Section: General Surgery

Original Research Article

PRE-OPERATIVE INTRA-INCISIONAL ANTIBIOTIC INFILTRATION AND PROPHYLACTIC INTRAVENOUS ANTIBIOTIC ADMINISTRATION FOR REDUCING SURGICAL SITE INFECTION

F.R.Jenitta Little Sophy[1], R.Lakshmi Devi[2], Sugirtharaj Sagayam[3], R.Rohit[4]

[1]Assistant Professor, Department of General Surgery, Tirunelveli Medical College Hospital, Tamilnadu, India.
[2]Assistant Professor, Department of General Surgery, Tirunelveli Medical College Hospital, Tamilnadu, India.
[3]Associate Professor, Department of General Surgery, Tirunelveli Medical College Hospital, Tamilnadu, India.
[4]Consultant, Department of General Surgery, Genezen Indus hospital, Madurai, Tamilnadu, India.

Received : *05/01/2023*
Received in revised form : *08/02/2023*
Accepted : *20/02/2023*

Keywords:
Ceftriaxone, laparoscopic surgery, Pre-operative intra-incisional infiltration antibiotic, prophylactic intravenous antibiotic, surgical site infection.

Corresponding Author:
Dr. Sugirtharaj Sagayam,
Email: jmlsugi@rediffmail.com.

DOI: 10.47009/jamp.2023.5.4.206

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2023; 5 (4); 1024-1028

Abstract

Background: Surgical site infections (SSIs) are of major concern since they make up almost 38% of all infections in surgical patients and are the most common nosocomial infections. They are associated with significant mortality and morbidity. Various routes and methods of antibiotic prophylaxis have been explored to mitigate the risk of SSI. Therefore, this comparative study was performed to assess the efficacy of pre-operative intra-incisional Ceftriaxone antibiotic infiltration in conjunction with intravenous (IV) versus prophylactic Ceftriaxone intravenous antibiotic therapy in reducing surgical site infection. **Materials and Methods:** 100 patients undergoing elective or emergency laparotomy surgeries were divided into 2 groups. Cases receive prophylaxis by intra-incisional Infiltration of the Antibiotic in addition to an IV dose (1 gram of ceftriaxone diluted with 10 ml of distilled water was infiltrated along with the incision site 20 minutes before incision after induction by the anaesthetist). Group B: Control group receives 1 gram of ceftriaxone administered intravenously 20 minutes before the surgery at the time of induction by an anaesthetist. **Results:** Post-operative SSI was noted in 12 cases in the case group and 29 in the control group. This observation that SSI was reduced in the cases group was statistically significant ($p < 0.001$). There was no statistical significance in SSI between those having elective or emergency surgery. When the wound was classified as dirty, a statistically significant result was noted regarding SSI outcome. **Conclusion:** Post-operative SSI was noted in 12 cases in the case group and 29 in the control group. This observation that SSI was reduced in the cases group was statistically significant ($p < 0.001$). There was no statistical significance in SSI between those having elective or emergency surgery. When the wound was classified as dirty, a statistically significant result was noted regarding SSI outcome.

INTRODUCTION

Surgical site infections (SSIs) have influenced the development of medical care throughout history. Before introducing Lister's aseptic method in the nineteenth century, wound complications played a key role in surgical death rates. Notwithstanding nearly two centuries of medical advancement, surgical infection management remains a major concern, and SSIs remain a major cause of nosocomial morbidity and mortality. As per the CDC's National Nosocomial Infection Study report, the prevalence rate of SSI is significantly high and accounts for nearly 38 % of all infections concerning surgical patients.[1,2]

The probability of having a surgical site infection is a risk associated with surgical patients. SSI can appear on the skin's surface, in the subcutaneous layer, in deep layers, in the area where the procedure is performed, or in a body organ. SSIs can cause pain, discomfort, loss of function, scar contractions, income loss, and reduced quality of life. Infections can manifest from a small purulent abscess to a

ISSN (O): 2687-5365; ISSN (P): 2753-6556

complicated life-threatening infection at the incision region.[2,3]

