

## Comparative Analysis of Chlorhexidine Gluconate, Povidone Iodine and Chloroxylenol as Scrubbing Solution

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**Abstract:** The study was carried out to determine the efficacy of stock concentration of the commonly used disinfectant as scrub solution for surgical site in goats. The evaluation of efficacy and safety of commercially available disinfectant and antiseptic (0.3% Chlorhexidine gluconate, 0.4% Chloroxylenol and 4% Povidone iodine) as scrub solution for surgical site, using stock concentration was assessed in thirty (30) Red Sokoto goats undergoing non elective surgical procedures at Usmanu Danfodiyo University, Veterinary Teaching Hospital and Zonal Veterinary Clinic, Sokoto. Colony counting was used to quantify skin bacteria Colony Forming Unit (CFU) at surgical site before and after skin preparation. Reduction of CFU before and after preparation was significant with all the three disinfectants compared ( $p < 0.05$ ) and the result shows that Povidone iodine and Chloroxylenol to be less efficacious than Chlorhexidine gluconate when mean colony forming unit after two minute of preparing the surgical sites.

**Key words:** Chlorhexidine gluconate, chloroxylenol, povidone iodine, red sokoto goat, scrubbing solution, surgical site

### INTRODUCTION

Antiseptic and disinfectants are chemical agents used to reduce the microbial load of a surface, either living or inanimate object, depending on the concentration they can be bacteriacidal or bacteristatic (McDonnell and Russell, 1999; McDonnell, 2007). Disinfectant and antiseptic were in used hundred years ago for antiseptis, disinfection and preservation (Block, 2001). The first germicide was deodorant, because foul odors are associated with disease, chlorinated soda (NaCl and NaCO<sub>3</sub>) was used on infected wound in the 19th century and was recommended to purify drinking water. In recent years, especially in the recognition of importance of nosocomial infection and the need to minimize the transfer of organisms to susceptible patient, those individuals whose clinical management has resulted in suppression of normal immunity are particularly at risk of nosocomial infection, however it has been realize that some agents previously considered safe like hexachlorophene, produce toxic effects with prolong usage (Russell, 2002; McDonnell, 2007). There are several mode of action by which these agents function; it could either be by alkylation or by affecting the cell permeability and interaction with bacterial membranes, thus causes leak in cell membrane, they could also act by denaturing protein content of microorganism (McDonnell and Russell, 1999; Russell, 2002).

Establishment of the most effective scrubbing solution when use in stock concentration, among the commonly used preparations at surgical site will help in prevention, reduce the cases of surgical site infection, decrease cost of treatment and the death of animals due to surgical infection. The outcome of this study may help in reducing post surgical complications that are related to surgical site infection such as wound dehiscence.

Due to increase in surgical wound complications especially surgical site that lead to economic losses as a result of prolong hospital over stay and losses due to death of many animals; the need for aseptic technique is however imperative. The efficiency of various antiseptics and disinfectants has been determined by various researchers using different concentrations based on their environments. Most cases presented to our Veterinary Teaching Hospital, are emergency cases ranging from dystocia to a highly devitalized patients involved in road traffic accident that need an emergency surgical intervention. Patients were prepared aseptically based on previous predetermined concentrations, yet they come down with complications related to infection few days after surgery. Therefore, this research intend to test the use of stock concentrations of some commercially available antiseptic or disinfectants used as scrubbing solution. The study is aimed at determining the safety and efficiency of stock concentration of most commonly used disinfectants as scrub solution for surgical sites,

Table I: Bacterial load of surgical sites two minutes post scrubbing with disinfectants (A, B and C)

Sr. No.	Chlohexidine gluconate (A) (CFU/mL)	Chloroxylenol (B) (CFU/mL)	Povidone iodine (C) (CFU/mL)
1	$3.5 \times 10^2$	$5.8 \times 10^4$	$3.1 \times 10^4$
2	$3.9 \times 10^4$	$6.2 \times 10^4$	$4.5 \times 10^3$
3	$4.2 \times 10^3$	$3.6 \times 10^3$	$3.2 \times 10^4$
4	$3.2 \times 10^3$	$4.1 \times 10^3$	$7.2 \times 10^4$
5	$6.2 \times 10^3$	$7.0 \times 10^3$	$3.3 \times 10^4$
6	$7.2 \times 10^3$	$3.6 \times 10^3$	$3.8 \times 10^4$
7	$8.5 \times 10^3$	$3.7 \times 10^4$	$1.8 \times 10^3$
8	$1.5 \times 10^4$	$3.2 \times 10^3$	$4.9 \times 10^2$
9	$5.1 \times 10^2$	$4.7 \times 10^4$	$3.7 \times 10^4$
10	$4.9 \times 10^3$	$3.1 \times 10^4$	$4.2 \times 10^3$
Total	$8.7 \times 10^4$	$1.8 \times 10^5$	$2.7 \times 10^5$
Mean	$8.7 \times 10^3$	$1.8 \times 10^4$	$2.7 \times 10^4$

pre-operative and to evaluate the most effective among the three selected disinfectants.

