

Original article

Do Antibiotic Coated Sutures Reduce The Risk Of Surgical Site Infections After Laparotomy?

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Abstract:

Introduction: Surgical Site Infections (SSI) are defined as wound infections following an invasive surgical procedure. They remain a cause of major morbidity in patients undergoing surgical procedures despite advances in operative techniques. Triclosan [5-chloro-2-(2, 4-dichlorophenoxy) phenol] is a broad-spectrum bactericidal agent which acts by attacking different structures in the bacterial cytoplasm and cell membrane. Triclosan-coated sutures should theoretically result in the reduction of SSI.

Aim & objective : The aim of this study is to ascertain the incidence of surgical site infections when antibiotic coated sutures are used versus conventional sutures in patients undergoing laparotomy and to compare the Post-operative pain and duration of hospitalization in both groups.

Methods: A comparative study of 232 patients undergoing laparotomy in the General Surgery department with abdominal sub-cutaneous wound closure either with Triclosan coated Polyglactin 910 sutures (study group) or conventional Polyglactin 910 sutures (control group) (116 patients in each group).

Results: There was no difference in demographic and preoperative profiles in both groups. There was a statistically significant reduction in the incidence of surgical site infection in the antibiotic coated-suture group compared to the control group. There was no difference in intensity of Post-Operative pain or duration of hospitalization.

Conclusion: Development of Superficial Surgical Site Infections after laparotomy was decreased with the use of Triclosan Coated Sutures .Triclosan-coated sutures could be used to decrease the risk of surgical site infection after laparotomy along with other infection control measures.

Key-words: Surgical Site Infection, Triclosan Coated sutures, Exploratory Laparotomy.

Introduction:

Surgical site infection continues to be a burden on healthcare resources even in the modern era of immaculate sterilization techniques and highly effective antibiotics ^[1]. The most widely recognized definition of infection is

that devised and adopted by the Centre for Disease Control and Prevention(CDC). An SSI is defined as an infection occurring within 30 days of surgery that meets the following criteria: (1) the diagnosis consists of infection of an anatomic plane by one of the following manifestations: collection, inflammatory signs (pain, edema, tenderness, redness), dehiscence, or positive culture; and (2) classification according to the anatomic plane as follows: superficial incisional SSI- infection of the skin and subcutaneous tissue, deep incisional SSI- infection of the deep soft tissue (fascia and muscles) and organ/space SSI- infection of the organ/space ^[1].

A system of classification of surgical wounds that is based on the degree of microbial contamination was developed by the US National Research Council group in 1964. Four wound classes with an increasing risk of SSI were described: clean, clean-contaminated, contaminated, and dirty ^[2]. In the present study, SSIs were documented based on each of the wound classes. Laparotomy wounds are at risk of SSI and therefore may lead to increased morbidity, delayed recovery and prolonged hospital stay. Surgical site infections (SSIs) have varied from 0.5% to 15%; studies in India have consistently shown higher rates ranging from 23% to 38% ^[3].The incidence of SSI was highest after gastrointestinal surgery,and the most common pathogens found were Staphylococcus aureus, Pseudomonas aeruginosa and Escherichia coli ^[3]. The development of SSI is a multifactorial phenomenon, and requires a multimodal approach to prevent and treat in a timely manner to avoid financial, psychological and health-related quality of life consequences. Various predisposing aetiopathological factors for SSI include immunosuppression, nutritional deficiencies, cardiac, hepatic or renal failure, use of steroids or chemotherapy agents, and diabetes mellitus. In additions to these factors, wound contamination and contaminated instruments also play a role. Surgical technique and sutures used to close tissues have also been reported to be responsible for SSI. The prevention of SSI by various invasive and non-invasive interventions by surgeons and other healthcare professionals is necessary to tackle this problem.

Triclosan(TC) [5-chloro-2-(2, 4-dichlorophenoxy) phenol] is a broad-spectrum bactericidal agent that has been used for more than 40 years in various products such as toothpaste and soaps. Higher concentrations of triclosan works as a bactericide by attacking different structures in the bacterial cytoplasm and cell membrane. At lower concentrations, triclosan acts as bacteriostatic agent, binding to enol-acyl reductase (ENR), a product of the Fab I gene and thus inhibiting fatty acid synthesis ^[4]. Triclosan inhibits the activity of Gram-positive and Gram- negative bacteria, common pathogens that are responsible for Surgical Site Infection (SSI) ^[5].

Aims and Objective:

1. To determine the incidence of Superficial Surgical Site Infection in laparotomy incisions closed with coated polyglactin910 suture with triclosan versus incisions closed with conventional polyglactin910 suture.
2. To compare the duration of hospitalisation of patients in Triclosan coated suture group with conventional suture group.
3. To estimate the severity of Post-Operative pain at laparotomy site in both the groups.
4. To identify the most common organism causing SSI in the post-operative period.

