TRICLOSAN COATED POLYDIAXANONE SUTURE VERSUS NONCOATED POLYDIAXANONE SUTURE IN PREVENTING SURGICAL SITE INFECTION IN PERFORATION PERITONITIS: A COMPARATIVE STUDY

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ABSTRACT

Background: Surgical site infection (SSI) has been pointed out as having the highest prevalence among infections associated with avoidable health care. Surgery for perforation peritonitis carries an exceptionally high risk of SSI. The Triclosan coated suture slowly releases Triclosan, which is an antibacterial agent that inhibits bacterial colonization of the suture and wound site and thus, promises prevention of surgical site infection. Methods: Fifty patients with confirmed diagnosis of perforation peritonitis reporting to surgery emergency and undergoing surgery were randomized in two groups: Group A in which Triclosan coated Polydioxanone suture was used for closure of rectus sheath (25 patients) and Group B in whom conventional non coated Polydioxanone suture was used for sheath closure (25 patients). Results: The signs and symptoms of wound infection, i.e. swelling, erythema, warmth, discharge and wound dehiscence were significantly less in Triclosan coated (TC) group (p=0.01) though the difference in pain at wound site was insignificant in both the groups. The incidence of surgical site infection (p=0.000156) and consequent hospital stay (p=0.0466) was significantly low in the TC group. Conclusion: Triclosan coated suture surely, helps in preventing one of the most dreaded postoperative complications, i.e. surgical site infection which, not only increases the morbidity of the patient but also has long-term implications.

KEYWORDS Surgical site infection, Triclosan coated Polydioxanone suture, Perforation peritonitis

Introduction

Exploratory laparotomy remains the mainstay of treatment in cases of perforation peritonitis. Surgery for perforation peritonitis carries a high risk of SSI because faecal ascites or intestinal contents contaminate the incision intraoperatively and in patients who undergo stoma creation, the incision is located near the infective origin and is subject to infection postoperatively.[1] The US Centers for Disease Control and Prevention (CDC), in the classification of surgery wounds, categorised perforation peritonitis into class IV (dirty) wounds.

Surgical site infection (SSI), is the second most common infection in the world among patients undergoing surgeries.[2,3] It is associated with increased length of hospital stay, hospital cost, patient morbidity and mortality.[4] A factor that may influence the incidence of surgical site infections (SSIs) is the suture used for closure of the abdominal wall. Sutures, like most other implants, provide a surface to which bacteria can adhere and form biofilms and thus, potentiate...
SSIs. Once established, these biofilms’ bacteria are difficult to treat because they are shielded within the matrix making them less susceptible to antibiotics and antisepsics.[5] To break this cascade, sutures can be coated with antibacterial substances that may reduce the bacterial load in the incision and thereby, help in reducing SSIs.[6] As a result, sutures coated with Triclosan (PDS Plus, Ethicon Inc.), which is an antibacterial, were developed.[7]

Triclosan [5-chloro-2-(2,4-dichlorophenoxy)phenol] is an antimicrobial biocide that exhibits broad-spectrum activity against gram-positive and gram-negative bacteria.[8,9] Higher concentrations of Triclosan work as a bactericide by attacking the bacterial cytoplasm and cell membrane.[10] At lower concentrations, Triclosan acts as a bacteriostatic agent, binding to enoyl-acyl reductase (ENR), a product of the Fab I gene and thus inhibiting fatty acid synthesis.[11,12]

In many randomised controlled trials and cohort studies, use of Triclosan-coated suture was associated with a statistically significant reduction in the incidence of infection after abdominal surgery.[13-16] Some other studies found that the coated suture did not reduce the likelihood of infection.[17,18]

Given lack of confirmation, whether antibiotic-coated suture is effective in controlling SSI or not, this study was conducted to compare Triclosan coated Polydiaxanone suture with noncoated Polydiaxanone suture for its effectiveness in preventing SSI in perforation peritonitis.

Methods

50 patients with confirmed diagnosis of perforation peritonitis reporting to surgery emergency and undergoing surgery were randomized in two groups: Group A in which Triclosan coated Polydiaxanone suture was used for closure of rectus sheath (25 patients) and Group B in whom conventional non coated Polydiaxanone suture was used for sheath closure (25 patients). Patients with diabetes mellitus, abdominal tuberculosis, malignancy, unfit for general anaesthesia and patients not giving consent were excluded from the study. Approval was taken from the ethical committee.

A detailed history was taken, and a general physical examination of each patient was done along with preoperative investigations and pre-anaesthetic checkup. Informed consent was taken from all the patients.

A. Operative Procedure

Exploratory laparotomy was performed under general anaesthesia. After cleaning and draping, skin incision (midline) was given. The incision was then deepened through the subcutaneous tissue, the rectus sheath and finally, the peritoneum. Abdominal exploration was done. The hollow abdominal organs were examined for evidence of perforation. The appropriate surgical intervention was done depending on the site, number and size of perforation. The abdominal cavity was thoroughly washed with normal saline. Upon completion of the procedure, layers of the abdominal wall were sutured in two layers (the first layer comprising the rectus sheath and the second layer, the skin). In group A patients, Triclosan coated Polydiaxanone suture was used to suture the first layer, and in group B patients, non coated Polydiaxanone suture was used. Aseptic dressing was done.

