



EFFECT OF CHLORHEXIDINE SCRUB ON SURGICAL SITE INFECTION - A HOSPITAL BASED RANDOMIZED STUDY

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ABSTRACT **Background:** In this study, we wanted to evaluate the effect of chlorhexidine scrub on surgical site infection, compare it with povidone iodine, and evaluate the microbiological organisms found in surgical site infections along with other risk factors contributing to the surgical site infections. **Materials And Methods:** This was a hospital based randomized control study conducted among 300 patients who presented with elective surgeries to the Department of General Surgery, Paediatric Surgery, and Cardiothoracic and Vascular Surgery units of PSG Institute of Medical Science and Research Centre, over a period of 9 months after obtaining clearance from Institutional Ethics Committee and written informed consent from the study participants. **Results:** Surgical site infections were isolated from 14 patients out of 300 (4.66%). 50% of isolated organisms (7 out of 14) were found in surgical site. The commonest organism isolated in one study was *Escherichia coli* followed by *Klebsiella* and *Staphylococcus spp.*, by univariate analysis. Patient's age, co-morbid conditions, socio-economic status, length of hospital stay, ASA scoring, duration of surgery, skin closure type and obesity were associated with significance in those with MDRO infected foot ulcers. Analysis by logistic regression indicated that about 3 factors significantly increased the risk of acquiring SSI infections: Skin closure type = suture, staples, Duration of surgery, Length of post op stay. **Conclusion:** Chlorhexidine scrub as a preoperative skin preparation had less number of surgical site infections when compared to povidone iodine. Factors like duration of surgery, type of surgery and length of post-operative stay had a significant impact in development of surgical site infections. *Escherichia coli* is the commonest isolate from the surgical site infected patients. Surgical site infections are still a real risk for surgery and represent a substantial burden of disease for both patients and health care services in terms of morbidity, mortality and economically. Surveillance of surgical site infections with feedback of appropriate data to surgeons would be desirable to reduce the surgical site infection rates. Chlorhexidine is commercially available in aqueous or alcohol formulations and has broad activity against gram positive and negative bacteria, anaerobes, yeast and some lipid enveloped viruses. Research has shown that surgical techniques, skin preparation and the timing, method of wound closure and length of hospital stay are significant factors that can influence of subsequent infection.

KEYWORDS : Chlorhexidine Scrub, Surgical, Infection, Povidone Iodine

INTRODUCTION

Surgical site infection is a dangerous condition and a heavy burden on the patient and social health system. Among hospital acquired infections, surgical site infections has been reported to be the main cause which is comprising around 14 to 16% of all inpatient infections. Surgical site infection incidence varies not just from one surgeon to other surgeon, but also from one hospital to other hospital, from one surgical procedure to other, and most importantly from one patient to another patient. There are several factors contributing to the incidence. Major source for surgical site infection from the patient is skin as it a main source for pathogens that cause the same. A reduction of these pathogens can significantly reduce the incidence of surgical site infections. There are many kinds of preoperative skin antiseptics which are available for preparation. Povidone iodine and chlorhexidine are the commonly used antiseptics in clinical practice. The present study has made an effort to evaluate the efficacy of chlorhexidine alcohol over povidone iodine in elective clean and clean contaminated surgeries. The major concern is about the increasing incidence of surgical site infections. Very few studies have been done in India to analyse the prevalence and risk factors of surgical site infections. Hence, this study was also done to analyse the prevalence, risk factors and impact of organisms in surgical site infections at a tertiary care hospital.

AIMS AND OBJECTIVES

- To study the effect of chlorhexidine scrub on surgical site infection, in comparison with povidone iodine.
- To assess the effect of chlorhexidine scrub on surgical site infection over povidone-iodine.
- To assess the microbiological organisms found in surgical site infections.
- To assess the other risk factors contributing to the surgical site infections.

MATERIALS AND METHODS

This was a hospital based randomized control study conducted among 300 patients who presented with elective surgeries to the Department of General Surgery, Paediatric Surgery, and Cardiothoracic and Vascular Surgery units of PSG Institute of Medical Science and

Research Centre, over a period of 9 months after obtaining clearance from Institutional Ethics Committee and written informed consent from the study participants.

Inclusion Criteria

- Elective open surgery

Exclusion Criteria

- Emergency/laparoscopy surgery
- Allergic to chlorhexidine
- Immuno-compromised patients

Statistical Methods

Data was entered in MS Excel and analyzed using Statistical Package for Social Sciences (SPSS) software. Results were presented as tables.

RESULTS

The association of factors like age and sex of the patient, socio-economic status, co-morbid conditions like diabetes mellitus, systemic hypertension etc, personal habits like smoking and alcohol, ASA (American Society of Anaesthesia) grading, type of surgery with surgical site infected cases were statistically insignificant.

