Section: Miscellaneous

Original Research Article

COMPARATIVE STUDY ON THE EFFICACY OF ANTIBACTERIAL (TRICLOSAN-COATED) SUTURES VERSUS CONVENTIONAL SUTURES IN REDUCING SURGICAL SITE INFECTIONS FOLLOWING ABDOMINAL SURGERY

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ABSTRACT

Background: Surgical site infections (SSIs) remain a critical burden in abdominal surgery, contributing to elevated morbidity, longer hospital stays, and higher healthcare costs. Although advances in sterilization, antibiotic prophylaxis, and operating room protocols have lessened these risks, SSIs have not been entirely eliminated. Since suture materials can act as a substrate for bacterial colonization and biofilm formation, antibacterial sutures coated with triclosan offer a promising strategy. This study compares the effectiveness of triclosan-coated antibacterial sutures (Vicryl Plus) with conventional non-antibacterial sutures (Vicryl) in reducing the incidence and severity of postoperative SSIs. **Materials and Methods:** A double-blind, randomized study was performed over two years (June 2022–June 2024) at Pandit Deendayal Upadhyay Hospital, Varanasi. A total of 280 patients were enrolled and randomized into two groups of 140 each. The study evaluated factors including age, sex, level of wound contamination, urgency of surgery, type of operative procedure, and patient conditions such as steroid use. SSI rates were classified following CDC recommendations, and postoperative hospital stay durations were also analyzed. **Result:** Overall, the Vicryl Plus group demonstrated lower SSI rates across various categories compared to the conventional Vicryl group. The most significant difference was observed in dirty surgical wounds, where the SSI rate was 29% in the Vicryl Plus group versus 60% in the conventional group. However, the differences in all subgroups—including age, sex, urgency of surgery, and wound contamination class—failed to reach statistical significance ($p > 0.05$). Notably, patients using steroids showed slightly higher SSI rates even in the Vicryl Plus group. Most infections were superficial, and no organ-space SSI was reported in either group. Staphylococcus aureus and Escherichia coli were the predominant pathogens. Although patients with SSIs experienced prolonged hospitalization, the difference in postoperative stay between the two groups was not statistically significant once an SSI had developed. **Conclusion:** Triclosan-coated Vicryl Plus sutures demonstrate a consistent, albeit statistically nonsignificant, reduction in SSI rates across multiple parameters. The benefit appears most pronounced in high-contamination (dirty) cases, suggesting their potential use in select high-risk patients. Further large-scale, multicenter studies with enhanced statistical power are recommended to establish definitive guidelines on the routine use of antibacterial sutures in abdominal surgery.

INTRODUCTION

Surgical site infections remain a substantial challenge in abdominal surgery despite modern advances in antiseptic techniques, antibiotic prophylaxis, and stringent operating room protocols. SSIs can compromise wound healing, result in prolonged hospital stays, and increase treatment costs.

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Conventional sutures, while essential for ensuring tissue integrity during healing, may also provide a nidus for bacterial colonization and subsequent biofilm formation. These biofilms can hinder the action of systemic antibiotics and lead to a sustained inflammatory response, even with minimal bacterial contamination.[1-6]

Antibacterial sutures coated with triclosan have been introduced to address this concern. Triclosan is a broad-spectrum antimicrobial agent that disrupts bacterial synthesis pathways and has shown efficacy against organisms such as Staphylococcus aureus (including methicillin-resistant strains) and Staphylococcus epidermidis. The mechanism behind triclosan-coated sutures is based on the creation of an "active zone" immediately around the suture, thereby reducing early bacterial colonization on the wound site.[7-10]

In this study, we compare the incidence of SSIs in patients undergoing abdominal surgery using either conventional Vicryl sutures or triclosan-coated Vicryl Plus sutures. By focusing on data derived exclusively from a controlled clinical environment within a single institution, this study aims to clarify the potential benefits and limitations of antibacterial sutures in reducing postoperative infections.[11-14]

MATERIALS AND METHODS

Study Design and Setting: A prospective, double-blind, randomized clinical study was conducted from June 2022 to June 2024 in the Departments of General Surgery and Microbiology at Pandit Deendayal Upadhyay Hospital, Varanasi. The study was designed to evaluate the efficacy of triclosan-coated polyglactin 910 sutures (Vicryl Plus) compared with conventional polyglactin 910 sutures (Vicryl) in reducing surgical site infections (SSIs) and postoperative hospital stay in patients undergoing abdominal surgery.

