THE EFFECT OF SKIN ANTISEPSIS AFTER PRIMARY SKIN CLOSURE ON THE INCIDENCE OF SURGICAL SITE INFECTION AFTER ABDOMINAL SURGERY FOR SEPSIS: A PRELIMINARY REPORT OF A RANDOMISED CONTROLLED TRIAL

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ABSTRACT

Background: **The role of skin antisepsis after skin closure in abdominal surgery for sepsis is not well reported. This study assessed the effect of skin antisepsis following primary skin closure on surgical site infection (SSI) after contaminated and dirty abdominal surgery.**

Methods: **This was a randomised controlled trial involving adult patients undergoing laparotomy for sepsis. Patients were randomised into a Control (C) group where the wound edge was cleaned once with 70% isopropyl alcohol before being covered with a dry sterile gauze dressing and a Povidone-iodine (PI) group in whom the wound edge was cleaned once with 70% isopropyl alcohol, then covered with a 10% povidone iodine-soaked gauze dressing. Both groups were compared for the presence of SSI. Statistical significance was set at a p value of <0.05.**

Results: **Thirty-seven patients (C group = 18; PI group = 19) were recruited. The median age was 36 years (Interquartile range, IQR = 72) with a male-to-female ratio of 2.7:1. The overall incidence of SSI was 48.6% (n = 18), comparable between the C group (n=10, 55.6%) and PI group (n = 8; 42.1%) (p = 0.413). In-hospital mortality rate was 10.8 % (n = 4), equally distributed between the groups (p = 1.000). The length of hospital stay was 8 days (IQR = 15) in the C group and 7 days in the PI group (IQR =9) (p = 0.169).**

Conclusion: **In laparotomy for sepsis, skin antisepsis after primary skin closure had no effect on the incidence of surgical site infection.**

Keywords: Antisepsis, Skin closure, Abdominal Surgery, Sepsis.

INTRODUCTION

The advances made in 21st century surgery were hinged mainly on a tripod of surgical technique with adequate haemostasis, anaesthesia and surgical antisepsis. Surgical practice in the prehistoric times was a fearful venture partly as a result of surgical site infection with attempts at its control foiled by failure to identify its aetiology.[1] Surgical site infection (SSI) was said to be so severe that surgeons rarely operated until the 1860's.[2] The burden of surgical site infection has generally declined in recent decades with overall rates as low as 5% compared to 9.8% just three decades ago.[3,4]

The microbial basis of infection was established by Louis Pasteur who discovered that tissue decay was caused by microbes.[5] Based on this discovery, Joseph Lister propounded that the presence of micro-organisms in surgical wounds was responsible for death in the post-operative period. He then started treating wounds with carbolic acid, hence the first use of antiseptic agent was credited to him.[5]

Over the years, greater attention to asepsis in surgery became the rule with agents and techniques used for this purpose undergoing modifications as more evidence became available. Current aseptic techniques involve a wide range of activities including instrument sterilization, use of sterile gloves and gowns, aseptic operating theatres suites, skin antisepsis and strict adherence to aseptic techniques during surgery.[5] However, the effects of skin antisepsis – risks and benefits – need to be considered.

The human skin has a self-sterilizing activity which has been ascribed to various factors such as low pH and some antimicrobial agents, including small chain fatty acids.[6] The resident bacteria are rarely pathogenic and

may be a direct asset to their host.[6,7] For example, the human skin secrets sebum which is rich in triglycerides.[8] The triglycerides are hydrolyzed by the resident bacteria to short chain fatty acids which provide an acidic medium that is in turn inhibitory to pathogenic microbes. It has, therefore, been noted that the continual reduction in the number of these resident flora by repeated application of an antiseptic agent may encourage not only cross infection with Gram negative bacteria but may become a source of tissue damage.[9]

Skin antisepsis refers to the use of chemical agents to destroy or inhibit the growth of micro-organisms in or on living tissue.[10] It is traditionally carried out before surgical skin incision to reduce microbial load and ultimately the burden of SSI.[11-13] This is because the development of SSI depends on the virulence of the microbe, the host immune response and the dose of the inoculum.[14] Various agents have been described to be effective in this regard, either singly or in combination. The commonly used antiseptics include alcohol-based (e.g., methylated spirit) iodophor-based (e.g., povidone-iodine) or chlorhexidine-based (e.g., savlon, hibitane) agents.[15] These agents not only reduce the microbial load prior to skin incision but also exert varying degrees of antimicrobial activity (microbistatic or microbicidal). The beneficial role of this pre-operative skin preparation has been fully established in several studies, persisting debate being essentially limited to which agent or combination of agents provides superior antiseptic benefit.[16-18]

However, following skin closure after abdominal surgery, and cleaning the wound edges and surrounding skin of blood and other tissue fluid with a soapy antiseptic agent, some surgeons clean the apposed skin edge with an antiseptic solution, either isopropyl alcohol (more commonly) or povidone-iodine, before application of sterile dressings.[19] The effects of this practice after skin closure in terms of post-operative wound outcome remains to be established. The aim of this study, therefore, was to examine whether skin antisepsis following skin closure in contaminated and dirty abdominal surgeries had an effect on surgical site infection in these patients.