Materials and Methods:

The source of data for this study were 232 patients(116 in each group) undergoing laparotomy in the Department of Surgery at Vydehi Institute Of Medical Sciences And Research Centre, Bangalore between February 2021 and January 2023.

Patients were assigned into two groups i.e Case group(Subcutaneous tissue closed with Triclosan Coated sutures) and Control group(Subcutaneous tissue closed with conventional sutures).

This study was approved by the Ethics Committee of the Institution (No:VIEC/PG/APP/114/2020-21). In addition, written informed consent was obtained from all patients. Patients were randomized to two groups- case group where the subcutaneous tissue was closed with Triclosan coated sutures and control group in whom the subcutaneous tissue was closed with conventional sutures.

Inclusion criteria:

- a. All patients between the age of 18 and 65 years requiring laparotomy
- b. Patients undergoing emergency and elective laparotomy.
- c. Patients willing to provide voluntary informed consent for participating in the study.

Exclusion criteria:

- a) Deep Surgical Site Infection and Organ space Infection in the post-operative period.
- b) Patients with HIV and those receiving radiotherapy or chemotherapy.

Method of Data Collection:

Data was collected on a pre tested proforma and included,

- a. History
- b. Clinical examination
- c. Investigations
- d. Operative diagnosis
- e. Surgical procedure
- f. Inspection of surgical site post-operatively
- g. Outcome.

The severity of pain at the laparotomy site was assessed from Post-Operative day 1 to Post-Operative day 3 using the visual analogue scale (VAS) ranging from 0 to 10, 0 indicating no pain and 10 indicating very severe pain.

Surgical Site Infection was diagnosed based on the presence of inflammatory signs (edema,tenderness and redness),wound dehiscence, discharge or positive culture upto post-operative Day 30.

The duration of hospitalization was measured in both groups. The microbiological profile of organisms isolated was also studied.

Patients were Followed up in the OPD upto Post- Operative day 30 preferably physically or were interviewed telephonically if theywere unable to come to the hospital.

Statistical Analysis:

Data was analysed using SPSS (Statistical Presentation System Software)

$$n = \frac{2PQ [Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}]^2}{[P_1 - P_2]^2}$$

P1 – Proportion of people in group-1

P2 – Proportion of people in group-2

Z_{1- α /2} – P at 95% confidence level

Z_{1- β} - Q at 80% power

n- sample size per group.Total sample size : 232

Anti-biotic coated Polyglactin910 suture group : 116 (Group A/ Case group)

Conventional Polyglactin910 suture group : 116 (Group B/ Control group)

The data was coded and entered into Microsoft Excel spreadsheet. Analysis was done using SPSS version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA) Windows software program. Descriptive statistics included computation of percentages, means and standard deviations. The data was checked for normality before statistical analysis using Shapiro–Wilk test. The unpaired t test (for quantitative data to compare two independent observations), paired t test (for quantitative data to compare before and after observations) and ANOVA test (for quantitative data to compare two and more than two observations) were applied. The chi square test was used for quantitative data comparison of all clinical indicators. Level of significance was set at $P \leq 0.05$.

Results:

The wound classification in these patients was as follows (Table 1) :

			Class Of Wound				Total
			Clean	Clean-Contaminated	Contaminated	Dirty	
Suture Used	Conventional	N	7	36	44	29	116
	Polyglactin 910 Suture	%	6.0%	31.0%	37.9%	25.0%	100.0%
	Triclosan Coated	N	5	47	44	20	116
	Polyglactin 910 Suture	%	4.3%	40.5%	37.9%	17.2%	100.0%
Total		N	12	83	88	49	232
		%	5.2%	35.8%	37.9%	21.1%	100.0%

Table 1: Percentage distribution of Wound Class

The difference between the wound classes in the two groups was not statistically significant ($P=0.32$).

The types of all surgical procedures performed and overall numbers in the subjects were as follows :

Hepatobilliary Surgeries : 69

Abdominal Wall Hernias : 66

Appendicular pathology : 44

Peritonitis : 18

Trauma cases : 4

Others : 31

The mean age of all patients in both groups was 41.06 ± 12.21 years with a range of 18-65 years. Males were 51.7% and females were 48.3%. The difference between the distribution of patients based on age and sex in the two groups was not statistically significant ($p > 0.05$). There was no age group associated with an increased risk of developing SSI. The mean BMI of the subjects was 25.93 ± 3.17 .

The difference between the distribution of patients based on smoking habit in the two groups was not statistically significant ($P=0.09$). The total number of smokers was 59 of which 35 were in the control group and 24 in the case group.

