Original Article

Effect of Fascia Closure with Triclosan-Coated Polydioxanone Suture on Surgical Site Infection in Open Appendectomy Wounds: A Comparative Study

Adewale A. Aderounmu[1,2], Olalekan Olasehinde[1,2], Funmilola O. Wuraola[1,2], Adewale O. Adisa[1,2], Oladejo O. Lawal[1,2]

[1]Department of Surgery, Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, [2]Department of Surgery, Obafemi Awolowo University, Ile-Ife, Nigeria

Abstract

Background: Interest in surgical site infections (SSI) has been sustained over the years because its occurrence may be ruinous to the overall success of surgical operations. The use of antimicrobial suture has been associated with a reduction in SSI, but its role in open appendectomy has not been evaluated. **Objective:** This study compared the effect of fascia closure with triclosan-coated polydioxanone (PDS) with plain PDS on SSI in appendectomy wounds. **Materials and Methods:** Ninety-three consecutive patients who had open appendectomy for uncomplicated acute appendicitis were randomised to either have fascia closure with triclosan-coated PDS (TCS) or plain PDS. Post-operative wound infection rates were compared. **Results:** SSI occurred in three of the 93 patients (3.2%), two of these occurred in the plain suture group, while one occurred in the TCS group (4.2% vs. 2.2%, $P = 0.6$). All three SSIs were superficial. *Staphylococcus aureus* was the predominant organism isolated in the infected wounds. **Conclusion:** The use of triclosan-coated polydioxanone for fascia closure in open appendectomy did not significantly affect the rate or severity of SSI. Further studies, perhaps evaluating the use of TCS in a different anatomical plane or complicated appendicitis are recommended.

Keywords: *Open appendectomy, surgical site infection, triclosan-coated suture*

Introduction

Wound infection remains an important surgical outcome because of its potential effect on the overall success of surgical operations. Although several gains have been made over the past decades in reducing SSI rates, there has been sustained interest in the surgical community to identify and promote measures that will further reduce its incidence.[1] Emergency abdominal operations—many of which are either contaminated or dirty—have the highest risk of developing wound infection, and have therefore been the focus of many interventions.[2]

Appendectomy is one of the most commonly performed emergency abdominal operations worldwide.[3] An appendectomy wound is classified as a contaminated wound when performed for an inflamed nonruptured appendix.[4] A systematic review of appendectomies performed in low and middle-human development-index countries revealed a high SSI rate with a pooled estimate of 17.9%.[5]

One of the recent additions to the anti-SSI armamentarium is the use of antimicrobial-incorporated sutures for wound closure. Incorporation of antimicrobials into sutures is supposed to facilitate better and more constant delivery of the antimicrobial agent locally, and prevent bacterial adhesion, biofilms formation, and ultimately reduce wound infection.[6,7] The antimicrobial that has been widely deployed for this purpose is triclosan, an agent with bactericidal properties and very rarely associated with antibiotic resistance. Reports on the use of triclosan-coated sutures (TCS) have demonstrated a reduction in surgical site infection, duration of hospital admission and overall cost of medical care, particularly in paediatric, cardiothoracic and general surgical patients.[8-11] A recent meta-analysis of different surgical operations evaluated

Received: 29-Jan-2023
Accepted: 17-Dec-2023
Published: 22-Feb-2024

Address for correspondence:
Dr. Adewale A. Aderounmu, Department of Surgery, Obafemi Awolowo University Teaching Hospitals Complex, PMB 5538, Ile-Ife 220222, Nigeria.
E-mail: waderounmu@gmail.com

Access this article online

Website: www.jwacs-jcoac.com

DOI: 10.4103/jwas.jwas_25_23

Quick Response Code:

How to cite this article: Aderounmu AA, Olasehinde O, Wuraola FO, Adisa AO Lawal OO. Effect of fascia closure with triclosan-coated polydioxanone suture on surgical site infection in open appendectomy wounds: A comparative study. J West Afr Coll Surg 2024;14:154-8.

the economic impact of its use and showed a significant mean saving per procedure.[12]

To date, there is limited data on its use in sub-Saharan Africa where SSI rates are known to be higher and overall outcomes poorer. This lacuna spurred the current work, which studied the influence of triclosan-coated sutures on the occurrence of SSI in appendectomy wounds.