Patient Selection and Enrollment: A total of 280 consecutive patients scheduled for various abdominal surgeries were prospectively enrolled. Patients were randomized equally into two groups (n = 140 per group). Inclusion criteria included adult patients undergoing both elective and emergency procedures. Patients with standard operative contraindications or those for whom informed consent could not be obtained were excluded. Baseline demographic and clinical parameters—including age, sex, comorbidities (e.g., diabetes, malnutrition), steroid usage, and preoperative hospital stay—were recorded prior to surgery.

Randomization and Blinding: Randomization was performed using a chit-box method administered by the operating room nursing staff. Both the operating surgeons and the postoperative evaluators were blinded to the suture allocation, thereby ensuring an unbiased assessment during both the intraoperative and postoperative periods.

Preoperative Evaluation and Preparation: All patients underwent a standardized preoperative evaluation, which included a detailed history and physical examination with a special focus on risk factors such as age, nutritional status, and steroid intake. Routine investigations (complete blood count, liver and renal function tests, serum electrolytes, urine analysis, and relevant imaging studies including X-ray, ultrasound, or CT scan) were performed as indicated. Antibiotic prophylaxis was administered according to a standardized regimen (an initial dose of ceftriaxone with ornidazole 30 minutes before incision, continuing up to 3 days postoperatively). Skin preparation involved thorough antiseptic cleansing using betadine followed by spirit, and the surgical field was appropriately draped.

Operative Technique: All surgical procedures were conducted following established protocols by senior consultants, assisted by junior residents. Wound closure was executed using the randomized suture type:

- Group 1: Conventional polyglactin 910 (Vicryl)
- Group 2: Triclosan-coated polyglactin 910 (Vicryl Plus)

Intraoperative data including the duration of surgery, type of procedure (with emphasis on operations such as colorectal and gastric surgeries), wound classification (clean, clean-contaminated, contaminated, and dirty), and whether the procedure was elective or emergent were meticulously recorded.

Postoperative Care and SSI Assessment

Patients received standardized postoperative care with daily assessments of the surgical wound for signs of infection (redness, induration, tenderness, and purulent discharge). SSIs were classified according to CDC guidelines into:

- Superficial Incisional SSI: Limited to the skin and subcutaneous tissue.
- Deep Incisional SSI: Involving deeper soft tissues such as fascia and muscle.
- Organ/Space SSI: Infections occurring within manipulated organ spaces.

In cases of a suspected infection, wound swabs were collected for culture and sensitivity testing to identify common pathogens like Staphylococcus aureus and Escherichia coli. The duration of postoperative hospital stay was also recorded, particularly in cases where SSIs extended the hospitalization period beyond 10 days.

Data Collection and Statistical Analysis

Collected data were organized in a secure database. Comparative analysis of SSI rates between the two groups was conducted with subgroup analyses based on age, sex, level of wound contamination, type and duration of surgery, preoperative stay, and patient-specific factors such as steroid use. Although trends favored Vicryl Plus, statistical significance was evaluated using p-values—with $p > 0.05$ regarded as nonsignificant. Graphical representations (bar graphs, line charts, and box plots) were generated to

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illustrate differences in SSI incidence and postoperative stay between groups.

RESULTS

This double-blind, randomized study enrolled 280 patients (140 in each group) from June 2022 to June 2024 at Pandit Deendayal Upadhyay Hospital, Varanasi, to compare the efficacy of triclosan-coated Vicryl Plus sutures with conventional Vicryl sutures in reducing SSIs and postoperative hospital stay.