There was no statistical difference between the types of procedures performed in the two groups, number of patients with infected abdominal pathology was similar ($P \text{ value} = 0.12$)

Development of Surgical Site Infection:

The results show that there was a statistically significant difference in development of SSI between the two groups (P value=0.003).In the case group, 13 patients (11.2%) developed surgical site infection while 103 (88.8%) patients didn't develop any. Among the control group 31 patients(26.7%) developed surgical site infection while 85 patients (73.3%) didn't develop the same. There was a significant difference in the incidence of surgical site infection between the two groups. Thus the control group had more patients developing surgical site infection compared to the patients in the case group in whom Triclosan coated Polyglactin910 suture was used.

			SSI		Total
			Absent	Present	
Suture Used	Conventional Polyglactin 910 suture	N	85	31	116
		%	73.3%	26.7%	100.0%
	Triclosan coated Polyglactin 910 suture	N	103	13	116
		%	88.8%	11.2%	100.0%
Total		N	188	44	232
		%	81.1%	18.9%	100.0%

Table 2 : Association between the suture material used and SSI.

The mean time of recognition of SSI was on Post-Operative Day 3.903±1.61 days among the patients in the Conventional Polyglactin 910 sutures and 4.61±1.80 days among the patients in the Triclosan Coated Polyglactin 910 sutures. There was no statistically significant difference between them (P-value=0.205). The mean time of development of SSI overall was Post-Operative Day 4.11±1.687days.

		Mean	Std. Deviation	P value
Development of SSI on Post-operative Day	Conventional Polyglactin 910 suture	3.903	1.61	0.205
	Triclosan coated Polyglactin 910 suture	4.61	1.80	

Table-3:Association between the suture material used and timing of recognition of SSI in the Post-operative period.

Among the 232 subjects 59 were smokers and of these 17 developed SSI and among the 173 non-smokers 27 developed SSI with P-value of 0.02 which shows that there is relation between smoking and the development of SSI.

Post-Operative Pain:

In this study the Post-Operative pain was assessed using VAS on POD-3 in all patients in both groups. The Mean value of Post-Operative pain on POD-3 was 6.11±1.002 among the subjects in the Conventional Polyglactin 910 sutures and 6.04±1.008 among the subjects in the Triclosan Coated Polyglactin 910 sutures. The Mean Value of the Post-Operative pain on POD-3 among all subjects was 6.07. There was statistically no significant difference between the two groups (P-value=0.602).

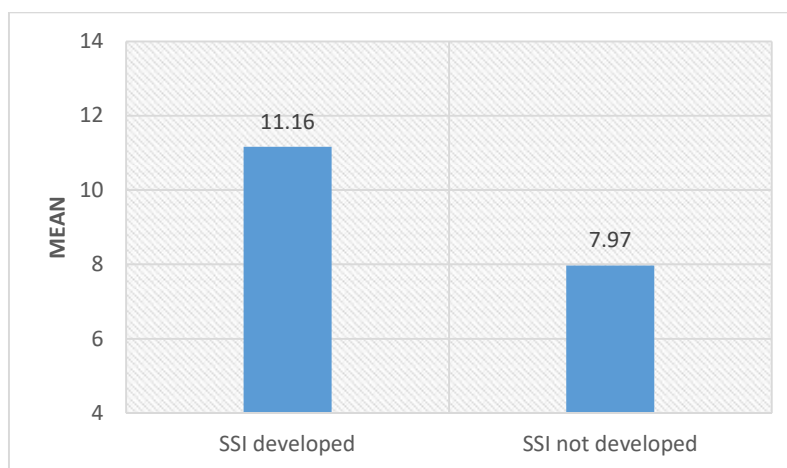
		Mean	Std. Deviation	P value
Pain scoring-VAS on Post-operative Day 3	Conventional Polyglactin 910 suture	6.11	1.002	0.602
	Triclosan coated Polyglactin 910 suture	6.04	1.008	

Table-4: Association between the suture material used and Post-operative Pain on POD-3.

Hospitalization Days:

The mean duration of Hospitalization was 8.78 ± 4.69 among the subjects in the Conventional Polyglactin 910 sutures and 8.37 ± 3.988 among the subjects in the Triclosan Coated Polyglactin 910 sutures. The Mean duration of Hospitalization among all subjects was 8.57 days. There was no statistically significant difference in the duration of hospital stay in the two groups (P value=0.4).

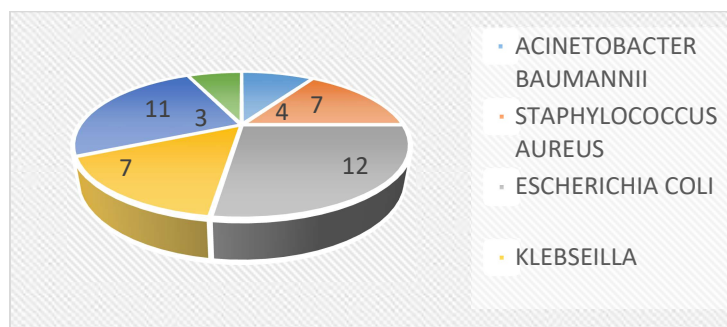
The Mean duration of Hospitalization was 7.97 ± 3.43 among the study subjects who did not develop SSI and 11.16 ± 6.47 among the study subjects who developed SSI. This shows that there was a statistically significant difference in the duration of hospital stay among the study subjects with SSI and who did not develop SSI (P value=0.001).