Subjects and Methods

Consecutive adult patients who had open appendectomy for acute appendicitis between October 2018 and August 2019 at a Nigerian tertiary hospital were enrolled and randomised into two groups, either to have the fascia layer of their wound closed with triclosan-coated polydioxanone suture (PDS plus) or with plain polydioxanone suture (PDS).

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics and research committee of the institution (IRB/IEC/0004553). Written informed consent was obtained from all the participants.

Study population

The study included consecutive adult patients who were 18 years or older with clinical and or radiological diagnoses of acute uncomplicated appendicitis who underwent open appendectomy were included in the study. Patients enrolled on the study with the impression of uncomplicated appendicitis with intraoperative findings of ruptured appendix were excluded from the study. Consenting patients were randomised into the test or control arm of the study.

Procedure

All operations were performed under general anaesthesia with endotracheal intubation. Perioperative antibiotics (intravenous: Ciprofloxacin, 200 mg, and Metronidazole, 500mg) were administered in all cases. Skin preparation was done in all cases using Chlorhexidine 0.3% plus Cetrimide 3% solution, followed by application of methylated spirit.

All operations were performed using the standard Lanz incision to access the peritoneal cavity. The length of the incision and the thickness of the subcutaneous tissue were estimated in centimetres. Appendectomy was performed in all cases after ligating the appendiceal artery and the appendiceal base without burying the stump. After removal of the inflamed appendix, the internal oblique muscle was apposed with absorbable sutures. For patients in the test arm of the study (group A), the external oblique aponeurosis was closed with the triclosan-coated monofilament polydioxanone: PDS plus 1 (Ethicon, Johnson & Johnson International, Somerville, NJ, USA) suture using simple continuous technique. Those in the control arm (Group B) had their fascia layer closed with a plain monofilament polydioxanone: PDS 1 (Ethicon) in the same manner as in the test arm.

In both arms of the study, the subcutaneous tissue was apposed with Vicryl 2/0 suture and skin closure was with Poliglecaprone 3/0 (Monocryl; Ethicon, Johnson & Johnson Company, Sommerville, NJ) sutures. The wound was then dressed with 3M soft cloth adhesive wound dressing (3M., St. Paul, Minnesota).

Post-operative evaluation for SSI

The wounds were inspected on post-operative days 2, 7, 14, and 30 by a doctor who did not participate in the operation and did not know the treatment arm the patient was assigned. Assessment of SSI was done with the Southampton wound classification system.

Statistical analysis

Data analysis was done using the computer software IBM SPSS Statistics (IBM version 22, Chicago, Illinois). Baseline demographic and clinical data were compared using the independent *t* test for continuous variables and Chi square test for categorical variables. SSI rates and severity were assessed using the Chi square test. A *P* value of less than 0.05 was considered significant.

Results

Baseline demographic and clinical data

Ninety-three patients were randomised and enrolled on the study. There were 45 patients in the TCS group and 48 in the plain PDS group. One patient in the plain PDS group was lost to follow up after the 14th post-operative day [Figure 1].

The mean age range of the patients in the TCS group 27.4 ± 10.3 years while that of the plain PDS was 25 ± 7.0 years with no statistically significant difference between the two groups ($P = 0.12$). Similarly, the gender distribution in the two groups was comparable, with TCS group having 21 males and 24 females and the plain suture group having 23 males and 25 females ($P = 0.90$). The mean BMI was 22.4 kg/m^2 in the TCS group and 22.6 kg/m^2 in the plain PDS group ($P = 0.73$) [Table 1]. All the patients in the study had normal haematocrit levels. Regarding the ASA score, the majority of the patients (92.7%) were classified as IE with only a few patients in class II. This pattern was similar in the two groups.

The mean length of the incision was 7.1 cm in the TCS group, similar to 7.0 cm in the plain PDS group ($P = 0.62$), and so was the mean duration of surgery (60.1 ± 15.0 vs. 57.0 ± 17.9 min, $P = 0.38$).