METHODS

This was a prospective randomized controlled study (ClinicalTrials.gov identifier, NCT05896462) conducted at the University College Hospital, Ibadan, Nigeria from the 19th of August 2019 to 2nd of December, 2021. Ethical approval was obtained from the joint University of Ibadan/University College Hospital ethical review committee with UI/UCH ethics committee assigned number UI/EC/19/0158. Study participants were recruited from adult patients presenting through the Surgery Out-Patient (SOP) department, Emergency departments and non-surgical wards of University College Hospital, Ibadan.

Since the main outcome variable for this study is the occurrence of surgical site infection, the sample size formula for comparing independent proportions was used giving 40 participants per study group

This gives a total sample size (N) of 80 study participants. Considering an attrition rate of 5%, the attrition factor, f, (given as 1/1-attrition rate) was 1.05 with a definitive sample size (N x f) of 84 participants. This preliminary report was based on 37 patients recruited so far.

All patients requiring laparotomy for sepsis aged 18 years and above were considered eligible while all cases of clean and clean-contaminated abdominal surgeries were excluded. Study participants were randomized into 2 groups: povidone iodine (PI) & Control (C) groups using blocked sequence randomization. Consecutive adult surgical patients (aged 18 years and above) booked to have abdominal surgery for sepsis were prospectively enrolled in turns into the two study groups.

Shaving of abdominal hair was done for all patients just before the surgery using a surgical blade. They were given a single dose each of intravenous ceftriaxone (1g; Zonon; Sanofi;) and metronidazole (500mg; Metrone; Aventra) at the induction of anaesthesia. After surgery, patients with contaminated wounds were given intravenous ceftriaxone and metronidazole, discontinued after 24hours post-operatively. Patients with dirty wounds received therapeutic doses of post-operative antibiotics intravenously (iv ceftriaxone 1g 12 hourly and iv metronidazole 500mg 8 hourly) for 10-14 days. This was converted to oral antibiotics (cefpodoxime 200mg 12 hourly and metronidazole 500mg 8 hourly) once oral intake was established.

Skin preparation was done as follows: scrubbing of the operation site twice over 3-5 minutes using savlon (0.3% chlorhexidine-gluconate in alcohol + 3% cetrimide) was followed by drying of the skin with a sterile gauze. The operation site was painted with 10% povidone iodine solution followed by 70% isopropyl alcohol before sterile draping. A midline incision that provides adequate exposure was made using a scalpel and deepened using monopolar diathermy. Upon gaining peritoneal access, a wound swab was taken from the focus of peritoneal contamination/sepsis.

The surgical procedures relevant for each case were carried out.

Having closed the skin and cleaned with savlon and 70% isopropyl alcohol, patients in the C group had the apposed skin edge covered with dry sterile gauze while in PI group, 10% povidone iodine-soaked gauze dressing was used to cover the apposed skin edge. The surgical site was assessed on the 3rd, 7th and 10th post-operative day for evidence of SSI, defined in this study as purulent drainage from the surgical wound or a drain inserted at surgery.

A swab was taken from the wound edge of all patients with a clinical feature of SSI using a sterile swab stick for microscopy, culture and sensitivity. The type of intervention, type and duration of post-operative antibiotics and other relevant information were documented in an identifier-free patient's proforma. The total duration of hospital stay, calculated from the first post-operative day to the day of discharge, was recorded.

Comparison of groups for surgical site infection was done using the Pearson's Chi-square (X^2) test. Multivariate logistic regression analysis was used to test for significance of association between potentially confounding variables and the development of SSI. Statistical significance was set at a p-value of <0.05 and Confidence Interval of 95%. Version 23 of the Statistical Package for Social Sciences for Windows (SPSS Inc. Il, USA) was used to analyze all data obtained from the study.

RESULTS

Thirty-seven patients (C group = 18; PI group = 19) were recruited. The CONSORT flow diagram depicting the flow of participants through the study is shown in figure 1 and their biodata shown in table 1. The median age was 36 years (IQR =72) with a male-to-female ratio of 2.7:1. There were two (5.4%) trauma-related and 35 (94.6%) non-trauma-related cases. There was no statistically significant difference between the groups in all perioperative characteristics studied (Table 2).

As shown in figure 2, the most common intra-operative diagnosis was gastric perforation (35.2%, 13) followed by ruptured appendicitis (32.4%, n = 12).