Graph-1: Association between the type of suture material used and Duration of Hospitalization.

Among the case group, 13 patients had surgical site infection of whom, *Acinetobacter Baumannii* was isolated in 3 patients and *Klebsiella*, *Staphylococcus* and *E.coli* was isolated in 2 patients each and in the other 4 patients there was no organism isolated. In the control group, 31 patients developed surgical site infection in whom 10 patients grew *Escherichia coli*, followed by *Staphylococcus Klebsiella Sps.* in 5, *Pseudomonas Sps* from 3 patients and in 7 patients no Organism was isolated and *Acinetobacter Baumannii* was isolated in 1 patient.

The most common organism isolated in the study was *Escherichia coli*, followed by *Klebsiella Sps* and *Staphylococcus Aureus*.



Graph-2: Percentage distribution of type of Culture positive.

Discussion:

Surgical site infection remains a major burden in hospitalized patients and it is imperative that more research is done to find new ways of reducing the same. The purpose of this study was to evaluate the effectiveness of antimicrobial coated suture i.e Triclosan coated polyglactin 910 suture in reducing superficial surgical site infection in laparotomy wounds. Contaminated and dirty wounds are mainly associated with increased incidence of Surgical Site wound infections and this was the reason to study wound infection rates in both elective and emergency procedures.

From this study we demonstrated a reduction of superficial SSI when Triclosan coated Polyglactin 910 was used in comparison to Conventional Polyglactin 910 suture in all categories of wounds. There was a statistically significant difference (P-value <0.05) demonstrated between the two groups. This is similar to other previous studies that also demonstrated significant reduction in infection with usage of Triclosan coated sutures. Triclosan (TC) is a broad-spectrum phenol family antiseptic, used for more than 30 years as a safe and effective antimicrobial agent [6], against the most common pathogen agents that cause SSI: *S. aureus* and *S.epidermidis*. The antimicrobial efficacy of this material in reducing both bacterial adherence to the suture and microbial viability have been proven in vitro [7,8] and in animal models [9,10] Coated sutures with TC were compared clinically to no impregnated suture material in extragynecological surgery, and were shown to perform better than traditional sutures with respect to intraoperative handling and wound healing in thoracic and abdominal surgery [11].

The addition of Triclosan to polyglactin910 suture does not affect the physical handling properties or performance characteristics like the ease of passage through tissues, first throw knot holding, knot security and so on. It is important to note that the mechanisms leading to surgical site infections are not fully understood; however the presence of a foreign material like a suture is known to increase the chances of infection but in case of Triclosan-Coated sutures it lowers the size of bacterial inoculi necessary to develop infection by creating an antibacterial environment within the wound and hence reduces the risk of SSI. This was the thinking behind the creation of antimicrobial coated sutures. Hence Triclosan coated suture can be used for the closure of the Subcutaneous tissue layer after laparotomy in addition to the other measures to reduce SSI such as pre-operative body wash with soap, preparation of surgical site with clipper, handwashing, pre-operative glycemic control in diabetics, prophylactic antibiotics at the time of Incision, maintaining asperis throughout the surgery, etc [12]. A similar study was conducted by Shivpreet Singh Samra to assess the impact of using Triclosan impregnated sutures on the incidence of SSI.They enrolled 150 patients over a span of 8 months.They concluded that 99.3% of wounds sutured with Triclosan coated sutures didn't develop SSI [13].

In a study to check the efficacy of Triclosan coated sutures by Seiichiro Hoshino, 12.2% out of 596 patients developed wound infection with conventional sutures and 6.6% of 455 patients in antibiotic coated sutures. They concluded that the use of Triclosan coated antimicrobial sutures leads to significant decrease in the incidence of SSIs [14].

A study by Edmiston CE, Seabrook GR et al proved that treating polyglactin 910 with triclosan was an effective strategy in decreasing SSI by proving decreased adherence of both Gram positive and Gram negative bacteria to Triclosan coated suture material [15].

Conclusion:

1. Superficial surgical site infection was higher in the control group, indicating that patients who didn't have closure with triclosan coated sutures had a higher risk of development of SSI.
2. There was no difference in the groups with respect to severity of post-operative pain or duration of hospitalization .
3. There was a statistically significant increase in the duration of hospitalization among the patients who developed SSI.
4. The most common organism isolated was Escherichia Coli.

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