STUDY OF CHLORHEXIDINE ALCOHOL AND POVIDONE IODINE FOR SURGICAL SITE ANTISEPSIS IN UNCOMPLICATED EMERGENCY OPEN APPENDECTOMY

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ABSTRACT

Introduction: *Surgical site infections (SSIs) cause severe morbidity and mortality along with enormous health costs. Skin antisepsis with chlorhexidine alcohol solutions has demonstrated superiority to povidone-iodine for the prevention of SSIs. Our objective was to determine if chlorhexidine-alcohol reduces the rate of SSIs in uncomplicated emergency open appendectomy compared with povidone-iodine and also analyze risk factors associated with SSIs.*

Materials and Methods: *This study was carried out at Tribhuvan University Teaching Hospital, Kathmandu. A total of 88 patients with acute uncomplicated appendicitis who underwent uncomplicated emergency open appendectomy were included. The protocols for antisepsis were use of 10% povidone-iodine (n = 44) and 2% chlorhexidine in 80% isopropyl alcohol (n= 44) over the surgical site. The rates of SSIs as defined by the Centers for Disease Control and Prevention (CDC) and risk factors for the occurrence of SSIs were determined.*

Result: *The two groups of patients were similar in regard to baseline characteristics and medical history. Thirteen patients (14.77%) developed superficial SSI. There was no significant difference between the two study groups in incidence of SSI (relative risk,0.57; 95% CI, 0.17 to 1.92). Antisepsis with chlorhexidine-alcohol was not associated*

with a reduction in the overall rate of SSI (11.4 % vs 18.2%, p= 0.37). Smoking was found to be associated with SSI in povidone-iodine group (p=0.042).

Conclusion: *This study demonstrates that chlorhexidine-alcohol showed similar antiseptic role as povidone-iodine in patients undergoing uncomplicated emergency open appendectomy in preventing SSI. This is of vital clinical importance for developing country like Nepal where povidone-iodine is the antisepsis of choice in daily surgical practice.*

Keywords: *Surgical site infections (SSIs), Skin antisepsis, Chlorhexidine alcohol (CHA), Povidone iodine (PI), Uncomplicated Emergency Open Appendectomy.*

INTRODUCTION:

Surgical site infections (SSIs) are defined as infections occurring in an incisional site within 30 days after the procedure in which the incision was made or within 90 days if prosthesis is implanted. Centers for Disease Control and Prevention (CDC) has classified SSIs into the three categories of: (1) Superficial incisional (2) Deep incisional, and (3) Organ space.[1] Although there are breakthroughs in prevention, SSIs remain a significant clinical obstacle as they are associated with substantial mortality and morbidity and impose severe demands on healthcare resources. SSIs can double the length hospital stay and thereby increase the costs of health care.[2],[3]

There are several antiseptic skin cleansing agents available to the surgeon to use for patients undergoing surgery.[4] This infection develops as a result of contamination of the surgical site with microorganisms. To minimize these infections, it is very much necessary to optimize the pre-operative skin antiseptics. The two most commonly used antiseptic agents are Chlorhexidine-alcohol (CHA) and Povidone-iodine (PI). Both the agents work with different mechanism of action and with different spectrum of efficacy.[5]

In 2002, the CDC recommended the use of CHA prior to central venous and peripheral arterial catheterizations. CHA has recently been shown to be superior to PI in the prevention of SSI for clean surgery.[6] However, a recently performed Cochrane review did not reach a clear consensus on which antiseptic skin cleansing agent is associated with the lowest risk of SSI .[5] Hence the present study was conducted with the prime objective to compare the efficacy of 2% chlorhexidine in 80% isopropyl alcohol with 10% povidone iodine for preventing surgical site infection in patients undergoing uncomplicated emergency open appendectomy.

