BRIEF COMMUNICATION

Year : 2002 | **Volume** : 20 | **Issue** : 4 | **Page** : 215-218

Hypochlorite (1%) is inefficient in decontaminating blood containing hypodermic needles

V Chitnis, DS Chitnis, S Patil, S Chitnis
Department of Microbiology, Choithram Hospital & Research Centre, Indore - 452009, M.P, India

Correspondence Address:
Department of Microbiology, Choithram Hospital & Research Centre, Indore - 452009, M.P, India

~ Abstract

Infectious biomedical waste and sharps have a potential hazard of transmission of pathogens. Among sharps, used needles form a major share and disinfection by 1 % hypochlorite is recommended in biomedical waste management rules of India. The aim of the present study was to evaluate the efficacy of hypochlorite for the decontamination of needles. Needles (16 g) filled with suspensions of standard strains and clinical isolates of gram positive and gram negative bacteria in plain normal saline and in human blood containing anticoagulant, were exposed to 1% hypochlorite and the surviving bacteria were subjected to viable counts. The observations indicated that 85 - 90 % of the needles filled with bacterial suspensions in saline are disinfected to a level of >5 log bacterial reduction (standard disinfection) on exposure to hypochlorite but only 15 to 30% needles contaminated with the challenge bacteria suspended in blood showed >5 log reduction in viable counts. Thus, hypochlorite treatment is inadequate for disinfecting needles contaminated with pathogenic bacteria in presence of blood and should not be recommended as an option for disinfection of the needles.

How to cite this article:
Chitnis V, Chitnis DS, Patil S, Chitnis S. Hypochlorite (1%) is inefficient in decontaminating blood containing hypodermic needles. Indian J Med Microbiol 2002;20:215-8

How to cite this URL:
Chitnis V, Chitnis DS, Patil S, Chitnis S. Hypochlorite (1%) is inefficient in decontaminating blood containing hypodermic needles. Indian J Med Microbiol [serial online] 2002 [cited 2011 May 19];20:215-8. Available from: http://www.ijmm.org/text.asp?2002/20/4/215/6960

The biomedical waste has recently emerged as an issue of major concern to hospitals, nursing homes, environmental law enforcement agencies, media and general public. Medical waste generated in hospital can be a serious health hazard for the patients in the hospital, hospital staff and if reaches to the community, can become a community health hazard. In order to control this biohazard MOEF (Ministry of Environment and Forests) enacted the Biomedical waste rules (BMW) 1998.[1] The sharps and specifically needles have been given special emphasis since needle stick injuries during handling or medical procedures have the potential to transmit blood borne infections. The diseases that can be transmitted include AIDS, hepatitis B, hepatitis C, malaria and many other bacterial and viral diseases.[2]

The sharps are to be disposed in special coloured puncture proof containers. The treatment options suggested by BMW rules are chemical disinfection with 1% hypochlorite or autoclaving or microwaving. The needles are to be mutilated after treatment. The rules also recommend monitoring of chemical disinfection from time to time. However, there is no data available on monitoring of chemical disinfection of needles.

Hypodermic needles range in length from 1 to 6 inches and thickness of 24 to 16 g are used for a number of clinical procedures in a hospital setup. In case of hypodermic needles which are attached to plastic or rubber tubing, the usual practice in Indian setups is to just cut the needle portion and immerse the needles in 1% sodium hypochlorite. The other needles after use are either directly added to hypochlorite containers or mutilated by cutting part of the needle mechanically in needle cutters or by burning the tip portions in electric needle destroyers before immersing in hypochlorite solutions. The studies[3] with

bacterial challenges to test the efficacy of chlorine releasing solutions are numerous but chlorine solutions used have been in the range of (0.0003 to 0.25%). The only study[4] with organic soiling used albumin (1%) and plasma (10 to 50%) which rendered 0.25% hypochlorite totally ineffective. Further, in a study[5] blood was used as organic material using *Staphylococcus aureus* as the challenge organism and quantitative suspension test was performed using 1% hypochlorite. To the best of our knowledge, studies on efficacy of hypochlorite have been undertaken for conditions simulating spillage but not for needle decontamination. The penetration of hypochlorite into the narrow lumen of needles, especially those filled with blood and body fluids, remains doubtful. Surprisingly scientific data to prove the efficacy of 1% hypochlorite for decontamination of hypodermic needles is not available. Hence, this study was designed to determine the efficacy of 1% sodium hypochlorite for disinfection of contaminated hypodermic needles with or without blood as organic soil.