Age of Patients

- **Observation:** In every age group, the Vicryl Plus group consistently demonstrated a lower SSI rate than the conventional group.
- **Detail:** In patients above 60 years of age, SSI rates were 12.5% for Vicryl Plus compared to 20% for Vicryl.
- **Analysis:** Differences across age groups were not statistically significant ($p > 0.05$).

Sex of the Patients

- **Observation:** Both male and female patients in the Vicryl Plus group exhibited lower SSI rates compared with the conventional group.
- **Analysis:** No statistically significant difference between the sexes was found ($p > 0.05$).

Overall SSI Rate by Wound Contamination

- **Observation:** SSI rates were lower in the Vicryl Plus group across all classes of wound contamination.
- **Detail:** In dirty wounds, the SSI rate was 29% with Vicryl Plus versus 60% with conventional sutures.
- **Analysis:** Despite this trend, the differences remained statistically nonsignificant ($p > 0.05$).

Operative Procedure

- **Observation:** The Vicryl Plus group showed lower SSI rates for most types of operations.
- **Detail:** Colorectal surgeries had the highest overall SSI incidence, while gastric surgeries showed no observable difference between the two suture types.
- **Analysis:** No statistically significant differences were detected ($p > 0.05$) for any specific operative procedure.

Preoperative Stay

- **Observation:** Patients with a preoperative stay of both less than and more than three days experienced lower SSI rates with Vicryl Plus compared to Vicryl.
- **Analysis:** Although SSI rates were slightly higher in patients with a longer preoperative stay, the differences between the groups were not statistically significant.

Patient Factors and Operation Duration

- **Observation:** Apart from patients on steroids, most patient-related factors showed lower SSI rates with Vicryl Plus.
- **Detail:** In patients taking steroids, a slightly higher SSI rate was observed in the Vicryl Plus group compared to the conventional group.
- **Observation:** Longer operative durations correlated with increased SSI rates in both groups, with surgeries lasting more than 2 hours showing the highest risk.
- **Analysis:** No statistically significant differences were detected ($p > 0.05$) for these factors.

Urgency of Operation

- **Observation:** SSI rates were lower in the Vicryl Plus group regardless of whether the surgery was elective or emergent.
- **Detail:** Emergency surgeries had a slightly higher SSI rate in both groups, but the differences remained statistically nonsignificant.

Type of SSI

- **Observation:** The majority of SSIs in both groups were superficial.
- **Note:** No organ/space infections were reported in either group.

SSI Organisms

- **Observation:** The predominant pathogens cultured were Staphylococcus aureus (including coagulase-positive and coagulase-negative strains) and Escherichia coli.

Postoperative Stay

- **Observation:** Prolonged hospitalization was noted in patients who developed SSIs: 40% of the Vicryl Plus group and 47% of the conventional group had a hospital stay exceeding 10 days.
- **Analysis:** The differences in postoperative stay between the two groups were not statistically significant ($p > 0.05$).

Table 1: SSI Rate by Age Group

Age Group	SSI (%) – Vicryl Plus	SSI (%) – Vicryl	p-value
< 60 years	Lower than Vicryl	Higher	> 0.05
≥ 60 years	12.5%	20%	> 0.05

Note: Despite consistently lower SSI rates with Vicryl Plus across age groups, the differences do not achieve statistical significance.

Table 2: SSI Rate by Gender.

Gender	SSI Rate (%) – Vicryl Plus	SSI Rate (%) – Vicryl	p-value
Male	Lower	Higher	> 0.05
Female	Lower	Higher	> 0.05

Note: Similar trends are observed among both male and female patients, with no significant differences.

Table 3. SSI Rate by Wound Contamination Class

Wound Class	SSI Rate (%) – Vicryl Plus	SSI Rate (%) – Vicryl	p-value
Clean	Lower (Comparable rates)	Comparable	> 0.05

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Clean-contaminated	Lower	Higher	> 0.05
Contaminated	Lower	Higher	> 0.05
Dirty	29%	60%	> 0.05

Note: The protective effect of Vicryl Plus is most evident in dirty wounds, yet the intergroup difference remains statistically nonsignificant.