MATERIALS AND METHODS:

This was a prospective comparative study conducted at Tribhuwan University Teaching Hospital, Kathmandu, Nepal. Patients with clinical features suspicious of acute appendicitis were studied from October 2019 to September 2020. The diagnosis of acute appendicitis was done clinically with supportive radiological and laboratory findings. Cases operated for emergency open appendectomy for uncomplicated acute appendicitis were included in the study with exclusion of patient aged < 16 years, those managed conservatively and those with appendicular lump, abscess and generalized peritonitis. Minimum sample size was calculated using $n= \frac{2(Z_{\alpha/2} + Z_\beta)^2 P(1-P)}{(P_1 - P_2)^2}$ with a total of 88 patients; 44 in each of the two groups. Patients were randomized into two groups using the computer-based randomization. (Figure 1)

Working Model

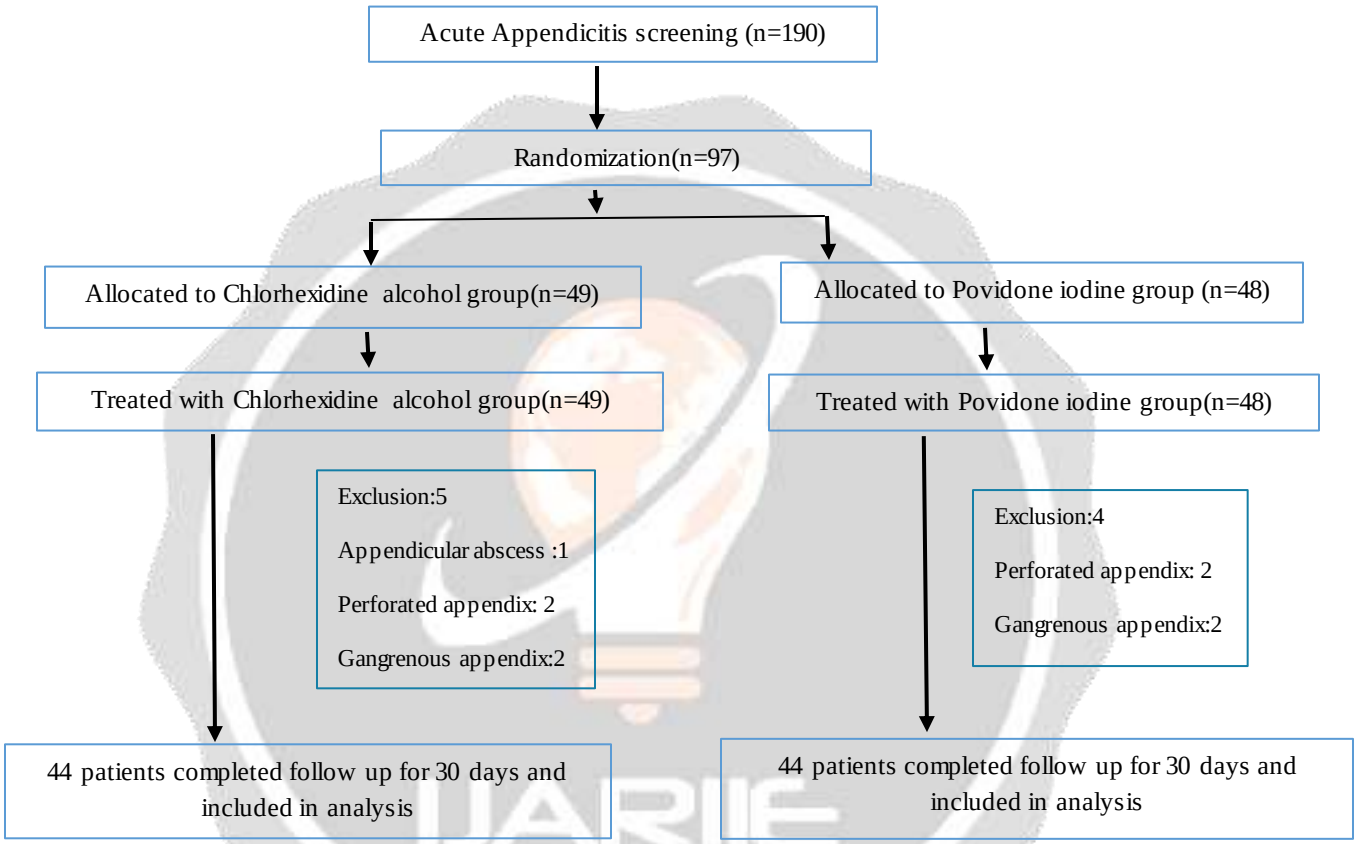

Figure 1: Screening, randomization and follow-up of study participants

Allocation concealment was done using sealed envelopes containing information about preoperative painting solution. Expected primary Outcome was occurrence of surgical site infections up to 30 days following surgery whereas secondary outcome was types of SSI and length of hospital stay. Ethical consideration and written permission were obtained from Institutional Review Board (IRB), Institute of Medicine, Kathmandu, Nepal.