The medical community has been researching various ways of overcoming SSIs since the time of Joseph Lister. Previously, antibiotics were only given after surgery to treat an infection at the surgical site that had already developed. Antibiotic prophylaxis was later adopted as an alternative. The antibiotics first enter the systemic pool following intravenous antibiotic administration, followed by the peripheral pool. This leads to low levels of the antibiotic in the region where it is most required. This led to an exploration of different modes of administration of prophylactic antibiotics. The intra-incisional infiltration method results in a significantly high concentration of antibiotics at the incision site and helps achieve instantaneous effective levels. Here, the antibiotic adheres to the tissues in the incision site and results in a high concentration during the incision. The antibiotic absorption from the incision site has produced systemic coverage. Also, it carries the advantage of reducing antibiotic exposure to other body parts. In comparison, intravenous, intramuscular, or oral administration is associated with a substantial delay in attaining the desired drug levels for antimicrobial action.[4,5]

The rate of SSI depends on the specific operative procedure and the presence of concomitant risk factors. However, it needs to be stressed that half of the SSIs can be prevented by implementing evidence-based practice.[1,4] Therefore, this comparative study was performed to assess the efficacy of pre-operative intra-incisional Ceftriaxone antibiotic infiltration in conjunction with intravenous (IV) versus prophylactic Ceftriaxone intravenous antibiotic therapy in reducing surgical site infection. Ceftriaxone was chosen because of its long half-life and proven effectiveness against various wound pathogens, even the obligate anaerobes, at quantities likely to be found locally.[4]

MATERIALS AND METHODS

This case-control comparative study was conducted on 100 patients undergoing surgery in the Department of General Surgery, Tirunelveli Medical College and Hospital, India, between September 2018 to July 2020. Institutional review board clearance and informed patient consent were obtained. All adult patients aged >20 years undergoing laparotomy

Surgeries for elective or emergency surgeries where Gastro-Intestinal Tract (GIT) was entered and those who willingly consented to be a part of the study and were not allergic to the test dose of ceftriaxone were included in the study. Patients who are allergic to the test dose of ceftriaxone and those suffering from liver failure, jaundice, diabetes, immunocompromised, and on prolonged steroid therapy were excluded.

A detailed clinical history, examination, and relevant radiological and biochemical investigations were performed on all the patients. The patients were randomly divided into case and control groups containing 50 subjects. A test dose of 0.5 cc intradermal ceftriaxone was given before iv, and the patient was observed for any adverse drug reaction.

Cases receive prophylaxis by intra-incisional infiltration of the

Antibiotic in addition to IV dose (1 gram of ceftriaxone diluted with 10 ml of

distilled water was infiltrated along with the incision site 20 minutes before the incision

after induction by the anaesthetist).

The control group received 1 gram of ceftriaxone administered intravenously 20 minutes before the surgery at the induction time by an anaesthetist.

Procedure

One gram of ceftriaxone diluted in 10 ml of distilled water (whose concentration equals 100 microgram/ml) was infiltrated uniformly around the margins of the incision planned for surgery using a disposable syringe and 16 Gauge needle in the subcutaneous tissue plane.

Sterile occlusive dressings covered the operative site for 48 hours in case of emergency surgeries and 72 hours for elective cases. The dressing was removed, and the suture site was first inspected after the period mentioned above. After that, the wound site was left open and was inspected every day except in patients who developed an infection. Assessment of SSI was done by assessing complications like infection, wound dehiscence, and wound discharge and classified as serious, seropurulent, and purulent discharge was observed and documented as per the Centres for Disease Control and Prevention Guidelines 2020. In cases where surgical site infection was suspected, the occlusive dressing was removed and switched to wound wash with normal saline and betadine twice daily. Pus swabs investigated patients developing any discharges from the incision site for culture and sensitivity, and appropriate antibiotics were administered as per the report. Alternate Suture removal was done on the 10th post-operative day, and the remaining were removed on the 12th post-operative day. Subsequently, all cases were followed up in the General Surgery OPD weekly once for a period of 1 month.

Statistical Analysis

Data were presented as frequency and percentage. The Chi-square test was used to find the association between groups and categorical variables. IBM SPSS Statistics for Windows, version 21.0 (IBM Corp., Armonk, N.Y., USA) was used. $P < 0.05$ was considered statistically significant.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

RESULTS

The study consisted of 100 patients divided into two groups – cases (n=50) and control (n=50). Twenty-three patients were less than 30 years, 19 were between 31 to 40 years, 20 were in the bracket of 41 to 50 years, 22 were in the 51 to 60-year group, and 16 were over 61 years. In addition, male preponderance was noted (n=72). Eighty-six patients had to undergo emergency surgery, while 14 were of elective surgical type. The patient characteristics are summarised in Table 1.