Peritoneal fluid MCS yielded no growth in 20 patients (54.1%) and a positive result in 17 patients (45.9%). All positive culture results were monomicrobial. The common isolates from intra-peritoneal fluid culture were members of enterobacteriaceae like *Escherichia coli* (35.3%; n = 6), and *Klebsiella pneumonia* (17.6%; n = 3) followed by *Candida albicans* (17.6%, n = 3) and Gram positive cocci like *Staphylococcus aureus* (11.8%; n =2) as shown in figure 3. Similarly, post-operative wound swab MCS yielded no growth in eight patients (53.3%) and a positive result in seven patients (46.7%).

Positive cultures were monomicrobial in 57.1% of cases and polymicrobial in 42.9% of cases. Gram negative organisms were the commonest isolates from the culture of post-operative wound swab in patients with features of SSI (Figure 4).

Table 3 depicts the antibiotic susceptibility patterns for peritoneal fluid and post-operative wound swab MCS.

Table 1: Biodata characteristics of the study participants

Variable	PI group n=19 (%)	Control group n=18 (%)	Total n (%)	P - value
Age (Median = 36 years; IQR = 72)				
<45	15 (53.6)	13 (46.4)	28 (75.7)	
45 – 64	4 (57.1)	3 (42.9)	7 (18.9)	0.323
≥65	0 (0.0)	2 (100.0)	2 (5.4)	
Sex				
Male	13 (48.1)	14 (51.9)	27 (73.0)	0.714
Female	6 (60.0)	4 (40.0)	10 (27.0)	
Occupation				
Artisan	4 (44.4)	5 (55.6)	9 (24.3)	
Trader	5 (71.4)	2 (28.6)	7 (18.9)	
Student	3 (42.9)	4 (57.1)	7 (18.9)	
Driver	3 (60.0)	2 (40.0)	5 (13.5)	
Civil servant (non-health worker)	3 (60.0)	2 (40.0)	5 (13.5)	0.789
Security officer	1 (50.0)	1 (50.0)	2 (5.4)	
Civil servant (health worker)	0 (0.0)	1 (100.0)	1 (2.7)	
Clergy	0 (0.0)	1 (100.0)	1 (2.7)	

