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COMPARISON OF EFFICACY OF ANTIBACTERIAL ACTIVITY OF HYPOCHLOROUS ACID VS. 70% ALCOHOL FOR PATHOGENIC MICROORGANISMS ISOLATED FROM HIGH TOUCH AREA OF NICU AND PICU IN A TERTIARY CARE HOSPITAL

Microbiology

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ABSTRACT

Introduction: Health-care associated infections are a significant cause of mortality and morbidity. As a health care personnel it is our responsibility to implement hospital infection control policy and maintain the sterility of environment in ICU settings. **Objective:** To compare the efficacy of antibacterial activity of Hypochlorous acid and 70% alcohol for pathogenic microorganisms present on high touch areas of NICU and PICU. **Material And Method:** This study was conducted in the department of Microbiology of a tertiary care hospital. Total 96 samples were collected from 16 high touch areas of NICU and PICU collectively, before and after cleaning with both hypochlorous acid and 70% alcohol. **Results:** Out of 96 samples collected, growth was observed in 9 samples. 7 isolates were *Staphylococcus aureus* and 2 were *Klebsiella pneumoniae.* Growth reduction of log = 2 was seen with hypochlorous acid as compared to 70% alcohol which has shown reduction of log = 1. **Conclusion:** in this study, hypochlorous acid was found to be more effective as cleaning solution than compared to alcohol.

KEYWORDS

Healthcare associated infections, Hypochrorous acid, 70% alcohol

INTRODUCTION:

Healthcare associated infections (HAI) are a major safety problem responsible for significant mortality and morbidity in pediatric age group admitted in pediatric and neonatal intensive care units (PICU, **NICU**) worldwide.[1] HAI are associated with increase length of stay and healthcare cost.[2]

One British study found that HAIs prolongs the stay of patients in hospital by 25%, nearly tripling the cost of hospital treatment.[3]

Multiple sources have documented increasing prevalence of HAI due to antibiotic resistant organisms in PICUS.[4] Prevalence of HAI in the pediatric age group varies from 6-12% in PICU and 10-25% in NICU.[5-6]

It is well documented that surfaces in the hospital environment are seriously contaminated.[7] It is estimated that environmental contamination are responsible for up to 20% of nosocomial infections.[8] Antiseptics and Disinfectants are used extensively in hospitals for a variety of topical and hard surface applications. and are an important part of infection control aid to prevent HAI [9]. So by evaluating and comparing the cleaning efficacy of different agents we can know the ideal compound to clean hospital surface to prevent nosocomial infections.

Key pathogens associated with HAI, such as *Methicillin Resistant Staphylococcus aureus* (MRSA), V*ancomycin Resistant Enterococcus (VRE)*, *Acinetobacter baumanni* and *Clostridioides difficile* are shown to persist on surfaces for long period of time, colonize hands of healthcare workers and cause outbreaks.[10] In a study conducted on MRSA carriers, it was shown that contact with commonly touched environmental surfaces in a patient room was equally likely to contaminate the hands of healthcare workers as was direct contact with patients.[11] Admission to a room previously occupied by a MRSA or VRE positive patients increases the odds of acquisition of MRSA and VRE by 40%.[12]

Thus by conducting research on the surface contamination of the PICU and NICU we can possibly achieve steps towards reducing outbreaks of HAIs and knowing which organisms could be responsible for such outbreaks thus help in delivering better healthcare services.

AIM AND OBJECTIVES:

AIM : Evaluation of high touch area of NICU and PICU to ascertain the surface contamination by pathogenic microorganisms and compare the efficacy of the cleaning solution of Hypochlorous Acid (HOCl) and 70% alcohol.

OBJECTIVES:

1. To isolate and identify aerobic and anaerobic bacteria from High touch areas of NICU and PICU isolated before and after cleaning from HOCl and 70% Alcohol.
2. To compare the efficacy of hypochlorous acid and 70% alcohol as cleaning solution for high touch areas.

MATERIAL AND METHODS:

The cross-sectional present study was conducted in the Department of Microbiology, in Government Teaching hospital after obtaining ethical clearance from the Institutional Ethical Committee (IEC) over a time period of two months.

A total of 96 samples were taken from 16 surfaces chosen randomly from NICU and PICU.

Sixteen surface locations were chosen for testing and they were classified in two units – NICU (baby cot, thermometer, crash cart, ventilator surface, IV stand, table top, weighing machine, measuring tape) and PICU (PICU bed, thermometer, crash cart, ventilator surface, IV stand, table top, infusion pump, PICU panel)

3 sets of samples were collected- one for aerobic and one for anaerobic bacteria respectively. Similarly the samples were collected both before cleaning and 2 sets after cleaning from hypochlorous acid (Sterigen solution) and 70% alcohol respectively. So in total of 6 samples were collected for each chosen surface. If Carbonization or fogging has been done within 24 hours in a location, then sample was not taken from that area.

All the collected specimens were transported immediately to the laboratory for further processing. Standard method for isolation and identification of aerobic and anaerobic bacteria were used.[14,15]

To determine the efficacy of disinfectants, bacterial colony count was noted in all plates (before cleaning and after cleaning) and log reduction[16] was calculated for both HOCl and 70% alcohol.