		SSI		P Value
		Absent	Present	
Age	<10years	90(97.8%)	2(2.2%)	0.275
	10-30 years	17(100%)	0(0%)	
	30-50 years	78(95.1%)	4(4.9%)	
	> 50 years	101(92.7%)	8(7.3%)	
Sex	Male	202(95.3%)	10(4.7%)	0.949
	Female	84(95.5%)	4(4.5%)	
Socio-economic Status	i	26(96.3%)	1(3.7%)	0.924
	ii	85(94.4%)	5(5.6%)	
	iii	141(95.3%)	7(4.7%)	
	iv	34(97.1%)	1(2.9%)	
	v	0	0	

Site	Abdomen	48(87.3%)	7(12.7%)	0.120
	Scrotum	20(100%)	0(0%)	
	Groin	48(98.0%)	1(2.0%)	
	Chest	92(93.9%)	6(6.1%)	
	Perineum	14(100%)	0(0%)	
	Limbs	23(100%)	0(0%)	
	Back	2(100%)	0(0%)	
	Breast	17(100%)	0(0%)	
	Neck & cheek	21(100%)	0(0%)	
	Axilla	1(100%)	0(0%)	
Co-morbidities	Yes	96(92.3%)	8(7.7%)	0.070
	No	190(96.9%)	6(3.1%)	

Table 1

		SSI		P Value
		Absent	Present	
Personal Habits	No	225(95.3%)	11(4.7%)	0.993
	Yes	61(95.3%)	3(4.7%)	
ASA-Grading	i	81(100%)	0(0%)	0.060
	ii	169(93.9%)	11(6.1%)	
	iii	36(92.3%)	3(7.7%)	
Type of Surgery	Clean cases	234(96.3%)	9(3.7%)	0.103
	Clean-contaminated cases	52(91.2%)	5(8.8%)	
Duration of Surgery	< 1 hr	56(100%)	0(0%)	<0.05
	1 – 3 hrs	213(96.8%)	7(3.2%)	
	> 3 hrs	17(70.8%)	7(29.2%)	
Type of Closure	Sutures	281(95.9%)	12(4.1%)	0.002
	Staplers	5(71.4%)	2(28.6%)	

Table 2

The factors associated with surgical site infections were analyzed. The test variables were compared using Chi-square test for qualitative variables and student's test for quantitative variables. The variables for which the association was statistically significant ($p < 0.05$) were introduced in a logistic model to explain the presence of surgical site infection.

Results of the univariate analysis showed site of surgery, duration of surgery, type of closure and length of post-operative stay were significantly associated with surgical site infection. However logistic regression indicated that the only factors that significantly increased the chances of acquiring surgical site infection were duration of surgery, type of closure and length of post-operative stay.

DISCUSSION

This study presents a randomized clinical and microbiological profile of surgical site infected wounds and two groups of patients using two different antiseptic preparations have been compared.

As already discussed, surgical site infections increases mortality, morbidity and financial burden due to an increase in length of stay. Surgical site infection represents about one fifth of all health care associated infections and in the most meticulous review of literature the infection rate is always higher.^[1]

Preoperative disinfection of skin is one of the milestones for reducing surgical site infections and from 2010 Chlorhexidine-alcohol has been suggested to be superior to the classical povidone iodine disinfection. We, therefore, made an effort to study the role of chlorhexidine scrub on surgical site infection at PSG Hospitals, Coimbatore.

The overall infection rate in the present study was 4.7% and compares favourably with other reported surgical site infection rates ranging from 2.5 to 41.9%.^[2,9] Number of studies carried out in India indicate an overall infection rate of 4.04 to 30% for clean surgeries and 10.06 to 45% for clean contaminated surgeries.^[3,5,8] Findings in the present study showed that there is significant rise in infection rate with increased degree of operative contamination. The rate of infection for clean surgeries was 3.7%, while in clean contaminated surgeries it was 8.8%.

The average baseline rate of surgical site infection at six participating hospitals was 14% with povidone iodine skin preparation. Our hypothesis was that substituting chlorhexidine alcohol for povidone iodine would reduce the surgical site infection.^[10]

The infection rates observed in chlorhexidine and povidone iodine in present study were 1.3% and 8.0% respectively. The difference in infection rates is statistically significant. It was concluded that

chlorhexidine is superior to povidone iodine in surgical site anti-sepsis.