Data Analysis Data entry, pie charts and bar diagrams were done using MS Excel 2016. Data analysis was done using SPSS version 21. Statistical significance was set at a p value <0.05. The significance of mean differences between the two study groups in terms of patient characteristics was determined with the use of the Mann Whitney U test for continuous variables and Fisher's exact test for categorical variables. The proportions of patients in the two study groups who could be evaluated and who had surgical-site infection, were compared using Fisher's exact

test and calculating the relative risk of infection and 95% confidence intervals. Chi square test was used to evaluate the association between categorical variables.

RESULTS:

The study population included predominantly of males encompassing 61% of the total population and remaining 39% being females. The mean age of the study population was 30.2 ± 11.86 years ranging from 18 to 70 years of age. Majority of the population were young adults. The most commonly encountered presenting clinical features in all the patients were RIF tenderness and rebound tenderness. (Figure 2)

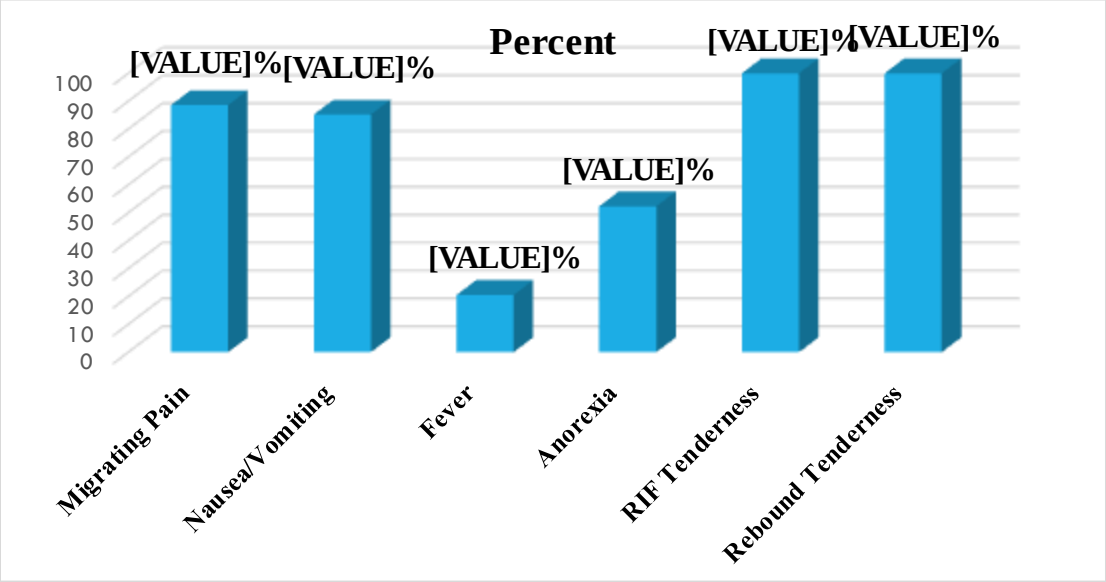

Figure 2: Presenting Clinical Features of Study Population

The patients in the two study groups (44 in the chlorhexidine–alcohol group and 44 in the povidone– iodine group) were similar with respect to demographic characteristics, coexisting illnesses, risk factors for infection, duration and types of surgery, hematological and biochemical parameters. (Table 1)