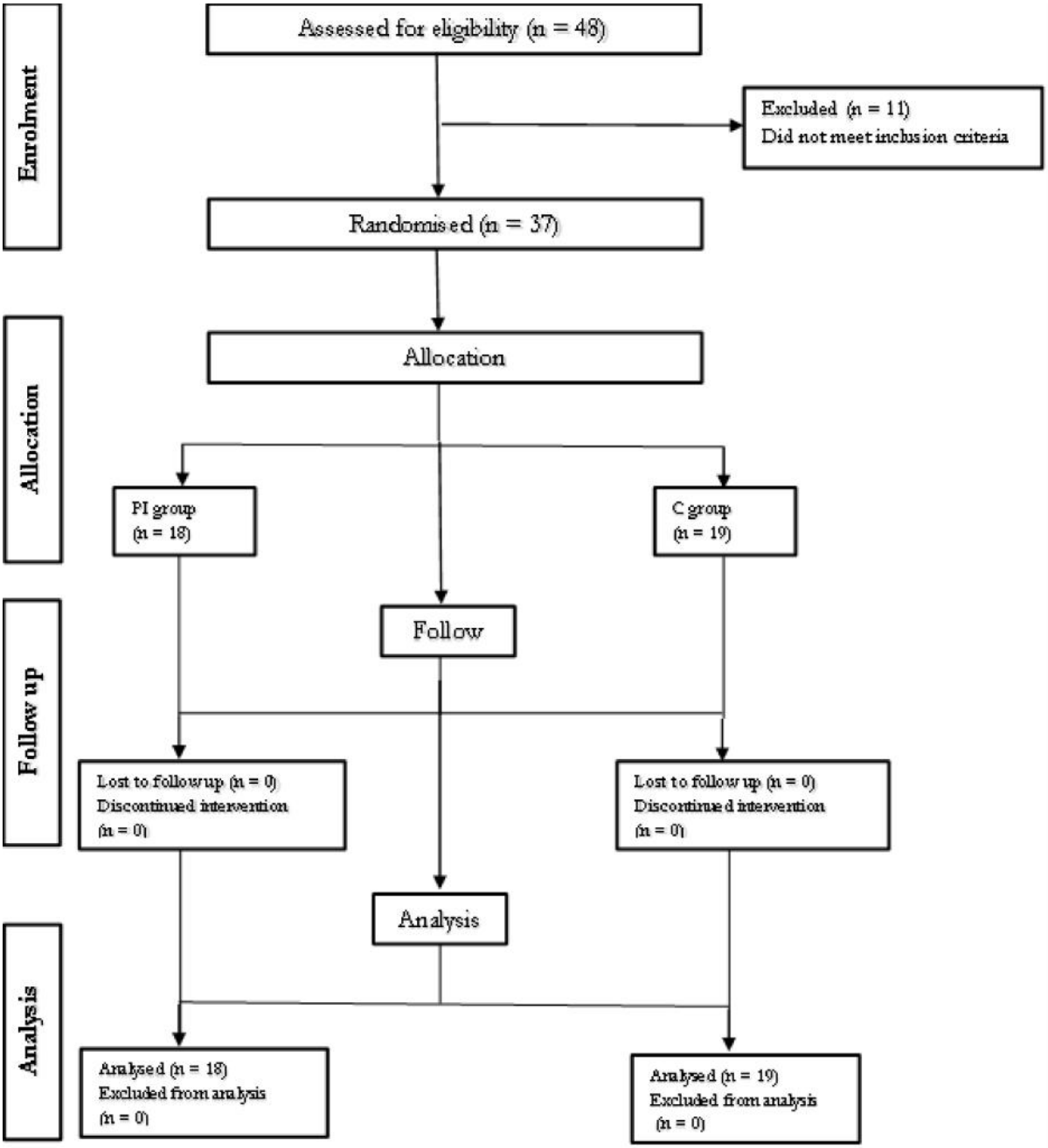

Figure 1: The CONSORT chart depicting participant flow through the study

The microbial sensitivity from peritoneal specimen was highest for Amikacin (26%; n = 8), followed by Tazobactam-Piperacillin (19.4%, n=6) and Meropenem (16.1%, n = 5) while resistance was highest for Ciprofloxacin (22.9%, n =11), followed by Amoxicillin-Clavulanate (12.5%, n = 6) and Gentamycin (12.5%, n = 6). Similar pattern of sensitivity and resistance was recorded from the post-operative wound swab specimen with the highest sensitivity recorded for Amikacin (21%, n = 40, followed by Tazobactam-Piperacillin (15.8%, n= 3) and Meropenem (10.4%, n = 2) while resistance was highest for Ciprofloxacin (13.8%, n =14), followed by Amoxicillin-Clavulanate (10.4%, n = 3) and Gentamycin (10.4%, n = 3). The percentage antibiotic resistance of the isolates is mostly 50% or higher for Amoxicillin-Clavulanate, Ciprofloxacin, Gentamycin and Cefepime.

There was no statistically significant difference between the groups in the incidence of surgical site infection and other post-operative outcomes (Table 4). In-hospital mortality rate was 10.8 % (n = 4). Although there was no statistically significant difference in post-operative outcomes between the study groups, patients

Table 2: Peri-operative characteristics of the study participants

Variable	PI group n=19 (%)	Control group n=18 (%)	Total n (%)	P - value
Comorbidity				
Present	3 (42.9)	4 (57.1))	7 (18.9)	0.693
Absent	16 (53.3)	14 (46.7)	30 (81.1)	
BMI (Median =22.2kg/m²; IQR = 2.6)				
<18	4 (66.7)	2 (33.3)	6 (16.2)	
18 – 24.9	12 (48.0)	13 (52.0)	25 (67.6)	0.597
25 – 29.9	3 (60.0)	2 (40.0)	5 (13.5)	
30 – 34.9	0 (0.0)	0 (0.0)	0 (0.0)	
35 – 39.9	0 (0.0)	1 (100.0)	1 (2.7)	
≥ 40	0 (0.0)	0 (0.0)	0 (0.0)	
ASA grade				
1	0 (0.0)	2 (100.0)	2 (5.4)	
2	8 (66.7)	4 (33.3)	12 (32.4)	0.075
3	8 (66.7)	4 (33.3)	12 (32.4)	
4	3 (27.3)	8 (72.7)	11 (29.7)	
Admission to intervention time				
≤24 hours	7 (46.7)	8 (53.3)	15 (40.5)	0.638
>24 hours	12 (54.5)	10 (45.5)	22 (59.5)	
Cadre of surgeon				
Senior registrar	19 (54.3)	16 (45.7)	35 (94.6)	0.230
Consultant	0 (0.0)	2 (100.0)	2 (5.4)	
Class of surgical wound				
III	2 (40.0)	3 (60.0)	5 (13.5)	0.660
IV	17 (53.1)	15 (46.9)	32(86.5)	
Drape type				
Single-use	15 (50.0)	15 (50.0)	30 (81.1)	1.000
Re-usable	4 (57.10)	3 (42.9)	7 (18.9)	
Skin closure material				
Staples	17 (50.0)	17 (50.0)	34 (91.9)	1.000
Prolene	2 (66.7)	1 (33.3)	3 (8.1)	
Wound drain insertion				
Yes	16 (50.0)	16 (50.0)	32 (86.5)	1.000
No	3 (60.0)	2 (40.0)	5 (13.5)	

in the intervention group had lower ICU admission, lower incidence of SSI and in-hospital mortality, and shorter duration of hospital stay than the controls. The overall incidence of SSI was 48.6% (n = 18).

