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The efficacy of surgical scrubs in reducing hand bacterial flora

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Abstract

Objective The objective of our study was to compare the efficacy of five different surgical scrubbing agents (plain soap, antiseptic soap, 4% chlorhexidine, 7.5% povidone iodine and a commercial preparation of alcohol hand rub) in reducing the hand bacterial flora in two operation theatres in the Colombo South Teaching Hospital before and immediately after scrubbing.

Design A comparative study.

Setting Two operation theatres of the Colombo South Teaching Hospital.

Participants Ten members of theatre staff who regularly operate or assist.

Methods Hand scrubbing with the respective agent/rubbing with alcohol by all participants on different days. On each occasion imprints of fingertips and palm of the dominant hand was taken immediately before and after hand hygiene procedure. The bacterial colony counts were taken after overnight incubation. The mean percentage reduction of colony counts was taken as the efficacy indicator. Statistical analysis was done by paired t test.

Results Highest reduction of colony counts was by alcohol hand rub and it was significantly better than plain soap, antiseptic soap and povidone iodine ($P<0.05$). There was no significant difference between colony count reductions by plain soap and antiseptic soap. There was no significant difference between alcohol hand rub and 4% chlorhexidine ($P>0.05$).

Conclusions Hand rubbing with alcohol and scrubbing with 4% chlorhexidine effectively reduced hand bacterial flora and they are superior to hand washing with plain soap and antiseptic soap. There is no added advantage in substituting antiseptic soap for plain soap in order to reduce bacterial burden in hands.

Key Words: Surgical scrab, Colony count, Operation theatre

Introduction

The surgeons feel and explore while their patients wait hoping for answers and healing. The same hands can also be a transmitter of infection. Surgical scrub is a process used to remove and reduce transient and the resident bacterial flora. Bacteria on the hands of the surgical team can cause wound infections if introduced into the operative field during surgery(1). Reducing resident skin flora on the hands for the duration of the surgery reduces the risk of bacteria being released into the surgical field if gloves are punctured or torn during surgery (2). Surgical site infections are known to be among the leading nosocomial causes of morbidity that

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prolong hospital stay, increasing the health care cost to the country. Hand washing is emphasized as the single most important measure to prevent cross transmission of micro-organisms and thus to prevent nosocomial infections (3).

In the absence of systematic surveillance of hospital acquired infections (HAI) in the country the prevalence of HAI is hard to determine. Studies done at National Hospital of Sri Lanka (NHSL) in 1994 and 1997 shows prevalence rates of 13.5% and 8.5% respectively (4). An audit done at Colombo South Teaching Hospital in 2001 showed a surgical wound infection rate of 20%(5). The wound infection rate in clean and clean-contaminated surgeries in that unit was found to be high when compared to published Western data. In Sri Lanka scrubbing with plain soap or antiseptic soap and water is the usual practice in most hospitals. There are no published data in our country to evaluate the efficacy of various scrubbing agents to our knowledge.

Previous studies done internationally shows that there is a difference in the bacterial colony counts according to the component of the scrub used (6). Scientific studies have not established the extent to which counts of bacteria on the hands need to be reduced to minimize transmission of pathogens in the healthcare facility (7). A Study done previously in Sri Lanka has assessed *Hibiscrub* and *Betadine* and the soap *(Sunlight)* (8)

The ability to reduce the number of bacteria released from hands immediately after scrubbing and after wearing gloves for 6 hours (persistent activity) are considered the most important times to evaluate the efficacy of antiseptic agents/disinfectants (9).

We carried out a comparative study to compare the efficacy of five different scrubbing agents in reducing hand bacterial flora during routine surgical hand antisepsis.

1. Plain soap- *Night and Day (BCC Ltd)*
2. Antiseptic soap(Triclosan,TCC)- *Dettol (Rickitt & Colmanns,, U.K.)*
3. 4% Chlorhexidine gluconate/n proponol –*Hibiscrub (SSL International, U.K.)*
4. 7.5% Povidone Iodine- *Betadine (Win Medicare Limited, New Delhi)*
5. Commercial preparation of alcohol hand rub (*Desderman N/ Schulke & Mayr, UK Ltd),(*composition- 96% ethanol, 2-biphenylol, polyvidone, sorbitol and 2-propanol)

Methods

The study design used was a comparative study of different antiseptics in reducing hand bacterial flora.

Enrolment of participants

The study was carried out from July to November 2003 in two operation theatre complexes in Colombo South Teaching Hospital. Participants were 10 volunteers of theatre staff, including 5 nurses and 5 doctors. Ethical clearance was obtained from the Ethical Review Committee of University of Sri Jayewardenepura.

Study procedure

A written protocol according to recommendations of the Health Care and

Infection Control Practice Advisory Committee (CDC/HICPAC2002) (9) was made available and hand scrubbing was done under supervision of an author to ensure quality of the technique. A scrub brush was not used.

Plain soap and antiseptic soap - 5 minutes scrub

4% Chlorhexidine - 4 ml used for 3-5 minutes scrub

7.5%Povidone Iodine - 4 ml used for 5 minutes scrub

Alcohol rub - Initial hand washing with plain soap. Hands were then rubbed with 5 ml of alcohol and left to dry for 3 minutes and the procedure repeated. As CDC guidelines mentioned to follow manufacturers instructions when using alcohol based products, in this study alcohol rub was used twice(9).