~ Materials and methods

Sodium hypochlorite

Sodium hypochlorite having an initial Cl2 concentration of 10% (checked by chlorinometer, Qualigens, India) was used to prepare in-use solution of 1% sodium hypochlorite.

Bacterial cultures

The standard strains of *S.aureus* sp NCTC 6538 and *E.coli* sp NCTC 10418 which were procured from Haffkine Institute for Training, Testing and Research, Mumbai, were used for the experiments. Isolates of *Staphylococcus aureus*, coagulase negative staphylococci, *E.coli*, *Klebsiella* species and *Pseudomonas aeruginosa* were obtained from clinical samples of patients.

Bacterial inoculum

Two sets of inoculum were used for the study :

a) Plain inoculum-Bacterial growth from fresh overnight grown nutrient agar slants were harvested in sterile normal saline to match the turbidity of 0.5 McFarland standard (1 x 108 CFU/mL). Suspension was vortexed to prevent clumping of bacterial cells.

b) Blood inoculum-CPDA (Citrate Phosphate Dextrose and Adenine) anticoagulated blood from blood bank was used for preparing the inoculum. Equal volumes of plain inoculum and blood were mixed to prepare the inoculum.

New sterile hypodermic needles (16 g) from blood donor set were used in the study for the experimental ease of flushing the needles and sterile 1% sodium thiosulphate solution was used after exposure of needles to neutralize residual chlorine present.

Procedure

Sterile hypodermic needles were filled with inoculum (plain or in blood) by aspiration with syringe. The needles were separated from the syringe and immersed in 1% sodium hypochlorite solution (300 mL) for 30 minutes. The needles were picked up with sterile forceps and 1 mL sodium thiosulphate (1%) was passed through the needles with a sterile syringe and collected in sterile tubes. Thereafter, dilutions were made in sterile normal saline. The undiluted and serial dilutions were further subjected to viable bacterial count by plating over nutrient agar in duplicate. The plates were incubated at 370C for 48 hours. Ten needles filled with plain inoculum of bacteria were exposed to hypochlorite solution in each experiment and a second set of ten needles filled with inoculum in blood were exposed similarly. As a control, three needles in each experimental set were filled up with plain and blood containing bacterial inoculum and immersed in normal saline and processed like exposed test needles. The experiments were repeated second time using identical number of needles for test and control.

Statistical analysis

Post- hypochlorite exposure reduction in CFU count for the bacterial suspension in plain normal saline versus bacterial suspension in blood were compared by Wilcoxon sign rank test.

~ Results

The survival of challenge bacteria *S.aureus* NCTC 6538 and *E.coli* NCTC 10418 in the experimental design, both for the plain and the blood containing inoculum is shown in [Table - 1] and [Table - 2] respectively. Greater than or equal to 5 log reduction in the bacterial count with reference to control was considered as standard level of

disinfection.[4] The standard level of disinfection was achieved for 90% (18/20) needles contaminated with plain suspension of *S.aureus* NCTC 6538. However, only 15% (3/20) in presence of blood showed > 5 log reduction in the challenge bacterial population. Using *E.coli* NCTC 10418 as a challenge, 85% of the needles revealed standard level of disinfection with plain bacterial suspension whereas only 30% of the needles were disinfected when the challenge was in the presence of blood. The summarized results of bacterial challenges with clinical isolates are shown in [Table - 3]. The results were similar to those for the standard strains of *S.aureus* and *E.coli*.