Comparison of SSI rates and severity

Overall, three patients had SSI, two in the plain suture group (4.2%) and one in the TCS group (2.2%). This difference did not attain statistical significance ($P = 0.6$). All cases of surgical site infection were observed on the

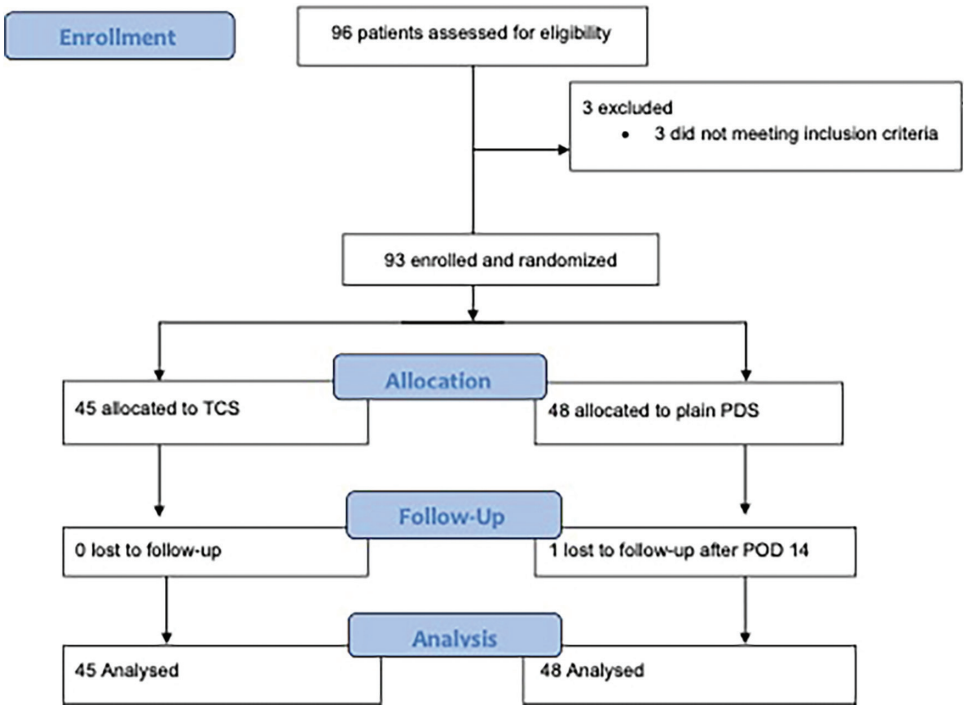

Figure 1: Study flow diagram. PDS: polydioxanone, TCS: triclosan-coated sutures, POD: post-operative day

Table 1: Comparison of the baseline characteristics of the two study groups

Variable	Plain PDS (n = 48)	TCS (n = 45)	p value
Age (years)	24.9 ± 6.9	27.4 ± 10.2	0.18
Sex (M/F)	23/25	21/24	0.90[a]
BMI (kg/m^2)	22.6 ± 2.2	22.4 ± 2.5	0.73
Length of incision (cm)	7.0 ± 1.2	7.1 ± 0.9	0.62
Thickness of subcutaneous layer (cm)	1.9 ± 0.8	1.9 ± 0.7	0.87
Duration of surgery (min)	57.0 ± 17.9	60.1 ± 15.0	0.38

PDS: polydioxanone, TCS: triclosan-coated sutures, M: male, F: female
[a]Pearson's Chi-squared

seventh post-operative day and were of the superficial incisional type.

The other wound events -such as bruising and erythema- were observed on the seventh post-operative day, with three patients having minor wound complications (grades 1–3). All patients with these minor wound complications on day 7 had reverted to normal (grade 0) by day 14 review without any form of intervention [Figure 2].

When the wound grades in the two groups were compared, patients in the control group (plain suture group) had more minor wound events—erythema and bruising—compared to the TCS group. This difference was statistically significant (P = 0.01), although most of these events were not clinically significant.

Microbiology of SSI

Wound swabs were taken for microbial culture in the three patients with clinical evidence of infection. *Staphylococcus aureus* was identified in all three cases. The microbiological sensitivity pattern showed sensitivity to the perioperative antibiotic.