As shown in Table 5, no categorical (Table 5a) or numerical (Table 5b) peri-operative factor had a statistically significant association with the occurrence of SSI.

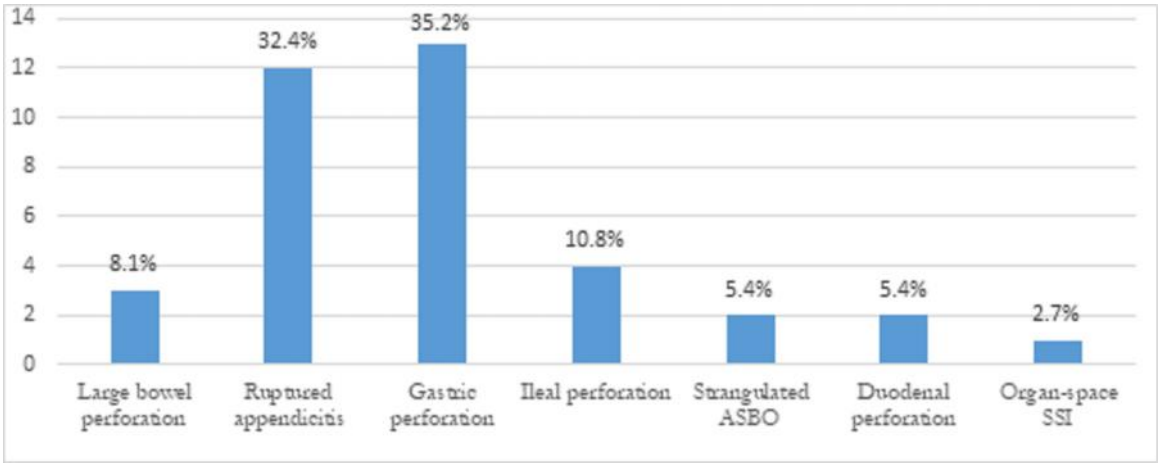

Figure 2: Distribution of intra-operative diagnoses

Table 3: Antibiotic susceptibility patterns

Antibiotic	Peritoneal fluid				Post-operative wound swab			
	Sensitivity	(%)	Resistance	(%)	Sensitivity	(%)	Resistance	(%)
	n		n		n		n	
Amikacin	8	26.0	2	4.2	4	21	*	-
Amoxicillin-Clavulanate	1	3.2	6	12.5	1	5.3	3	10.4
Ampicillin	*	-	1	2.1	*	-	*	-
Cefepime	*	-	4	8.3	*	-	3	10.4
Cefoxitin	*	-	*	-	2	10.4	1	3.4
Cefpodoxime	*	-	1	2.1	8	-	1	3.4
Ceftriaxone-sulbactam	*	-	1	2.1	*	-	*	-
Cefuroxime	1	3.2	*	-	1	5.3	3	10.4
Ciprofloxacin	1	3.2	11	22.9	1	5.3	4	13.8
Clindamycin	1	3.2	*	-	*	-	*	-
Colistin	*	-	*	-	1	5.3	1	3.4
Erythromycin	1	3.2	1	2.1	1	5.3	*	-
Gentamycin	1	3.2	6	12.5	1	5.3	3	10.4
Levofloxacin	2	6.5	2	4.2	1	5.3	2	6.9
Meropenem	5	16.1	3	6.2	2	10.4	2	6.9
Piperacillin	1	3.2	*	-	*	-	*	-
Sulbactam	*	-	1	2.1	*	-	1	3.4
Tazobactam	*	-	*	-	1	5.3	*	-
Tazobactam-Piperacillin	6	19.4	2	4.2	3	15.8	*	-
Tigecycline	1	3.2	*	-	*	-	1	3.4

*****_No microbial sensitivity / resistance; n = number of times sensitivity or resistance to drug was recorded_

Table 4: Comparison of post-operative outcomes between the study groups

Variable	PI group n=19 (%)	Control group n=18 (%)	Total n (%)	P - value
ICU admission				
Yes	1 (25.0)	3 (75.0)	4 (10.8)	
No	18 (54.5)	15 (45.5)	33 (89.2)	0.340
Surgical site infection				
Present	8 (44.4)	10 (55.6)	18 (48.6)	0.413
Absent	11 (57.9)	8 (42.1)	19 (51.4)	
In-hospital mortality				
Yes	2 (50.0)	2 (50.0)	4 (10.8)	1.000
No	17 (51.5)	16 (48.5)	33 (89.2)	
Length of stay (days)	7 (9)	8 (15)	8 (9)	0.169