Table 1: Patients characteristics

Patients Characteristics		Case	Control	Total
Age group	<30	7	16	23
	31-40	7	12	19
	41-50	10	10	20
	51-60	16	6	22
	>61	10	6	16
Gender	Female	11	17	28
	Male	39	33	72
Elective/Emergency	Elective	9	5	14
	Emergency	41	45	86

The diagnosis of acute intestinal obstruction (n=18) and appendicular abscess (n= 11) was the most common diagnosis. The various gastrointestinal diagnosis of the patients is tabulated in table 2.

Table 2: Diagnosis

Diagnosis	Case	Control	Total
Acute intestinal obstruction	12	6	18
Appendicular abscess	3	8	11
Appendicular perforation	0	4	4
Blunt injury abdomen	4	2	6
CA caecum	2	0	2
CA esophagus	1	0	1
CA rectum	0	1	1
Calculous cholecystitis	2	3	5
Carcinoma stomach	3	1	4
Duodenal diverticulum +GOO	1	0	1

Following the prophylactic protocol, a surgical site infection assessment was done. Post-operative SSI was noted in 12 cohorts in the cases group and 29 in the control group. This observation that SSI was reduced in the cases group was statistically significant ($p < 0.001$). There was no statistical significance in SSI between those having elective or emergency surgery. When the wound was classified as dirty, a statistically significant result was noted regarding SSI outcome. The genres of bacteria did not influence the outcome. The outcomes are noted in table 3.

Table 3: Outcomes

Outcome		Case	Control	Total	P value
Post OP infection	Yes	12	29	41	0.001
	No	38	21	59	
Post OP infection	Elective	2	2	4	0.890
	Emergency	10	27	38	0.390
Class of wound	Clean Contaminated	2	2	4	0.482
	Contaminated	3	9	12	0.132
	Dirty	7	18	15	0.004
PUS culture	E.coli	3	6	9	0.262
	Klebsiella	5	6	11	
	Pseudomonas	0	6	6	
	Staph aureus	4	11	15	

DISCUSSION

This study aimed to assess the effectiveness of pre-operative intra-incisional Ceftriaxone antibiotic infiltration and prophylactic intravenous antibiotic therapy in reducing surgical site infection. A hundred cohorts with various gastrointestinal clinicopathological diagnoses scheduled for either elective or emergency laparoscopic surgery were assessed for surgical site infection after prophylactic antibiotics. The cases group that received pre-operative intra-incisional Ceftriaxone infiltration significantly reduced SSI compared to the control group. However, the wound alone cannot be used to determine appropriate risk stratification for SSI. Several patient-related, microbial, and perioperative factors can majorly impact SSI risk in surgical patients. In the present study, the wound classified

ISSN (O): 2687-5365; ISSN (P): 2753-6556

as dirty influenced the outcome of SSI, while the genus of bacteria did not.

SSI is one of the commonest post-operative surgical complications. Various techniques have been tried in the past to lower the risk of SSI, mechanical cleaning and systemic and oral antibiotics. At the start, the antibiotics were administered post-operatively only for those n whom SSI had already been established. Later on, the theory of antibiotic prophylaxis gained acceptance. It has been proven by many trials that preoperatively giving prophylactic antibiotics reduces wound infection. An analysis of Twenty-three RCTs and eight cohorts on the efficacy of oral antibiotic prophylaxis and mechanical bowel preparation in preventing SSIs in elective colorectal surgery deduced that the addition of oral antibiotics to systemic antibiotics could potentially reduce the risk of SSIs.[2,6,7]

A study by Inderchand and Kulkarni evaluated the effectiveness of prophylactic parenteral antibiotics compared to combined parenteral and pre-operative intra-incisional antibiotic administration in decreasing surgical site infection in 120 patients. The first group of 60 cohorts received a single intravenous dose of 1.5 grams of Cefoperazone with sulbactam (CS) in 100ml normal saline 20 minutes before the surgical incision. Group 2 (n=60) received a combination of prophylactic 1.5 gram of CS IV simultaneously and IV 1.5 gram of CS diluted in 10 to 15 ml of distilled water which was infiltrated along with the planned incision 20 minutes before the procedure. In group 1, 11.7 % of patients developed SSI, compared t group 2, where only 1.7 % developed SSI. Analogous to the present study, the group which revived only prophylactic IV antibiotics showed a statistically higher incidence of SSI.