	Chlorhexidine-alcohol (N=44) Mean ± SD	**Povidone-Iodine (N=44) Mean ± SD**	**P value**
Age(yr)	29.18 ± 11.51	30.86 ± 12.26	0.32
Weight(kg)	60.52 ± 10.53	60.72 ±7.9	0.80
Height(m)	1.60 ± 0.07	1.61 ± 0.08	0.78
BMI	23.44 ±3.42	23.40 ±2.75	0.97
Duration of surgery(mins)	59.66 ± 10.96	59.09 ± 12.72	0.66
Total Count	14093.86 ± 5053.89	13831.36 ± 4337.21	0.67
Neutrophil (%)	77.70 ± 8.47	78.56 ± 8.37	0.60
Urea(mmol/l)	4.35 ±1.42	4.21±1.89	0.22
Creatinine(mmol/l)	81.18±17.49	83.42±21.08	0.74
RBS (mmol/l)	5.43 ± 0.58	5.54±1.15	0.36
Sodium(meq/l)	136.02 ± 22.10	137.75 ± 2.64	0.73
Potassium(meq/l)	3.88 ± 0.56	3.96 ± 0.32	0.35

Table 1: Comparison of Baseline Characteristics Between Two Groups

Thirteen patients (14.77%) who underwent uncomplicated emergency open appendectomy developed superficial incisional SSI. None of the patients had deep or organ space SSI. The average length of hospital stay was two days. (Table 2)

Characteristics	Category	Number	Percentage
SSI	Yes	13	14.77
	No	75	85.23
Total		n=88	100

Table 2: Proportion of SSI among study group (n=88)

Although the overall rate of surgical-site infection was lower in the chlorhexidine–alcohol group (11.4%) than in the povidone–iodine group (18.2%), it was not statistically significant (p = 0.37). There was no significant difference between the two study groups in the incidence of surgical site infection (relative risk,0.57; 95% ci, 0.17 to 1.92). (Table 3)

	Chlorhexidine- alcohol (N=44)	**Povidone-iodine (N=44)**	**Relative Risk (95% Cl) ***	**P value Î**
Surgical Site Infection	11.4%	18.2%	0.57(0.17-1.92)	0.37

Table 3: Proportion of Patients with SSI.

Association of SSI with different factors were analyzed. Body mass index, smoking status and drinking status were the main factors assessed. Among these, smoking was found to be significantly associated with surgical site infection. (Table 4)

ANTISEPSIS			SSI (n=13)	No SSI (n=75)	Total	P value
Povidone-Iodine	**SMOKING STATUS**	Smoker	4	6	10	**0.042***
		Non-Smoker	4	30	34	
	Total		**8**	**36**	**44**	
Chlorhexidine-Alcohol	**SMOKING STATUS**	Smoker	2	7	9	0.25
		Non-Smoker	3	32	35	
	Total		**5**	**39**	**44**	

Table 4: Analyses of association of Smoking status with surgical site infection in Two Groups

DISCUSSION:

Acute appendicitis is the most common cause of an acute abdomen requiring surgery, with a lifetime risk of about 7%.[7] This study demonstrated a greater magnitude of acute appendicitis in young adults in the age group 21 to 30 years and particularly among males (61%). It has been suggested that the peak in the development of lymphoid tissue which occurs during adolescence leads to an increased liability of the appendix to obstruct, and so accounts for the high incidence of the disease.[8]

The diagnosis of acute appendicitis is mainly clinical and presentation of acute appendicitis may be typical or atypical. Typical presentation starts with vague peri-umbilical pain for several hours, which later migrates to the right iliac fossa (RIF), associated with lack of appetite, nausea, or vomiting [9] which is in concordance to our study wherein signs and symptoms of acute appendicitis were dominated by abdominal pain felt in the RIF and rebound tenderness.