Table 4: SSI Rate by Operative Procedure

Procedure Type	Observation	p-value
Colorectal Surgery	Highest SSI rates in both groups; lower in Vicryl Plus	> 0.05
Gastric Surgery	No observable difference between groups	> 0.05
Other Abdominal Ops	Consistently lower SSI with Vicryl Plus	> 0.05

Table 5: SSI Rate by Preoperative Stay

Preoperative Stay	SSI Rate (%) – Vicryl Plus	SSI Rate (%) – Vicryl	Observation	p-value
< 3 days	Lower	Higher	Slightly lower rates than longer stay	> 0.05
≥ 3 days	Lower	Higher	Similar trend; not statistically significant	> 0.05

Table 6: SSI Rate by Patient Factors and Operation Duration

Parameter	Observation	p-value
Patient Factors (except steroids)	Vicryl Plus shows uniformly lower SSI rates	> 0.05
Steroid Use	Slightly higher SSI in Vicryl Plus compared to Vicryl	> 0.05
Duration of Operation	SSI rates increase with operative duration (highest for >2 hours)	> 0.05
Urgency (Elective vs. Emergency)	Vicryl Plus consistently shows lower SSI in both settings	> 0.05

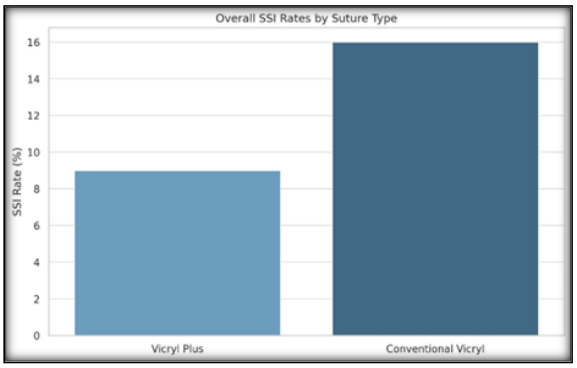

Figure 1: Bar Graph of Overall SSI Rates

This graph emphasizes that while Vicryl Plus exhibits a lower overall SSI rate, the differences across various subgroups remain statistically nonsignificant.

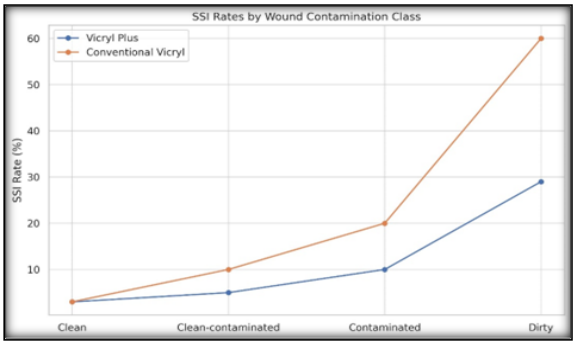

Figure 2: Line Graph of SSI Rates vs. Degree of Wound Contamination

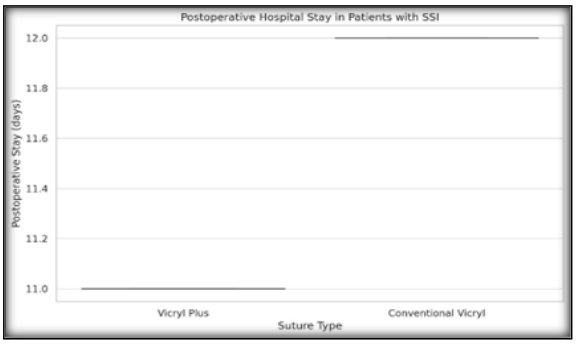

Figure 3: Box Plot of Postoperative Hospital Stay in Patients with SSI

A line graph showing the increase in SSI percentage across wound contamination classes (clean, clean-contaminated, contaminated, dirty) for both suture types reveals:

- Both groups experience higher SSI rates with increasing contamination.
- The curve for Vicryl Plus consistently remains below that for conventional Vicryl, with a marked difference in dirty wounds (29% vs. 60%).