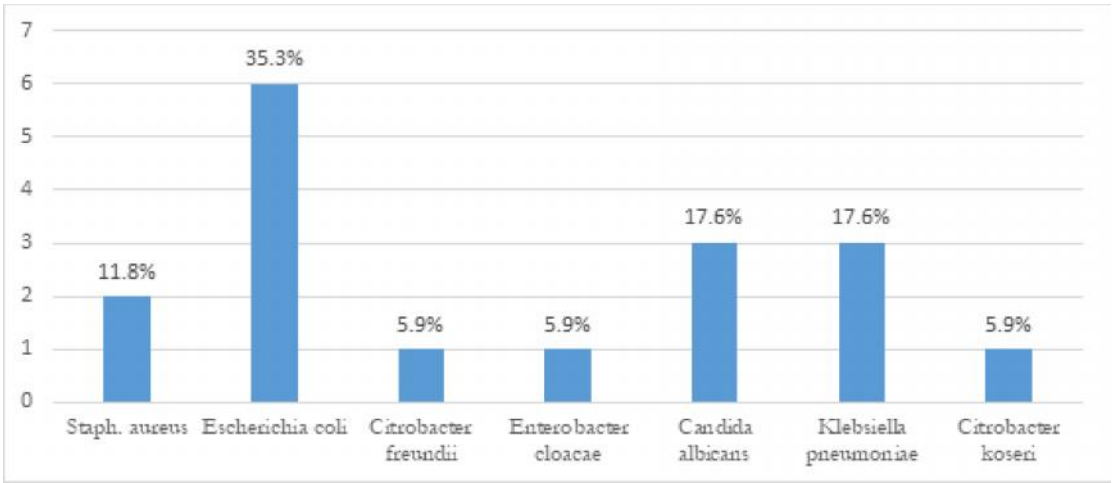

Figure 3: Pattern of distribution of common micro-organisms from intra-peritoneal fluid culture

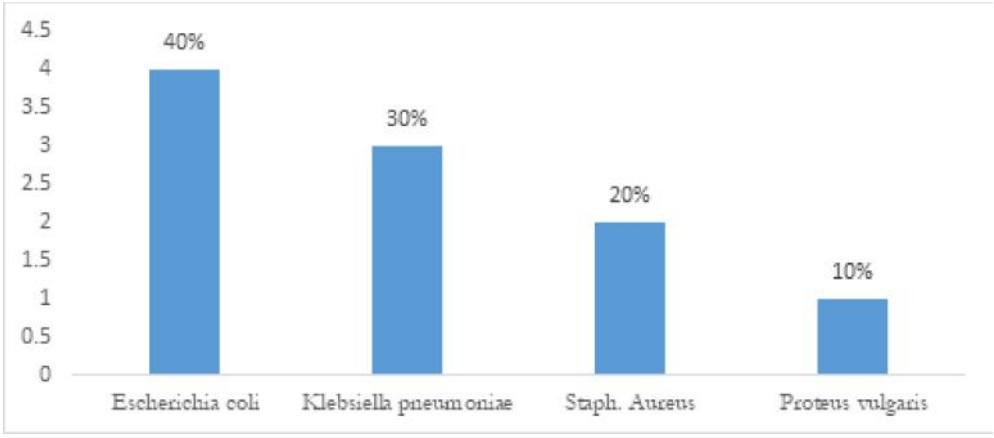

Figure 4: Pattern of distribution of common micro-organisms from post-operative wound swabs

Table 5a: Categorical factors associated with surgical site infection

	Surgical site infection			
	No	**Yes**	**Test statistic**	**p-value**
Gender				
Male	15 (55.6)	12 (44.4)	0.221[cc]	0.638
Female	4 (40.0)	6 (60.0)		
Age				
<45 years	17 (60.7)	11 (39.3)		
45 – 64 years	2 (28.6)	5 (71.4)	4.548[Fi]	0.103
≥65 years	0 (0.0)	2 (100.0)		
Comorbidity				
Yes	4 (57.1)	3 (42.9)	< 0.000[cc]	1.000
No	15 (50.0)	15 (50.0)		
No	82 (95.3)	4 (4.7)		
BMI				
Underweight	4 (66.7)	2 (33.3)	1.88[Fi]	0.597
Normal	12 (48.0)	13 (52.0)		
Overweight	3 (60.0)	2 (40.0)		
Obese	0 (0.0)	1 (100.0)		
ASA Grade				
Grade 1	1 (50.0)	1 (50.0)		
Grade 2	8 (66.7)	4 (33.3)	2.126[Fi]	0.547
Grade 3	6 (50.0)	6 (50.0)		
Grade 4	4 (36.4)	7 (63.6)		
Surgery type				
Elective	2 (66.7)	1 (33.3)	0.307[cc]	1.000
Emergency	17 (50.0)	17 (50.0)		
Cadre of Surgeon				
Senior registrar	18 (51.4)	17 (48.6)	0.000[cc]	1.000
Consultant	1 (50.0)	1 (50.0)		
Admission to intervention time				
≤ 24 hours	8 (53.3)	7 (46.7)	0.40[x2]	0.842
> 24 hours	11 (50.0)	11 (50.0)		
Drape type				
Single-use	17 (56.7)	13 (43.3)	1.793[Fi]	0.232
Re-usable	2 (28.6)	5 (71.4)		
Skin closure material				
Staples	17 (50.0)	17 (50.0)	0.307[Fi]	1.000
Prolene	2 (66.7)	1 (33.3)		

