incidence was 14 (28%) with 8 males (22.22%) and 6 females (42.85%). The difference in the incidence of wound infection among different sexes and in different groups was found statistically significant. ($\chi^2 = 4.213$, df = 1, p value <0.05)

Grading of wound infection

In group A out of total 10 cases of post-operative wound infection, 6 were of Grade-1, 3 were of Grade-2 and only one was of Grade-3. In present study it was observed that in Group B, out of 14 cases 8 were of Grade-2, 3 of Grade-3 and 3 were of Grade-4.

The difference in the incidence of different grades of wound infection in Group A and Group B was statistically insignificant. (df = 3, P value > 0.05, $\chi^2 = 4.635$). No significant association was found between the type of surgical procedure and the development of wound infection in both the groups in present study.

Isolates and their antibiogram from wound infection

Pus was collected from grade 3 and grade-4 wounds from all the cases in both the groups. The isolates from the pus were *Pseudomonas* from one case in group B which was sensitive to Piperacillin + tazobactum and Meropenem. *Staphylococcus aureus* was the other isolate from all the other cases which was resistant to methicillin and sensitive to vancomycin, Teicoplanin and linezolid in the study.

Factor associated with development of wound infection in the study

Age

In group A 4 cases (15.39%) below 40 years developed post-operative wound infection and 6 cases (25%) were of above 40 years. The difference in the development of wound infection between the two age groups in Group A was not significant statistically. (df=1, P value > 0.05, $\chi^2 = 2.121$) In group B, 8 cases (22.22%) <40 years developed post-operative wound infection and 6 cases (42.85%) were above 40 years. The difference in the development of wound infection between the two age groups in Group B was not statistically significant. (df=1, P value > 0.05, $\chi^2 = 2.013$).

Sex

In Group A 5 cases of male (15.63%) and 5 cases of female (27.78%) developed post-operative wound infection. The difference in the incidence of post-operative wound infection between the two genders was not statistically significant. ($df=1$, P value >0.05 , $\chi^2 = 0.245$) In Group B, 8 male (28.57%) and 6 female (27.27%) developed wound infection postoperatively. However, the difference in the incidence of post-operative wound infection between the two genders in present study was not statistically significant. ($df=1$, P value >0.05 , $\chi^2 = 0.416$).

Hemoglobin

In present study, in cases of Group A, 7 cases (43.75%) with $Hb > 11\text{gm\%}$ developed post-operative wound infection and 3 cases (8.82%) with $Hb < 11\text{gm\%}$ developed wound infection. In Cases of Group B, 7 cases (50%) with $Hb > 11\text{gm\%}$ and 7 cases (19.45%) with $Hb < 11\text{gm\%}$ developed post-operative wound infection. The difference of post-operative wound infection in patients with $Hb > 11\text{gm\%}$ or with $Hb < 11\text{gm\%}$ was statistically significant in both Group A ($df=1$, P value <0.05 , $\chi^2 = 4.316$) and Group B ($df=1$, P value <0.05 , $\chi^2 = 3.248$). This observation clearly explains that development of post-operative wound infection was common in cases with low Hemoglobin values.

Body mass Index

In present study, In Group A, 2 cases with Normal BMI developed wound infection and 4 cases in obese and 4 in undernourished with low BMI developed post-operative wound infection. In Group B, the rate of wound infection in normal cases was 13.34% and 50% in obese and undernourished cases. This clearly states that rate of wound infection in group A was higher in obese cases and underweight cases than in normal cases. In cases of Group B, the rate of wound infection was almost equal in both obese and undernourished when compared to normal cases. The difference of post-operative wound infection was statistically significant in both group A and Group B cases. (Group A: $df=2$, P value <0.05 , $\chi^2 = 6.896$) (Group B: $df=2$, P value <0.05 , $\chi^2 = 9.458$) Comparing the overweight status of Group A and Group B patients, wound infection was statistically significant in Group B patients than Group A patients. (P value <0.05)

Presence of Drain

In Group A cases, 6 cases (42.86%) with drain developed post-operative wound infection and 4 cases (11.11%) without drain. In Cases of group B, 9 cases (50%) with drain and 5 cases (15.63%) without drain developed wound infection. This clearly indicates that presence of drain was associated with risk of development of wound infection. (Group A: $df=1$, P value <0.05 , $\chi^2 = 4.216$) (Group B: $df=1$, P value <0.05 , $\chi^2 = 4.258$). In present

study it was observed that drain was associated with development of wound infection and associated risk was more BMI and less Hb%.