The wound site was examined until 30 days postoperatively for evidence of swelling, pain, erythema, warmth, discharge and dehiscence Descriptive statistical analysis has been carried out in this study. The significance is assessed at 5% level of significance. Chi-square test has been used to find significance of study parameters between the two groups.

Significant figures:

Suggestive significance (P value<0.05)
Moderately significant (P value 0.01-0.05)
Strongly significant (P-value <0.01)

Results

In this study, maximum no. of patients were in the age group of 21-40 years. The mean age with standard deviation was 35.3±16.28 years. The majority of the patients included in the study were males (92%). The most frequent site of perforation was gastric and ileal (20 each) followed by appendicular perforation (5), jejunal (4) and colonic perforation (1).

In our study, the incidence of surgical site infection was more in group B for all age-matched groups. In the age group of 1-20 years, none of the patients had SSI in group A whereas as many as 50% (2 out of 4 patients) of group B had wound infection. In the age group 21-40 years, SSI in group A was 50% (5 out of 10 patients) and group B was 69.2% (9 out of 13) and in 41-60 years patients, the infection rate was 37.5% (3 out of 8) and 57% (4 out of 7) in group A and B respectively. (Bar graph 1)

Bar Graph 1: Incidence of SSI according to age in the two groups

The incidence of SSI was lesser in both gastric and ileal perforation when Triclosan coated suture was used. 33.33% (3 out of 9 patients) of gastric perforation in group A and 54.5% (6 out of 11) in group B had SSI. Similarly, for small bowel perforation, i.e. jejunal and ileal perforation, 30% (4 out of 12 patients) in group A and as many as 83% (10 out of 12) patients in group B had SSI respectively. None of the patients with appendicular perforation had SSI in either group. (Bar graph 2)

Bar Graph 2: Incidence of SSI according to the type of perforation.

In this study, the percentage of patients having SSI increased with the increase in the time elapsed between the onset of symptoms and surgical intervention but this increase is not statistically significant. It was also seen that the rate of SSI is significantly lower in Triclosan coated group (Group A) as compared...
Table 1 Presence of SSI in the two groups depending upon the duration of onset of symptoms to surgical intervention

<table>
<thead>
<tr>
<th>Duration of Symptoms (in days)</th>
<th>Presence of SSI in group A</th>
<th>Presence of SSI in group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>1-2</td>
<td>4/13</td>
<td>13</td>
</tr>
<tr>
<td>3-4</td>
<td>3/9</td>
<td>33.3</td>
</tr>
<tr>
<td>&gt;4</td>
<td>1/3</td>
<td>33.3</td>
</tr>
<tr>
<td>Total</td>
<td>8/25</td>
<td>32</td>
</tr>
</tbody>
</table>

Table 2 Incidence of symptoms and signs of wound infection in the two groups

<table>
<thead>
<tr>
<th>Signs of Infection</th>
<th>Group A (Triclosan coated)</th>
<th>Group B (non coated)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Pain</td>
<td>15</td>
<td>60</td>
<td>17</td>
</tr>
<tr>
<td>Swelling</td>
<td>7</td>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>Erythema</td>
<td>7</td>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>Warmth</td>
<td>7</td>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>Discharge</td>
<td>7</td>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>Dehiscence</td>
<td>Skin only</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Skin and sheath</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

to non coated suture group (Group B) not only when the surgical intervention is done early but also when there is a delay in presentation or surgery. (Table 1)

There was a significant difference (p=0.01) in the two groups in terms of swelling, erythema, warmth and discharge at the wound site. These signs of infection were significantly low in patients in whom Triclosan coated PDS suture (only 28%, i.e. seven patients) was used as compared to 68%, i.e. 17 patients in noncoated PDS group. Pain at the wound site was lower in Triclosan group, but this was insignificant. Wound dehiscence was present in only one patient (4%) in group A and in 13 patients (52%) in group B which was significantly low (p=<0.00001). (Table 2) SSI was considerably lesser in patients in whom Triclosan coated PDS was used. (Table 3)

It was observed that the incidence of SSI was lower in group A as compared to group B even when renal functions were deranged preoperatively (50% of the patients with deranged renal functions had SSI whereas all patients in group B with deranged renal functions suffered from wound infection (Table 4).

Only three patients (27.3%) in group A with a stoma (ileostomy) showed surgical site infection whereas as many as nine patients (90%) with a stoma in the noncoated group reported SSI. This is highly significant. (Table 4)

The mean hospital stay was significantly longer (12.36 ±2.585 in group A versus 19.36 ± 9.525 in group B) in patients in whom non coated suture was used because of a higher rate of SSI leading to increased morbidity. When the cost of the two sutures was compared, it was significantly higher for PDS PLUS (Triclosan coated) as compared to non coated PDS (603.7±6.05 vs 339.7±6.21) though the overall cost was lesser in Triclosan group due to decreased hospital stay.