Sampling of hand imprints was carried out. Each participant was identified by a number, the same 10 participants were tested for each agent twice, on different days over a period of 4 months for each of the antiseptics.

Microbiological sampling and processing

Fingerprints and palm imprint of the dominant hand was gently pressed for five seconds on separate, laboratory prepared 150 mm diameter nutrient agar plates immediately before and after the hand cleansing procedure. . Persistent activity (hand imprint after surgery which needs to be after 6 hours according to CDC guidelines) and cumulative activity of antiseptics (done repeatedly for five days) will be done in a subsequent study .

Plates were then incubated overnight at 37^0 C under aerobic conditions. The number of colony forming units (CFU) were counted with the use of a colony counter by 2 individuals and the average obtained. The precise count was taken up to a maximum of 300 CFU because beyond this point colonies formed a confluent growth (10).

Statistical analysis

The reduction of bacterial colony counts in hands with each surgical scrubbing agent was determined. The percentage reduction of colony counts for each participant was then calculated. Further the average percentage reduction for each agent was obtained. The significance of average percentage reduction was analyzed by using paired t test. $P<0.05$ was considered significant.

Results

The pre - and post - colony counts obtained with each of the antiseptics is shown in Table1.The highest mean percentage reduction of 94 % was obtained by the alcohol hand rub. The rest of the agents in the descending order of their mean percentage reduction were chlorhexidine, povidone iodine, plain soap, and antiseptic soap (Table2). In fact both alcohol and chlorhexidine were significantly better than soap, antiseptic soap and povidone iodine ($p < 0.05$). The difference between chlorhexidine and alcohol was not statistically significant.

Both soap and antiseptic soap had a percentage increase of their mean colony counts in post - plates. There was no significant difference between average reduction of colony counts obtained by plain soap and antiseptic soap.

Discussion

The highest reduction of bacterial colony counts was achieved by alcohol hand rub and it was significantly better than povidone iodine, plain soap or antiseptic soap. Recent studies have shown that alcohol based hand rubs are better or at least as effective as antiseptic soap or plain soap (7,11). There was no significant difference between the efficacy of alcohol hand rub and chlorhexidine.

Guidelines recommend that agents used for surgical scrubbing should substantially reduce microorganisms on intact skin, have a broad spectrum of activity, contain a non irritant preparation, and be fast acting and persistent (12). Chlorhexidine can remain active on skin for 5-6 hours, therefore, it has a substantial residual activity. Chlorhexidine also can remain active in the presence of organic material whereas the activity of alcohol may be reduced in the presence of organic material like blood and pus. Hence, removal of organic matter would be necessary prior to using the alcohol preparation for optimum effect.

Alcohol hand rub preparations are not readily available in the market in Sri Lanka. Therefore chlorhexidine which was found to be similar to alcohol in efficacy in our study would be a feasible choice in our operation theatres as an alternative to plain soap and antiseptic soap. However, 4% chlorhexidine is known to cause irritant dermatitis of skin on frequent application. (13)

Antiseptic soap was not found superior to plain soap in reducing hand bacterial flora. Therefore the advantage of substituting antiseptic soap (which is more expensive) for plain soap in operating theatres expecting greater performance is questionable.

Hand washing with plain soap is known to cause a paradoxical increase in colony counts (13). Plain soap and antiseptic soap giving a percentage increase in colony counts in our study could be explained by rubbing of hands during the scrubbing procedure, which can bring out resident micro-organisms in the stratum corneum. Studies have further shown that using a scrub brush will further increase the post - colony counts due to trauma to the skin (14). Hence we did not use a scrub brush in our study. Limitations identified in our study were that we assessed bacterial contamination by taking agar fingerprints of the dominant hand without using the glove juice technique to assess the bacterial colony count in hands. Agar plate method may have underestimated the microbial burden of hands but our study which was done during routine theatre hours did not allow using the glove juice technique. However since a comparison of bacterial burdens were done by using the same technique our findings remains valid. The maximum colony count had to be taken as 300 colony forming units because beyond this value colonies formed a confluent growth (10). Therefore when pre - and post-plates were counted, for counts beyond 300 colonies, the percentage reduction had to be taken as zero.

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Table 1 Average pre- and post- counts for each antiseptic agent

Antiseptic	Mean pre- count	Mean post- count	% Reduction of mean
Alcohol	231.1	13.4	94.2
Chlorhexidine	220.5	23.9	89.2
Betadine	238	55.9	76.5
Plain soap	180.8	118.3	34.6
Antiseptic soap	216	228.3	-5.7*

**(- increase of post - plate counts)*

Table 2. Percentage reduction of colony counts for hand scrubbing agents

Index number	Alcohol	Chlorhexidine	Betadine	Plain soap	Antiseptic soap
D1	99.3	88.3	88.0	65.7	0.0
D2	92.3	98.7	73.3	28.8	0.0
D3	93.3	100.0	94.7	-175.8	0.0
D4	94.0	99.3	62.0	-32.2	-279.6
D5	99.0	88.3	73.3	-27.6	0.0
N1	92.9	100.0	70.9	63.7	-44.3
N2	97.0	98.1	21.1	35.0	81.4
N3	84.0	45.2	88.7	82.3	0.0
N4	92.9	97.6	87.7	-174.3	-435.7
N5	95.2	99.6	20.8	57.8	83.0
Average percentage Reduction	**93.9**	**91.6**	**68.0**	**-7.6**	**-59.5**

D- doctor, N- nurse (- denotes an increase in post plate counts)