DISCUSSION

Surgical site infections are a global problem in all types of surgeries in spite of an effective sterilization practices and well developed surgical procedures. However, the incidence rate of post-operative infections are less in clean surgeries than in contaminated surgeries in various studies reported globally. Development of SSI is multi factorial dependent and interrelated with many modifiable and non-modifiable factors. Antibiotic prophylaxis is one among the most important determining factors in development of wound infection in clean and contaminated surgeries. Most of the studies determine administration of antibiotic before or during surgery and few reported after surgery. In spite of antibiotic administration pre or post-surgery, SSI is still a substantial threat in terms of morbidity, mortality and economic burden.

In present study we compared the development of SSI with administration of antibiotic pre and during surgery with administration after surgery. The overall incidence of SSI in present study was 24% which is high when compared with many other studies. In developing countries, the incidence of SSI is high when compared to countries like US and UK where the rate is only 2-3% as mentioned in various studies. The incidence of SSI reported globally is 0.4-30.9/100 surgical patients.⁷

In present study the incidence of post-operative wound infection was less in Group A patients who received antibiotic pre and during surgery when compared with Group B cases who received post-surgery. A statistically significant association was also observed in wound infection between the two groups (P value <0.05) and in Group B cases who received antibiotic post-surgery the grading of the wound was also high. This can be explained by the fact that lesser incidence of wound infection may be due to lesser emergence of resistant strains in Group A cases when compared with Group B cases. Findings of present study were in concordance with the findings of Dellinger EP et al who reported the same in their studies.⁸ This clearly explains the superiority of three dose pre-operative regimen than post-operative administration in development of SSI. An effective three dose regimen helps in reducing the development of SSI and hospital stay.⁹ In the present statistically, significant association in development of SSI was found with $Hb < 11\text{gms\%}$, association of drain and with increased body mass index. (P value <0.05)

Yavuz S et al in their studies reported a clear association of reduced Hemoglobin as a risk factor in development of SSIs and was statistically significant in his study.¹⁰ Reduced hemoglobin reduces or impairs oxygenation to the tissues making the tissues more vulnerable for

development of infection. Reduced oxygenation to the tissues also retards wound healing making the site more favorable for development of resistant microbes leading to delay in treatment and increasing the hospital stay.¹¹

Choban et al in their study clearly mentioned that significant association exists between obesity (↑BMI) and development of SSI.¹² Increased BMI is associated with under micro perfusion, subcutaneous adipose tissue micro ischemia, increased wound tension cum tissue pressure and the oxygen availability to the wound. In present study a clear cut statistically, significant association was observed between development of wound infection in undernourished and overweight cases in both Group A and Group B patients which is in association with findings of Lewis et al.¹³

So, in the present study we observed clearly that a short course of antibiotic administration during surgery appears to be better than post-operative administration of antibiotic in preventing development of SSI. Associated risk factors for development of SSI include presence of drain, low Hb% and increased BMI. In present study it is also observed that post-operative administration of antibiotics is associated with development of high grade wound infection and more resistant organisms. These organisms increase the economic burden and increase the hospital stay by prolongation of duration of treatment.

CONCLUSION

Present study strongly recommends the use of antibiotics during surgery than administration after surgery. More care and proper management of the cases are required with associated risk factors like increased BMI, presence of drain and low Hb%. Large multicentric studies are further required to establish further associated risk factors and to identify the local pathogens and their resistance pattern. Appropriate use of antibiotics can substantially reduce the emergence of resistant pathogens and limit the cost of treatment.

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