**Discussion**

Many intrinsic and extrinsic factors influence SSI.[19-21] Age, sex, BMI, the existence of comorbidity, medical history and habits (e.g., smoking) are some patient-related factors. Surgery-related factors are debridement, skin sterilisation, adequate ventilation of the operation room, refined and aseptic operative techniques and operative time. As patient-related factors cannot be modified, efforts can be made to alter surgery-related factors to reduce surgical site infections. One of the landmark developments in this respect, in the previous decade, is the use of Triclosan-coated sutures.

In our study, maximum patients were in the age group of 21-40 and majority (92%, i.e. 46 patients) were males. The mean age is in accordance to earlier studies in the tropical countries as compared to the studies in the west where the mean age is 45-60 years.[22-24] This can be attributed to the dietary and lifestyle habits of males and that too in this age group.

In our study, maximum patients had gastric and ileal perforation whereas there was only one patient with colonic perforation. It is a well-known fact that perforation of the large bowel constitutes a higher proportion of peritonitis cases in developed countries than in developing countries like India.[26-27] This was confirmed by our study. Various factors like the lower incidence of infectious diseases, especially typhoid and tuberculosis, and, higher incidence of inflammatory colitis, like Crohn’s disease and diverticulitis, in these countries contribute to this fact. Also, the SSI incidence was more in small bowel perforations as compared to gastroduodenal perforation. This is because of the nature of contents spilling into the abdominal cavities in small bowel perforation. The intestinal contents contaminate the incision intraoperatively, and in patients who undergo stoma creation, the incision is located near the infective origin and is subject to infection postoperatively.[1]

The percentage of patients developing SSI increases as the time elapsed from symptom onset to laparotomy increases. This...
is expected, as the delay in presentation or delay in surgical intervention leads to the development of sepsis and purulent exudation of the peritoneal contents. Although, the SSI percentage increases as the delay in laparotomy is more, this difference is not statistically significant. This is because most of the patients had received prior antibiotics.

Renal impairment has long been known to affect wound healing. It is known that patients with renal failure have an impaired immune system and are predisposed to infections. The effect of uremic toxins, chronic inflammation, and immune system activation are the leading underlying causes.[70] The coated suture was able to prevent surgical site infection even in the presence of deranged renal functions.

Amongst the symptoms and signs of infection, only pain was comparable in the two groups with an insignificant difference. Rest of the signs like warmth, local swelling, erythema, wound discharge and dehiscence were significantly lesser in Triclosan coated group. This proves that the incidence of signs of infection is considerably lower in Triclosan coated suture group when it is used in perforation peritonitis.

In our study, it was proved that Triclosan coated suture significantly helps in reducing SSI in perforation peritonitis especially deep and organ/space infection. The effect of Triclosan coated sutures on surgical site infections has been a topic of debate. Ford et al., Fleck et al., Rozelle et al., Justinger et al, Rasic et al., Zhang et al., Lass et al., Nakamura et al., Ruiz Tovar et al. [4,6,13-16,28-32] favoured the use of Triclosan coated suture showing its beneficial effect in the prevention of SSI in varied surgeries. Others like Baracs et al., Mingmalairak et al., Deliaert et al., Chen et al., the PROUD trial of 2014,[17,18,33-35] refuted Triclosan coated suture, showing that it has not been able to contain the infection and has no beneficial effect.

The duration of hospital stay was significantly lesser in Triclosan coated group when compared with a noncoated group (p=0.0466). This is due to increased SSIs in the noncoated group. These patients required daily aseptic dressings and symptomatic treatment including intravenous antibiotics and sometimes, wound toileting and debridement of the wound was needed which added to the cost.

As far as the cost of the suture is concerned, statistically, Triclosan may be costlier but it significantly reduces surgical site infections and cuts down the cost for diagnosing, investigating and treating such infections. SSIs raise costs due to prolonged hospitalisation, additional diagnostic tests, therapeutic antibiotic treatment, and rarely, additional surgery. This can be brought down by the usage of the antibiotic-coated suture.

Conclusion

Triclosan coated suture, surely, helps in preventing one of the most dreaded postoperative complications, i.e. surgical site infection which, not only increases the short-term morbidity of the patient but also has long-term implications. The desire of a good cosmetic result postoperatively, both by the surgeon and the patient is hindered if postoperative surgical site infection occurs. Also, surgical site infection and consequent wound dehiscence can lead to an incisional hernia which leads to long-term morbidity. Triclosan coated suture cuts down the cost for management of surgical site infection, though it is slightly costlier than the conventional non coated suture. So, we can say that Triclosan coated PDS is a new hope in the prevention of surgical site infection postoperatively.

References

7. Instruction for use: PDS Plus – 389688.R02