DISCUSSION

The use of some form of antisepsis on wounds generally is to reduce microbial load and – in some cases – completely remove them. This holds true in surgical wounds, considering the breach in the skin defence that accompanies skin incisions which exposes

Table 5b: Numerical factors associated with surgical site infection

	Surgical site infection		
	No	Yes	p-value
Age	35 (12)	37 (34)	0.218
Body Mass Index	22.2 (2.6)	22.2 (1.8)	0.366
Length of skin incision	18 (2)	18 (6)	0.061
Duration of surgery	67 (35)	79 (62)	0.050
Estimated blood loss	100 (100)	175 (225)	0.307
Length of hospital stay	7 (7)	9 (14)	0.109

the surgical wound to pathogenic organisms. It is therefore routine practice to apply antiseptic solutions to the operation site prior to skin incision. SSI has a high incidence in patients undergoing abdominal surgeries and is associated with prolonged hospital stay in patients.[20] It is known that some surgeons would repeat skin antisepsis following primary skin closure in a bid to prevent or mitigate SSI.[21] The thrust of this study was to examine the effect of such skin antisepsis after skin closure on SSI using adult general surgical patients undergoing laparotomy for sepsis at the UCH, Ibadan, Nigeria.

The studied population was young and predominantly of the male gender with most of the cases being non-trauma similar to previous reports by Afolabi *et al.*[22] on the pattern of general surgical procedures in Ibadan. Neither gender nor age had a significant relationship with the occurrence of SSI. The influence of age and gender on SSI following abdominal surgeries has been previously reported with increasing age being a significant factor while gender played no role.[23] According to Alkaaki *et al.*[24] however, male sex has been implicated as an independent predictor of SSI following abdominal surgery.

Gram negative bacilli were the most common isolates from both the peritoneal fluid and the post-operative wound swab, with *Escherichia coli* being the most common organism, followed by *Klebsiella pneumoniae*. Cultures from the peritoneal swab were all monomicrobial while 42.9% of the post-operative wound swab cultures were polymicrobial. This is similar to the finding of Mima *et al.*[25] in Kenya who reported *E. coli* as accounting for the majority of mono-isolate SSI recorded in patients that underwent emergency laparotomy while *E. coli* and *Klebsiella pneumoniae* were the most common dual-isolates. *E. coli* has similarly been reported as the commonest organism responsible for SSI following abdominal surgery by Dalhatu *et al.*[26] in Kano and Múnez *et al.*[27] in Spain. The monomicrobial nature of our peritoneal swab isolates may be due to the fact that we performed only aerobic cultures and did not have the facilities for anaerobic cultures at the time of the study. Over half of the peritoneal and post-operative wound culture yielded no growth. This is likely because most of the patients must have been on antibiotics prior to presentation and usually, pre-operative antibiotics are continued/commenced prior to surgery which in this study occurred after 24 hours of presentation in most patients. Notably, organisms from both peritoneal and post-operative wound swabs showed highest resistance for ciprofloxacin, followed by Amoxicillin-Clavulanate and Gentamycin and highest sensitivity to Amikacin, followed by Tazobactam-Piperacillin and Meropenem. Nearly a decade ago, quinolones like Ciprofloxacin and aminoglycosides like gentamicin were effective antimicrobial agents in the management of surgical site infection in Nigeria and neighbouring sub-Saharan African countries while microbial resistance was high for B-lactam antibiotics like Amoxicillin-Clavulanate and ampicillin.[28-30] In recent years within the West African sub-region, however, there has been increasing resistance to previously effective antibiotics like ciprofloxacin and third generation cephalosporins like ceftriaxone.[31-33]

All the patients had some form of peritoneal sepsis (either class 3 or 4 surgical wounds), the most common aetiologic factor being gastric perforation, followed by a ruptured appendicitis. Wound class is an independent risk factor for SSI, the incidence of which rises with wound class: less than 2 % in clean, 6-9% in clean-contaminated, 13-20% in contaminated and 40% for dirty wounds.[34] These rates are higher in developing countries compared to the developed nations.[35] We recorded a high overall SSI incidence of 48.6% with comparable rates between the study groups. The high SSI rate in this study may be in part due to the fact that all the surgeries were dirty and/or the effect of antimicrobial resistance afore-mentioned. According to Muchuweti *et al*,[36] the higher rates of SSI after abdominal surgeries in sub-Saharan Africa could be related to the higher prevalence of HIV infection, improper use of blood transfusions, delayed administration of prophylactic antibiotics and higher incidence of dirty wounds. This may well explain the

practice of skin antisepsis after primary abdominal wound closure by some surgeon despite pre-incision skin antisepsis.