The frequency of comorbidities was quite minimal in our study group and the most common comorbidities were hypertension followed by diabetes mellitus, valve replacement and hypothyroidism similar to the prospective cohort study carried out over a period of three years by Saeed et al. [10]

Although the overall rate of surgical-site infection of 14.77% in this study was higher than those reported in some previous studies [11], they are similar to the previous study rates at the participating hospitals and those reported in other studies [12] and are lower than the rates reported in trials that used the CDC definition of infection and had adequate follow-up [13], as we did in this study.

Correct preoperative skin preparation has been proven to have a positive impact on SSI rates and can eliminate patient discomfort, functional impairment and increased health care costs associated with this often-preventable event. The evidence base guiding appropriate selection of antiseptic agents is poor. [12]

Hence, we compared povidone iodine with chlorhexidine alcohol for skin antisepsis to prevent surgical site infection after uncomplicated emergency open appendectomy. No significant differences were found between povidone iodine with chlorhexidine alcohol for the prevention of surgical site infection after uncomplicated open appendectomy. The relative risk of surgical-site infection among patients whose skin was preoperatively cleansed with chlorhexidine–alcohol versus povidone–iodine was 0.57 (95% confidence interval [CI], 0.17 to 1.92). Our result was similar to a study by Rodrigues et al. where the incidence of surgical site infection in operations classified as clean and potentially contaminated, whose skin preparation was done with iodopovidone 10% in hydroalcoholic solution and 0.5% alcoholic chlorhexidine, was similar. [14]

A landmark study found that 2% chlorhexidine in 70% isopropyl alcohol was superior to aqueous 10% povidone iodine; however, given that alcohol is known to have important antimicrobial properties, its presence in the chlorhexidine preparation was likely an additional active treatment component.[15] A meta-analysis conducted by Noorani et al., seeking to recognize the effectiveness of chlorhexidine compared to iodopovidone in wounds classified as clean-contaminated, concluded that chlorhexidine was more efficient ($p = 0.019$).[16]

However, Swenson et al. following 3209 general surgery procedures concluded that iodophor compounds are superior to chlorhexidine in preventing SSI ($p = 0.001$). [17] Thus, it can be seen that, although there is a tendency of the authors towards the indication of chlorhexidine, there was no consensus on the superiority of this antiseptic for skin preparation.

Besides, present study also established the causal relationship of smoking, with SSI. Smoking was found to be significantly associated with SSI particularly in the povidone-iodine antisepsis group($p=0.042$). Garcell HG et al showed active smokers most frequently had SSIs (RR 2.21; 95% CI 0.92–5.29; $p = 0.060$). Smoking delays the healing of SSIs by causing local and systemic vasoconstriction resulting in tissue hypoxia and an environment conducive to SSI.[18]

Hence in this comparative study, it was possible to verify that the groups receiving chlorhexidine-alcohol and povidone-iodine were similar and among the risk factors assessed smoking was the only one factor influencing the incidence of SSI.

CONCLUSION:

The results of this study show that the incidence of SSI in patients undergoing open uncomplicated appendectomy, whose skin preparation was done with 2% chlorhexidine in 80% isopropyl alcohol and aqueous 10% povidone iodine was similar. Hence this study helps in guiding and evaluating the efficacy of the routinely used cheap povidone iodine in comparison to relatively expensive chlorhexidine-alcohol skin antisepsis in Nepalese scenario for the prevention of surgical site infection.

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