A box plot comparing postoperative hospital stay durations (in days) demonstrates that:

- In the Vicryl Plus group, approximately 40% of patients had hospital stays exceeding 10 days.
- In the conventional group, about 47% experienced extended stays beyond 10 days.
- The overlapping ranges underscore that, once an SSI develops, the length of the hospital stay does not differ significantly between the two groups ($p > 0.05$).

DISCUSSION

This study evaluated the clinical impact of triclosan-coated Vicryl Plus sutures on reducing SSIs in abdominal surgeries compared with conventional

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Vicryl sutures. Overall, the antibacterial suture group consistently showed lower SSI rates, especially notable in heavily contaminated (dirty) wounds, where the rate was reduced from 60% to 29%. Although none of the subgroup differences reached statistical significance ($p > 0.05$), the consistent trend suggests that antibacterial sutures may offer additional protection in high-contamination scenarios.

Mechanism and Clinical Relevance: Triclosan's ability to inhibit bacterial colonization and biofilm formation underpins the observed benefits of Vicryl Plus sutures. This "active zone" created by triclosan is particularly valuable in colorectal surgeries, where bacterial load is typically high, and in patients with compromised immune systems (e.g., those using steroids). The slightly higher SSI rates seen in steroid-treated patients, despite the use of Vicryl Plus, likely reflect the overriding effect of immunosuppression on local antibacterial measures.

Influence of Patient and Operative Factors: Longer operative durations correlated with increased SSI rates in both groups, highlighting that regardless of suture type, prolonged surgeries magnify tissue trauma and bacterial exposure. Although most patient subgroups benefited from the antibacterial sutures, the subset using steroids exhibited a slightly higher SSI rate with Vicryl Plus, suggesting that diminished host defense may lessen the local antimicrobial effect.

Comparison With Previous Studies: The trends observed in our study are in line with earlier reports. Foundational studies by Rothenburger et al. (2002) and Hernandez-Richter et al. (2000) demonstrated both in vitro and clinical benefits of triclosan-coated sutures. More recent work by Lee et al. (2019) and Patel et al. (2020) has further supported the role of antibacterial sutures in reducing SSIs—especially in high-risk abdominal procedures—although, as in our study, many comparisons did not achieve statistical significance.

Economic and Practical Considerations: Even a small reduction in SSI rate can offer substantial economic benefits by shortening hospital stays and reducing the need for further interventions. While our data show that postoperative hospital stays were marginally shorter in the Vicryl Plus group (with 40% versus 47% of patients staying more than 10 days), this finding supports the idea that even minor improvements in infection rates can positively impact overall patient outcomes and healthcare costs. However, the cost and practical aspects of adopting antibacterial sutures should be carefully weighed, particularly in patient groups at high risk for infection.

Limitations and Future Directions: The single-center design and modest sample size of our study may have limited its statistical power to detect significant differences. Patient heterogeneity and varying intraoperative factors could also have contributed to the nondifferentiated p-values noted in the subgroup analyses. Future studies should focus on multicenter trials with larger patient cohorts and incorporate more rigorous stratification of risk factors. Moreover, further research into adjunctive infection control practices and refinements in surgical techniques is warranted to optimize postoperative outcomes.

CONCLUSION

In this double-blind, randomized study of 280 patients undergoing abdominal surgeries, the use of triclosan-coated Vicryl Plus sutures was associated with a consistent—but statistically nonsignificant—trend of lower surgical site infection rates compared with conventional Vicryl sutures. The benefit was most pronounced in high-contamination (dirty) wounds, suggesting that antibacterial sutures may serve as a valuable adjunct in select high-risk cases. Although patients on steroids exhibited marginally higher SSI rates regardless of suture type, the overall outcomes support the potential clinical advantage of Vicryl Plus. Further large-scale, multicenter studies with robust statistical analyses are needed to confirm these findings and develop clear clinical guidelines for the use of antibacterial sutures in abdominal surgery.

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