The duration of post-operative hospital stay ranged from two to four days with a mean post-operative stay of 2.3 ± 0.5 days. Only four patients stayed for 4 days due to postoperative nausea and vomiting. The mean duration of postoperative hospital stay did not differ between the two study groups (P = 0.4).

Discussion

The interest in studying SSI in appendectomy wounds stemmed from the high rates of its occurrence particularly in low-resource settings as reported in earlier studies.[13-16] The use of triclosan-coated sutures is one of the measures currently being evaluated in some advanced countries.[12] Owing to the limited data on its use in sub-Saharan Africa, this study explored the effectiveness of triclosan-coated PDS in reducing infection rates in appendectomy wounds. The potential impact of wound infection on a

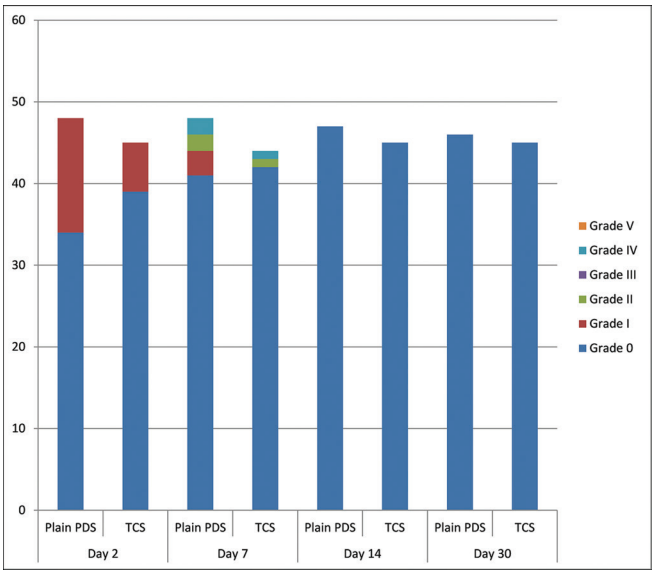

Figure 2: Comparison of the Southampton wound scores of the study groups. PDS: polydioxanone, TCS: triclosan-coated sutures

predominantly young, economically viable population which represents the majority of the patients in this study underscores the importance of this work.[17] Although some studies had earlier evaluated the role of triclosan in reducing SSI, the majority of these were done in a heterogeneous population of patients with various wound classes and diagnoses.[10,18] This study, however, focussed on uncomplicated appendectomy wounds, which represents a more homogeneous cohort, thereby limiting the effect of confounding factors.

The baseline socio-demographic characteristics of patients in this study reflect a population that is relatively young, educated and majorly students. Although there was no strict matching of patients in the two treatment arms, baseline similarity in terms of demographic features such as age, level of education, and occupational status was achieved. Similarly, other preoperative clinical characteristics such as BMI and laboratory parameters were comparable between the two groups.

The SSI rates reported in this study (2.2% in the triclosan-coated PDS arm, 4.2% in the plain PDS arm and 3.2% overall) are lower than earlier reports from Nigeria.[13,14] In a systematic review of appendectomies performed in low and middle-income countries, a pooled estimate of 17.9% was reported.[5] This difference may not be unconnected with the highly selected nature of participants in this study. The strict inclusion criteria adopted account for a study population with normal ASA status, normal BMI, with no comorbidities, representing a low-risk population. The majority of studies that have however demonstrated higher infection rates were observational and were non-selective in terms of comorbidities and presence of complications such as perforation and abscess formation.[13-16] These methodological differences may have impacted the infection rates recorded in this study compared to earlier reports.

Regarding the grade of wound infection, all cases of SSI found in this study were of the superficial incisional variety. These were infections limited essentially to the skin and subcutaneous layers, none of which required prolonged hospitalisation, readmission or re-operation. These infections occurred in an anatomical plane different from the fascia plane where the intervention was applied. This finding was also observed by Baracs *et al*.[19] in his study on the use of TCS for fascia closure of laparotomy wounds during colorectal operations. This might suggest the use of TCS in multiple anatomical planes to maximise its benefits. This was also the recommendation of Leaper *et al*.[12] in a meta-analysis on the use of antimicrobial sutures.