In a prospective randomized clinical trial conducted between April 2004 and May 2008 at six universities in United States, on a total of 809, the overall rate of surgical site infection was significantly lower in chlorhexidine group than in the povidone iodine group (9.5% vs 16.1%, P value = 0.004). Chlorhexidine was significantly more protective than povidone iodine against both superficial and deep incisional infections.^[11]

A meta-analysis of clinical trials was conducted to determine whether preoperative antiseptic with chlorhexidine or povidone iodine reduced surgical site infection in clean contaminated surgeries. It concluded that chlorhexidine reduced post-operative surgical site infection when compared with povidone iodine (pooled odd ratio- 0.68, $P = 0.019$).^[12]

This study was conducted to determine if chlorhexidine antiseptic scrub protocol reduces the rates of SSI's in elective surgeries compared with povidone-iodine antiseptic. Patients undergoing elective surgeries from the department of General and G.I Surgery, Cardiothoracic and vascular surgery and Paediatric surgery were treated with either chlorhexidine or povidone iodine for pre-operative skin disinfection. The rate of surgical site infection as defined by the centres for disease control and prevention (CDC), and the risk factors for the occurrence of surgical site infections were calculated.

Antisepsis with chlorhexidine was associated with a reduction in the overall rate of surgical site infections from (8.0) to (1.3%) when compared with povidone iodine protocol ($P = 0.103$). The two groups of subjects were similar in regard to baseline characteristics and clinical history.

Apart from the povidone iodine, risk factors found to be associated with surgical site infections were duration of surgery, type of closure, length of post-operative stay. In a retrospective study, risk factors like systemic hypertension and type 2 diabetes mellitus have been found.^[13] However, they were found not to be statistically significant.

There was evidence from one study suggesting that pre-operative skin preparations with chlorhexidine in methylated spirits led to a reduced risk of surgical site infections compared with an alcohol based povidone iodine solution.^[14]

Nine randomized control trials were included in a meta-analysis which revealed that chlorhexidine antiseptic was associated with significantly fewer surgical site infections and positive skin culture results than iodine antiseptic.^[15] In this randomized study, the application of chlorhexidine reduced the risk of surgical site infection by 1.3% as compared with the most common practice in the United States of using povidone-iodine which is 8.0% in this study.

Although both antiseptic preparations possess broad-spectrum antimicrobial activity, the superior clinical protection provided by chlorhexidine is probably related to its more rapid action, persistent activity of despite exposure to bodily fluids and residual effects.

The superior clinical efficacy of chlorhexidine in our study correlates well with previous microbiological studies showing that chlorhexidine based antiseptic preparations are more effective than povidone iodine containing solutions in the operative field.

According to data from the NNIS system, the distribution of pathogens isolated from surgical site infections has not changed markedly during the last decade. *Staphylococcus aureus*,^[16,17,18] Coagulase negative staphylococci, Enterococcus spp., and *Escherichia coli* remain the most frequently isolated pathogens.^[19,20] Pathogens commonly associated with wound infections and frequency of occurrence.

In our study, the overall surgical site infection was found in 14 patients. Out of which, 12 were from povidone iodine group and 2 from the chlorhexidine group. The microbiological examination for all surgical site infected patients revealed positive organism growth for 7 patients out of 14 patients and the remaining had no organism growth. The commonest organism found in this study was *Escherichia coli* followed by *Klebsiella pneumoniae* and *Staphylococci* species.

Apart from the pre-operative skin antiseptic, we also made an effort to analyse the risk factors involved in developing the surgical site

infections. We found by multi-variate analysis, the factors which influence the surgical site infection were type of surgery, duration of surgery and length of post-operative stay.

In our study, length of post-operative stay had significance in developing surgical site infection. As it was already mentioned in a previous study, prolonged stay with exposure to hospital environment has been shown to increase the rate of surgical site infection. Prolonged post-operative hospitalization, which is a major concern, has been evident in patients developing surgical site infection.

In the present study, duration of surgery had significance in developing surgical site infection. The other studies reported that it has been observed that wound infection rate is influenced by duration of operation. With increase in duration of surgery, the rate of infection increased in direct proportion. The results were found to be statistically significant.

CONCLUSION

Chlorhexidine scrub as a pre-operative skin preparation had less number of surgical site infections when compared to povidone iodine. Factors like duration of surgery, type of surgery and length of post-operative stay had a significant impact in development of surgical site infections. *Escherichia coli* is the commonest isolate from the surgical site infected patients. Surgical site infections are still a real risk for surgery and represent a substantial burden of disease for both patients and health care services in terms of morbidity, mortality and economically. Surveillance of surgical site infections with feedback of appropriate data to surgeons would be desirable to reduce the surgical site infection rates. Chlorhexidine is commercially available in aqueous or alcohol formulations and has broad activity against gram positive and negative bacteria, anaerobes, yeast and some lipid enveloped viruses. Research has shown that surgical techniques, skin preparation and the timing, method of wound closure and length of hospital stay are significant factors that can influence of subsequent infection.

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