Log reduction = $\log_{10}(A/B)$
A= colony count before treatment

B = colony count after treatment

All data was maintained in Microsoft office Excel. All statistical analysis was carried out using Excel, applying appropriate Test of Proportion.

OBSERVATION AND RESULTS:

Total 96 samples were taken from two groups – NICU and PICU.

The distribution of culture positive samples in different units of the various surfaces is shown in Table 1.

Table 1 : Culture positivity amongst different units of various areas in Teaching hospital

NICU (aerobic + anaerobic n=48 samples)		PICU (aerobic + anaerobic n=48 samples)	
Area	**No. of positive culture (%) (n=5)**	**Area**	**No. of positive culture (%) (n=4)**
Before cleaning	3 (60%)	Before cleaning	3 (75%)
After cleaning from alcohol	1 (20%)	After cleaning from alcohol	1 (25%)
After cleaning from HOCl	1 (20%)	After cleaning from HOCl	0 (0%)
Total	5 (10.42%)	**Total**	4 (8.33%)

Out of 96 samples, 9(9.37%) samples were culture positive on aerobic culture only. More culture positive samples were from NICU 5 (10.42%). Commonly infected areas were baby cot, weighing machine, measuring tape and thermometer.

Out of the 9 culture positive samples, most commonly isolated organism was *Staphylococcus aureus* (7) followed by *Klebsiella pneumoniae* (2).

The colony count of *Staphylococcus aureus* before cleaning was 10^3 which were reduced to 10^2 after cleaning with alcohol (log reduction = 1) and 10 after cleaning with HOCl (log reduction = 2). Antimicrobial resistance pattern for *Staphylococcus aureus* (n=7) was Erythromycin 3(43%); Clindamycin 5(72%); Ampicillin 7(100%); Co-trimoxazole 3(43%); Doxycycline 3(43%); Ciprofloxacin 4(57%); Gentamicin 3(43%) and Chloramphenicol 3(43%).

Out of 7 *Staphylococcus aureus*, 5 (71.43%) MRSA were found. Among which 3 were from NICU and 2 were from PICU.

Another organism identified was *Klebsiella pneumoniae* (n=2), both from NICU, one before cleaning and one after cleaning with alcohol, log reduction = 2.

Antimicrobial resistance pattern of *Klebsiella pneumoniae* (n=2) isolate was Norfloxacin - 1(50%); Ampicillin (AMP) - 2(100%); Ciprofloxacin (CIP)- 0; Gentamicin (GEN)- 0; Cefuroxime-2(100%); Piperacillin-tazobactam(PIT)-2(100%); Imipenem was the only drug to which the isolates were sensitive.

Total around 66.6% resistance to Beta-Lactams for *Klebsiella pneumonia o*bserved in our study.

DISCUSSION:

In present study a total of 96 samples were taken from NICU and PICU. Samples were taken from the surface both before and after cleaning by alcohol and HOCl respectively. As observed, out of 96 samples, 9 (12.5%) were Culture Positive were aerobic bacteria only.

In present study *Staphylococcus aureus* was the major microorganism isolated and in a similar study done by Fauci *et.al*.[19] who also found *Staphylococcus aureus* to be the major pathogen in the environmental surfaces.

In a contrast study done by Banerjee SN *et.al*.[5] the predominant organism isolated was *Pseudomonas aeruginosa* (105) followed by *Escherichia coli* (77), *Klebsiella pneumoniae* (41) and *Staphylococcus aureus* (18). In our study the majority organism isolated was *Staphylococcus aureus,* which is usually found on hand surfaces. Other isolate found was gram negative bacteria, *Klebsiella pneumoniae* 2 (7.1%) which may be due to cross transmission. Less percentage of gram negative isolates in our study signify that appropriate methods of disinfection practiced in our hospital are successful against gram negative bacteria.

In Present study: out of 7 isolated *Staphylococcus aureus*, 5(71.43%) were MRSA and 2 (28.57%) were MSSA. Other organism isolated was *Klebsiella pneumoniae* (n=2). High incidence of MRSA strains was also observed in study done by Robakowska *et al*[5].

Various studies have shown MRSA infection as the most common problem from inanimate objects. It may be due to the fact that health workers harbor MRSA on their hands/skin/ nasopharynx which serve as a reservoir of MRSA that may spread to other health workers with whom they subsequently contact.

In our study Antimicrobial susceptibility pattern of *Klebsiella pneumoniae (n=2)* showed 100% resistance to Ampicillin; and 50% resistance towards Gentamicin. Similar study done by Teshale Worku (2018)[20] showed 38.4% strains resistant to Ampicillin and 23% strains resistant to Gentamicin. This shows increase in resistance of *Klebsiella pneumonia* to Ampillicin and Gentamicin i.e. Beta Lactams which may be due to increased used of these antimicrobials in our hospital and non judicious prescription leading to mutant strains. Total 66.6 % resistance to Beta Lactams for *Klebsiella pneumonia* was observed in our study.

Infectivity is less on surfaces cleaned with HOCl as compared to surfaces cleaned with 70% alcohol. Thus indicating that HOCl might bring down infectivity in the hospital environment.

CONCLUSION:

Infectivity was more with the surfaces that were cleaned with 70% alcohol as compared to those cleaned with HOCl, thus warranting the use of HOCl as a better disinfectant for cleaning hospital surfaces and to prevent.HAIs

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