However, some pertinent questions need to be addressed. First, does the source of SSI in peritoneal sepsis reside within the peritoneal cavity, or the skin or both places? Sources of SSI following abdominal surgeries could be endogenous (due to microbial contamination of surgical wound from the patient's skin, an opened part of the gastrointestinal tract or via haematogenous seeding) or exogeneous (from external microbial contamination of surgical site via sources like surgical instruments and theatre environments) in origin.[37] Of all these, endogeneous sources from the skin and gastrointestinal tract are the major contributors of post-operative SSI following abdominal surgery.[38] During laparotomy for sepsis, there is not only a localized or generalized peritoneal contamination but also spillage of contaminated peritoneal fluid unto the wound edge/skin. It may therefore appear justifiable that in addition to pre-incision skin antisepsis, adequate source control at laparotomy, strict peri-operative asepsis and good surgical technique, skin antisepsis after primary skin closure may reduce SSI.

Second, does an antiseptic solution applied on an apposed surgical wound reduce the risk of SSI? In this study, topical application of povidone iodine-soaked gauze on the wound edge after primary skin closure following laparotomy for sepsis did not have any significant effect on the incidence of SSI. Similarly, there was no significant difference in ICU admission rates, in-hospital mortality or duration of hospital stay between the study groups. Studies on topical wound antisepsis after primary skin closure in abdominal surgery are scarce. However, some studies that examined the effect of wound edge care after laparotomy just before skin closure on SSI showed conflicting results with most of them revealing no significant benefit from such practice. Iqbal *et al.*[39] compared the frequency of superficial surgical site infection after appendicectomy, with and without perioperative irrigation of subcutaneous tissue with 1% povidone-iodine solution. He found out that although the irrigation of the subcutaneous tissue with 1% diluted povidone-iodine solution significantly reduced the formation of pus within the infected wound cavity, this did not affect the overall infection rate. In a systematic review of studies investigating the efficacy of intra-operative PI irrigation of subcutaneous tissue following elective colorectal surgery, Gilla *et al.*[40] reported that the irrigation of subcutaneous tissues with PI following abdominal fascial closure is associated with a reduced incidence of surgical site infection. A study by Harihara *et al.*[41] on the effect of applying povidone iodine just before skin closure reported that although this was effective in eliminating skin contamination, reduction of SSI in the group with PI could not be demonstrated. Again, absorption of iodine can occur in places where integrity of skin is compromised or when there is excessive topical application. Wong *et al.*[42] has demonstrated that there is systemic absorption and toxicity of iodine following topical application before skin closure. Some researchers have noted other demerits of iodine use beyond toxicity to include allergy and ineffective penetration.[43] We however did not record any side effect of povidone iodine use in the intervention group of our study. What is known among all these wound edge care protocols is that irrigation of wound edge prior to closure could have beneficial effect on SSI by removing debris, clots and may decrease the bacterial burden at the wound edge after a contaminated surgery, otherwise, it is just sufficient to apply a sterile dressing for 24-48 hours after primary wound closure.[44]

According to the World Society of Emergency Surgery recommendations in 2018 on the prevention of SSI in patients with intra-abdominal infections in the emergency setting, the use of antibacterial (triclosan-coated) sutures and wound edge protectors are effective in preventing SSI after abdominal surgeries.[45] Similarly, Li *et al.*[46] in a meta-analysis involving 22 randomised controlled trials and 4,492 patients demonstrated that wound edge protectors were efficient in reducing overall SSI in patients undergoing abdominal surgery, more effective for superficial than deep and organ/space SSI. Wound edge protectors are not commonly used in our environment due to non-availability and cost. From this study, it may therefore be just enough to adopt the standard practice of pre-incision skin antisepsis, adequate source control with peritoneal lavage and good surgical technique in patients undergoing laparotomy for sepsis without additional skin antisepsis after primary skin closure. Second, whilst the culpable micro-organisms in peritoneal sepsis may remain the same as in previous studies, the antimicrobial susceptibility pattern is changing. Judicious antibiotic and antiseptic use in these patients may change the current trajectory of increasing antimicrobial resistance.

This study is limited by its small sample size. This is however a preliminary report of a long-term study. The microbial profile reported in this study may not be a true representation of the patients' microbiome since anaerobic cultures were not done, although our findings were similar to previous studies on similar patient populations.

CONCLUSION

Skin antisepsis following primary skin closure does not have any effect on surgical site infection (SSI) after abdominal surgery for sepsis.

Conflict of interest: None

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