When infection rates in the two groups were compared, the use of triclosan-coated sutures demonstrated a slightly lower but non-statistically significant advantage over plain sutures (2.2% vs. 4.2%). This finding is similar to the results of the latest randomised controlled trial which evaluated the effectiveness of triclosan-coated PDS in reducing SSI when used for closure of contaminated and dirty abdominal wounds (29.4% vs. 30.7%, RR 0.98, CI 077–1.06).[20] Baracs *et al*.[19] in their study on TCS use in colorectal operations, also demonstrated no significant advantage following the use of triclosan-coated PDS. It is interesting to note, however, that the few studies that showed significant advantages with the use of TCS in reducing wound infection rates used Polyglactin 910 rather than PDS.[21-23] While there is no clear explanation for this observation, the difference in suture configuration (monofilament versus braided) is one of the theories that have been postulated.[24]

This study also examined the microbiology of infected wounds. *Staphylococcus aureus* was the only microorganism isolated in all cases. In a study on appendectomy wounds, Salim *et al*.[25] also reported the predominance of *S. aureus.* It is possible that the application of TCS in the fascia plane might have prevented the migration of enteric bacteria from deeper layers into the subcutaneous plane but did little in preventing *S. aureus* which is a skin commensal and is also found in the nares of health workers from colonising the wound from without. Contamination could therefore have come from any of these exogenous sources. This is perhaps another justification for the use of TCS in multiple tissue planes such as in the subcutaneous layer and possibly, the skin.

It is noteworthy that the scope of the microbial culture in this study did not include anaerobes; as such the results of this study should be interpreted in this context. This study also did not evaluate the concept of cost benefit which is an important consideration when adopting new interventions in economically limited settings.

From the foregoing, this study has highlighted the prevalence, pattern and microbiology of infected wounds following an operation for selected cases of uncomplicated appendicitis in a Nigerian tertiary hospital. It shows limited advantages for the use of TCS for fascia closure in uncomplicated appendicitis in this setting. While it may be argued that a much larger sample size might be able to demonstrate a statistically significant difference, whether such difference will be clinically relevant in a low-risk, super-selected population is unlikely, given the low infection rates overall. It is however possible that a clinically significant difference might be demonstrated in a high-risk population such as in patients with complicated appendicitis. This study therefore provides a background for the conduct of future studies to focus on wound classes with higher risk of infection or to use TCS in different or multiple tissue planes.