In contrast to our study, a statistically significant difference was found in the growth of organisms between groups.[5]

Another retrospective consecutive case series study investigated the effectiveness of pre-operative, intra-incisional prophylactic clindamycin in decreasing the risk of developing SSIs in patients undergoing Mohs micrographic surgery. Similar to the present study, these researchers also observed a decreased infection rate of 0.3%, which is 2.5–10 times lower than recorded procedures of the same type and location. Also, there was no variance observed between gram-positive and negative infections.[8]

The present study results concur with that of Sudhir et al., who evaluated 50 cases with clinical presentation of peritonitis due to non-traumatic perforation of the small intestine. In a study group of 25 cases, ceftriaxone (1gm diluted with 10cc of distilled water) subcutaneously subcutaneous infiltration was given before primary skin closure for laparotomy due to peritonitis, whilst the other 25in the control group received no infiltration. The wound infection rate was 48% in the control group and 32% in the study group. The study concluded that indicated using ceftriaxone injections subcutaneously at the stage of wound closure may be more successful in decreasing SSI.[4]

Another randomized study in England recruited consecutive eligible 624 patients scheduled for abdominal operations and administered a prophylactic single pre-operative dose of 1.2 g Augmentin to assess the effectiveness of surgical wound infection. They were randomly assigned to have the antibiotic given intravenously during anaesthesia induction (n = 328) or infiltrated subcutaneously along the planned incision line (n = 296). The incidence of wound infections was 8.4% in the group with antibiotics administered to the abdominal wall compared to 15.9 % in the other group.[9]

Another study compared the effectiveness of prophylactic antibiotics in reducing SSI in patients aged between 20 to 60 years. Group A received pre-operative intra-incisional antibiotic infiltration (One gram of Cefotaxime diluted in 10 ml of distilled water), while group B got administered with a single dose of 1 gram of Cefotaxime (IV 20 minutes before the surgical incision), and group C had both systemic and intra-incisional infiltration of the. Each group had 40 patients. SSI incidence in Group A was 10%, in Group B 18%, and in group C 2.5%. The efficacy of combination prophylactic therapy was more effective than in our study.[10]

Dixon et al. randomized prospectively 205 patients of elective and emergency gastrointestinal tract surgery and examined them for risk of SSI. The patients were grouped into three groups: the control group (which did not receive any antibiotics), the group which received 1 gram of Cephamandole IV, and the other group which received the antibiotic intra-incisional. They concluded that the intra-incisional infiltration is more efficacious than IV administration.[11]

Another study concluded pre-operative intra-incisional antibiotics administration decreased SSI rate in all wound classes.[12]

A study on a similar concept investigated the efficacy of prophylactic antibiotics in inguinal hernia patients aged 20-60 years. Two groups of 100 patients each were studied, where group A got pre-operative Intra incisional infiltration of 1 gram of Cefotaxime diluted in 10 ml of distilled water, while group B was administered a single dose of 1 gram of Cefotaxime IV. In contrast to our study, this study found there is no significant difference in the occurrence of surgical site infection between the groups.[2] Similar findings were noted by Greenall et al., who compared the effect of intravenous and intra-incisional Cephaloridine. They concluded that both the modes were equally efficacious.[13]

Studies by Patil, Uppin, and Singh et al inferred that the incidence in cases with intra-incisional antibiotics infiltration was lower but not statistically significant. 14,15

The present study evaluated the efficacy of both intravenous alone and intraincisional + IV ceftriaxone in managing SSI risk. It demonstrated

ISSN (O): 2687-5365; ISSN (P): 2753-6556

that the combination of simultaneous IV and intraincisional antibiotics was statistically more efficient in managing SSI. A larger sample size with more parameters like duration of surgery and its association with SSI and the association of SSI with co-morbidities would have certainly contributed to further the understanding of SSI.