### MATERIALS AND METHODS

The study was carried out at Usmanu Danfodiyo University, Veterinary Teaching Hospital and Sokoto state Zonal Veterinary Clinic in Sokoto between August and October, 2008 (within ten weeks). Thirty (30) Red Sokoto goats presented to the two clinics mention above for various surgical procedures were used for the research. Those free of any dermatological lesion were selected. Patients presented were mainly for emergency surgery.

The proposed surgical sites were shaved, two sterile swabs sample were taken immediately, before and two minutes after scrubbing. The samples were taken from three groups (A, B and C) of animals each containing ten goats. Chlorohexidine gluconate (Jam germ®) was used to prepare patients in group A; Chloroxylenol (Dettol®) was used to prepare patients in group B and Povidone iodine was used to prepare patients in group C.

Peptone water was prepared for serial dilution of the samples taken. Ten fold serial dilution of each sample was made. Nutrient agar was prepared according to manufacturer's direction. 1ml each of the serially diluted samples were spread plated on the nutrient agar plates according to Carter and Cole (1991). The plates were incubated for 10-24 h at 37°C for optimum bacterial growth. Bacterial colonies were counted, and colony forming unit of each plate was calculated based on the dilution factor used. Plates having between 30-300 colonies were considered for counting while those with fewer than 30 and above 300 were not considered for statistical reasons.

### RESULTS

The mean values of bacterial load from the surgical sites were obtained after culturing on nutrient agar and presented as Colony Forming Unit/ml. The mean values were  $8.7 \times 10^3$ ,  $1.8 \times 10^4$  and  $2.7 \times 10^4$  for chlohexidine, chloroxylenol and povidone iodine, respectively (Table 1).

The mean colony counts of the three disinfectants indicated that all disinfectants are effective in reducing bacterial load of the scrubbed sites, with disinfectant A (Chlohexidine gluconate) reducing to  $8.7 \times 10^3$  CFU/mL, disinfectant B (Chloroxylenol) reducing  $1.8 \times 10^4$  CFU/mL and disinfectant C (povidone iodine) reducing  $2.7 \times 10^4$  CFU/mL. Therefore, Chlohexidine gluconate has shown to effective in reducing bacteria loads than Chloroxylenol and Povidone iodine, this indicates that Chlohexidine gluconate is more effective than Chloroxylenol, Chloroxylenol is more effective than Povidone iodine.

### DISCUSSION

The goal of any type of pre surgical care and therapy is to facilitate fast healing and recovery by preventing unwanted post surgical complications due to infection, to shortened the duration and cost of post surgical care and hospital stay.

From the results of this work it was observed that there were heavy bacterial load on the skin of all the patients used, which was enough to cause surgical site infection when surgery is carried out without treating the skin with antiseptic solution as reported by Daly (1985) and Harari (1990). Bacterial factors that affect the wound sepsis include the type of organisms, virulent, growth requirement and a dose greater than  $10^5$  organisms per gram of tissue is usually necessary to initiate infection. From the results of this work it was found that all the three groups were having an average of bacterial load count on the skin ranging from  $2.1 \times 10^7$  to  $3.2 \times 10^7$  CFU/mL before scrubbing.

Post scrubbing results shows great reduction in bacterial load count of the patients' skin of each group. The highest reduction was noticed in group A, which Chlohexidine gluconate was used as scrubbing solution ranging from  $3.3 \times 10^7$  to  $8.7 \times 10^3$  CFU/mL. The result of this study is in line with the work conducted by Sanchez *et al.* (1988). They used 0.05 to 0.1% Chlohexidine gluconate as wound lavage and found it very effective in facilitating wound healing than using saline or Povidone iodine. This work is also in line with the work of

Alexander *et al.* (1983) in which they used 0.05 to 0.1% of Chlohexidine gluconate on experimentally infected wound and it was found very effective in reducing bacterial load and decreasing wound infection. The result also supported the work of Platt and Bucknal (1984); they used 0.05% Chlohexidine gluconate on Guinea pigs as scrubbing solution and concluded that, Chlohexidine gluconate can prevent chances of surgical infection when used before surgery compared with Benzalkonium chloride, Povidone iodine and Saline.

The result obtained from other group B and C (Chloroxylenol and Povidone iodine) also shows great reduction of bacterial count to minimum level that cannot allow surgical infection. This shows that these disinfectants can be used as scrubbing agent as the mean colony counts are less than  $10^5$ , which is the minimal counts for any wound to be infected.

### CONCLUSION

It is evident from the study that all the three disinfectant tested are effective in reducing microbial load contamination, with Chlohexidine gluconate giving a better result. Therefore, it can be concluded that the three disinfectants can be used as scrubbing solution.

The result of this study, it can be concluded that, both solution (Chlohexidine gluconate, Chloroxylenol and Povidone iodine) can comfortably be used during emergency procedures using stock concentration as scrubbing solution with wide safety margin. However, Chlohexidine gluconate is much more effective in prevention of surgical site infection due to drastic reduction of bacterial colonies at surgical site.

### RECOMMENDATION

The disinfectants can be used during emergency procedures as stock concentration as scrubbing solution. They can also be used as cleansing agent in contaminated wounds before dressing.

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