Acknowledgement

The authors acknowledge the general surgery residents and all the perioperative nurses for their support.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Nespoli A, Geroulanos S, Nardone A, Coppola S, Nespoli L. The history of surgical infections. Surg Infect (Larchmt) 2011;12:3-13.
2. Olmez T, Berkesoglu M, Turkmenoglu O, Colak T. Effect of triclosan-coated suture on surgical site infection of abdominal fascial closures. Surg Infect (Larchmt) 2019;20:658-64.
3. Salminen P, Paajanen H, Rautio T, Nordström P, Aarnio M, Rantanen T, *et al*. Antibiotic therapy vs appendectomy for treatment of uncomplicated acute appendicitis: The appac randomized clinical trial. JAMA 2015;313:2340-8.
4. Williams N, Bulstrode C, O'Connel P. Surgical Infection. Baileys and Love Short Practice of Surgery. 26th ed. London: Taylor & Francis Group; 2013. p. 50-67.
5. Foster D, Kethman W, Cai LZ, Weiser TG, Forrester JD. Surgical site infections after appendectomy performed in low and middle human development-index countries: A systematic review. Surg Infect (Larchmt) 2018;19:237-44.
6. Barbolt TA. Chemistry and safety of triclosan, and its use as an antimicrobial coating on coated VICRYL* plus antibacterial suture (coated polyglactin 910 suture with triclosan). Surg Infect (Larchmt) 2002;3:S45-53.
7. Edmiston CE, Seabrook GR, Goheen MP, Krepel CJ, Johnson CP, Lewis BD, *et al*. Bacterial adherence to surgical sutures: can antibacterial-coated sutures reduce the risk of microbial contamination? J Am Coll Surg 2006;203:481-9.
8. Fleck T, Moidl R, Blacky A, Fleck M, Wolner E, Grabenwoger M, *et al*. Triclosan-coated sutures for the reduction of sternal wound infections: economic considerations. Ann Thorac Surg 2007;84:232-6.
9. Laas E, Poilroux C, Bezu C, Coutant C, Uzan S, Rouzier R, *et al*. Antibacterial-coated suture in reducing surgical site infection in breast surgery: A prospective study. Int J Breast Cancer 2012;2012:819578.
10. Galal I, El-Hindawy K. Impact of using triclosan-antibacterial sutures on incidence of surgical site infection. Am J Surg 2011;202:133-8.
11. Olasehinde O, Aderounmu A, Etonyeaku AC, Mosanya AO, Wuraola FO, Agbakwuru EA. Effectiveness of triclosan coated suture for subcutaneous wound closure in preventing surgical site infection following mesh repair of inguinal hernia: A pilot study. West Afr J Med 2021;38:566-70.
12. Leaper DJ, Edmiston CE, Holy CE. Meta-analysis of the potential economic impact following introduction of absorbable antimicrobial sutures. Br J Surg 2017;104:e134-44.
13. Edino ST, Mohammed AZ, Ochicha O, Anumah M. Appendicitis in Kano, Nigeria: A 5-year review of pattern, morbidity and mortality. Ann Afr Med 2004;3:38-41.
14. Adeyanju MA, Adebiyi A. An audit of appendicitis at a tertiary centre in Lagos, Nigeria. J Sci Res Stud 2015;2:126-34.
15. Chianakwana GU, Ihegihu CC, Okafor PIS, Anyanwu SNC, Mbonu OO. Adult surgical emergencies in a developing country: The experience of Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State, Nigeria. World J Surg 2005;29:804-7; discussion 808.
16. Ali N, Aliyu S. Appendicitis and its surgical management experience at the University of Maiduguri Teaching Hospital Nigeria. Niger J Med 2012;21:223-6.
17. Sullivan E, Gupta A, Cook CH. Cost and consequences of surgical site infections: A call to arms. Surg Infect (Larchmt) 2017;18:451-4.
18. Henriksen NA, Deerenberg EB, Venclauskas L, Fortelny RH, Garcia-Alamino JM, Miserez M, *et al*. Triclosan coated sutures and surgical site infection in abdominal surgery: The TRISTAN review, meta analysis and trial sequential analysis. Hernia 2017;21:833-41.
19. Baracs J, Huszár O, Sajjadi SG, Horváth OP. Surgical site infections after abdominal closure in colorectal surgery using triclosan-coated absorbable suture (PDS Plus) vs uncoated sutures (PDS II): A randomized multicenter study. Surg Infect (Larchmt) 2011;12:483-9.
20. Ademuyiwa AO, Hardy P, Runigamugabo E, Sodonougbo P, Behanzin H, Kangni S, *et al*. Reducing surgical site infections in low-income and middle-income countries (FALCON): A pragmatic, multicentre, stratified, randomised controlled trial. Lancet 2021;398:1687-99.
21. Jung KH, Oh SJ, Choi KK, Kim SM, Choi MG, Lee JH, *et al*. Effect of triclosan-coated sutures on surgical site infection after gastric cancer surgery via midline laparotomy. Ann Surg Treat Res 2014;87:311-8.
22. Justinger C, Schuld J, Sperling J, Kollmar O, Richter S, Schilling MK. Triclosan-coated sutures reduce wound infections after hepatobiliary surgery—A prospective non-randomized clinical pathway driven study. Langenbecks Arch Surg 2011;396:845-50.
23. Justinger C, Moussavian MR, Schleuter C, Kopp B, Kollmar O, Schilling MK. Antibacterial [corrected] coating of abdominal closure sutures and wound infection. Surgery 2009;145:330-4.
24. de Jonge SW, Atema JJ, Solomkin JS, Boermeester MA. Meta-analysis and trial sequential analysis of triclosan-coated sutures for the prevention of surgical-site infection. Br J Surg 2017;104:e118-33.
25. Salim M, Ahmed J, Bhuyian N, *et al*. Comparative study of surgical site infection between laparoscopic appendectomy and open appendectomy. Med Today 2017;29:6-11.