CONCLUSION

The advantages of using intraincisional antibiotic prophylaxis are multiple. Since the medicine is delivered locally only into the dermal and subcutaneous layers, only a tiny amount enters the systemic circulation, thereby decreasing the chances of developing antibiotic resistance and drug interactions with other systemic medications and preventing disruption of the intestinal microbiome. The incidence of SSI is gradually being employed as an outcome and surrogate measure for assessing the quality of surgical care. Although SSI is an interplay of modifiable and non-modifiable factors, incorporating evidence-based practice will go a long way in improving patient care and reducing mortality and morbidity.

REFERENCES

1. Young PY, Khadaroo RG. Surgical site infections. Surg Clin North Am. 2014;94(6):1245-1264.
2. Jambukala AY, Mahadevaswamy KM, Ganiger D, Kumar S. A study comparing pre-operative intra incisional antibiotic infiltration and prophylactic intravenous antibiotic administration for reducing surgical site infection. Eur J Mol Clin Med 2022;9:314–20.
3. Bashaw MA, Keister KJ. Perioperative Strategies for Surgical Site Infection Prevention. AORN J. 2019;109(1):68-78.
4. Sudhir S., Telkar K. G. A study of the wound performance following subcutaneous infiltration and topical instillation of ceftriaxone before primary closure of skin in laparotomy for peritonitis due to non-traumatic perforation of small intestine. Int Surg J 2017; 4 (12): 3956-3961.
5. Inderchand DS, Kulkarni DA. The comparative efficacy of prophylactic parenteral antibiotics with combined parenteral and pre-operative intra-incisional antibiotic administration in reducing surgical site infection. Int J Surg Sci 2021;5:86–9. https://doi.org/10.33545/surgery.2021.v5.i3b.742.
6. Utzolino S, Eckmann C, Lock JF. Prevention of Surgical Site Infections. Anasthesiol Intensivmed Notfallmed Schmerzther. 2021;56(7-08):502-515.
7. Koullouros M, Khan N, Aly EH. The role of oral antibiotics prophylaxis in prevention of surgical site infection in colorectal surgery. Int J Colorectal Dis. 2017;32(1):1-18.
8. Soleymani T, Brodland DG, Zitelli JA. A retrospective case series evaluating the efficacy of pre-operative, intra-incisional antibiotic prophylaxis in Mohs micrographic surgery: An effective method to reduce surgical-site infections and minimize systemic antibiotic use. J Am Acad Dermatol. 2020;83(5):1501-1503.
9. Pollock AV, Evans M, Smith GM. Preincisional intraparietal Augmentin in abdominal operations. Ann R Coll Surg Engl. 1989;71(2):97-100.
10. Dogra BB, Kalyan S, Rana KV, Panchabhai S, Kharade K, Priyadarshi S. A study comparing pre-operative intraincisional antibiotic infiltration and prophylactic intravenous antibiotic administration for reducing surgical site infection. Med J DY Patil Univ 2013; 6:405-9.
11. Dixon JM, Armstrong CR, Duffy SW, Chetty U, Davies GC. A randomized prospective trial comparing the value of intravenous and preincisional cefamandole in reducing post-operative sepsis after operation upon the GIT. Surg Gynecol Obstet 1984; 158:303-7.
12. Samir A, Batra R, Arora B, Atwal S, Dahiya RS. A comparative study of pre-operative intra-incisional infiltration of ceftriaxone vs. intravenous ceftriaxone for prevention of surgical site infections in emergency cases. J evol med dent sci 2016; 5(64): 4537.
13. Greenall MJ, Atkinson JE, Pollock AV. Single dose antibiotic prophylaxis of surgical wound sepsis: which route of administration is best? A controlled clinical trial of intra-incisional against intravenous cephaloridine. J Antimicrobial Chemo 1981;7(3):223-7.
14. Patil A, Uppin V. Intra-incisional versus intravenous route of antibiotic administration in preventing surgical site infections: a randomized controlled trial. Int Surg J, 2018; 5(4), 1438-1442
15. Singh A, Salim M, Singh B, Akshita. A comparative study of pre-operative intraincisional infiltration of ceftriaxone vs. intravenous ceftriaxone for prevention of surgical site infections. Int Surg J 2019;6:1686-92.

ISSN (O): 2687-5365; ISSN (P): 2753-6556