~ Discussion

Hypodermic needles form a major proportion of the hospital waste among sharps and disinfection with 1% hypochlorite of the needles has been one of the treatment options in the BMW rules. The disinfection is necessary for even the injection needles undergoing partial destruction in the electric needle destroyer since only part of the needle gets melted in the instrument and the left out portion may have the blood borne pathogens.
In the present experimental work, large bore needles were used (16 g) so that flushing of the needles after the treatment could be done easily. However, it is not likely to affect the experimental conclusions and on the contrary penetration of hypochlorite in the small bore needles may be more difficult. Documented reports[5] of infections transmitted by needles are for HIV, hepatitis B, Brucellosis More Details, leptospirosis, diphtheria and staphylococcal endocarditis. Our experimental data suggests that even needles filled with plain bacterial suspension failed to be disinfected to an extent of 10 to 15%. Further, it was very disturbing to observe that 85% of needles filled with *S.aureus* and 70% of needles filled with *E.coli* suspended in blood failed to show reduction in bacterial viability of equal or more than 5 logs. Similar observations were seen in the challenge study using clinical bacterial isolates. Thus the recommended needle decontamination procedure has failed to achieve proper decontamination of needles under this designed challenge study. The viral challenge studies were not possible due to experimental difficulties but one may extrapolate the inference for viruses as well.
Blood is known to be an interfering factor in action of hypochlorite but the purpose of our

study was to highlight the inefficiency of needle decontamination procedure using 1% hypochlorite.[4] Our design has used CPDA (anticoagulant) containing blood but clotted blood in the needles is likely to make the entry of hypochlorite even more difficult. The experiment was designed taking standard bacterial challenges and neutralizer solution. The standard log reduction (greater than or equal to 5 log) in challenges as used in quantitative suspension tests for disinfection testing was used in this study to interpret the results.[4] The design has tried to simulate the practice of disposal of needles in field conditions.

CDC has recommended concentrated sodium hypochlorite (5.25%) for decontamination of drug syringes and needles due to difficulty in cleaning the inside of needles.[6] They have also recommended an extensive procedure of precleaning with water, rinse with concentrated bleach and so on. This was specifically to reduce the risk of HIV transmission by injecting drug users who reuse or share a needle or syringe. In a busy hospital practice it is very difficult to follow the elaborate CDC procedure for needle decontamination using concentrated bleach. In addition, CDC itself has expressed doubts on inactivation of HIV by bleach as a disinfectant.

To conclude, the submitted data is alarming and authorities must take a serious note to amend the BMW rules to recommend heat treatment (autoclaving or hot air oven) for disinfection of used needles in medical care facilities and not to allow chemical disinfection of needles using hypochlorite or bleaching powder.

~ Acknowledgements

The authors are grateful to the CSIR EMR (SRF award) to Mr.V Chitnis and management of Choithram Hospital and Research centre, for providing the required support to carry out this research work.

~ References

1. Ministry of Environment & Forests Notification, New Delhi. *Bio-medical waste (Management and Handling) Rules, 1998.*

2. Coad A. Managing Medical Wastes In Developing Countries. In: *Industrial Safety Chronicle* 1998;29:43-60.
3. Rutala WA, Weber DJ. Uses of Inorganic Hypochlorite (Bleach) in Health Care Facilities. *Clinical Microbiol Rev* 1997;10:597-610.
4. Bloomfield SF, Miller EA. A comparison of hypochlorite and phenolic disinfectants for disinfection of clean and soiled surfaces and blood spillages. *J Hospital Infection* 1989;13:231-239.
5. Collins CH, Kennedy DA. Microbiological hazards of occupational needle stick and sharps injuries. *J Applied Bacteriology* 1987;62:385-402.
6. Center for Disease Control. Statement on the role of Bleach in HIV prevention programs for injecting drug users. *CDC National AIDS Hotline Training Bulletin* 1993;48.