CRITICAL CARE

LETTER

# Letter to the Editor

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**The effectiveness of hand-disinfection by a flow water system using electrolytic products of sodium chloride, compared with a conventional method using alcoholic solution in an intensive care unit**

Organisms that cause nosocomial infections can be transmitted via the hands of physicians, nurses, technicians, and other hospital personnel [1-4]. Thus, the disinfection of hands is a most important procedure for preventing nosocomial infection. In any intensive care units (ICUs), the disinfection of hands is particularly important, because the patient in ICUs are seriously ill and with immunologically compromised conditions such as post-organ transplantation, severe infection and immunodeficiency syndrome [2,5]. Increased chances of contact with patients by medical staff for various treatments further increases the risk of hand-transmitted nosocomial infection [2,5]. Therefore, implementation of an effective hand-disinfection system should be required in ICUs.

Recently, we have developed a flow-water hand-disinfection system using electrolytic products of sodium chloride (the flow-water plus electrolyte; FWE) and reported its effective bactericidal and antiseptic performance *in vitro* [6]. This FWE system produces large amounts of antiseptic solution on use, resulting from the electrolysis of saline, containing hypochlorite and active oxygen, both of which play a part in the solution's antiseptic effects [6]. In this preliminary report, we evaluated the antiseptic effects of the system as used by the medical staff in the ICU and compared its antiseptic effects with those of a conventional hand-disinfection method: application of alcohol lotion after hand-washing with soap.

Forty members of the medical staff of the ICU is Osaka University Hospital (Osaka, Japan) without skin disease on their hands were included in this study. Each subject disinfected their hands by following three different methods (one method per day). Each subject's hands were sampled on 3, not necessarily consecutive, days after they had finished their routine work schedules. They were asked to keep their hands unwashed 1 h prior to the experiment. The hand-disinfection methods used in this study were as follows:

1. A flow-water hand-washing method using electrolytic products of sodium chloride (FWE; $n$ = 40): the apparatus (BK-WASHER$^{TM}$; TRP Co Ltd, Osaka Japan) was adjusted to supply antiseptic solution (residual chloride 20 ppm, pH 5.7, flowing at 6 l/min) for 15 s. This apparatus readily produces hypochlorous acid when used and is supplied in water from a faucet after adjusting the dilution of the electrolytic product of 20% sodium chloride with a tap mixer. The FWE subjects disinfected their hands using this system, and then dried hands with sterile paper towels.

2. The conventional (alcohol lotion; WELPASTU; Maruishi Pharmaceutical Co., Osaka, Japan) method ($n$ = 40); the subjects washed their hands with tap water (6 l/min) using plain soap for 15 s. They then dried their hands with sterile paper towels. Following this, 3 ml alcohol lotion was applied to the hands. The hands were rubbed together according to the manufacturer's recommendation and then dried.

3. Tap water (water method; $n$ = 40): in addition, to rule out the possibility that the effect of FWE may be because of the physical removal effects of running water, the effects of tap water flowing at 6 l/min were also tested. The subjects washed their hands with tap water for 15 s and dried their hands with sterile paper towels.

The number of bacteria on the hands before and after hand-disinfection was evaluated by putting the entire palm surface of both hands on tryptic soy agar (Difco Co, Detroit, Michigan, USA). These plates were cultured at 37°C for 24 h, and the number of colonies growing on the plates was counted. The percentage of bacteria removed from both hands was calculated according to following equation: removal rate (%) = 100 x [1- (the

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number of bacteria after hand-washing/the number of bacteria before hand-washing)]. Values are calculated from raw data and expressed as mean ± SEM. Each value was analysed using Mann-Whitney (between two groups) or anlaysis of variance (ANOVA; among three groups) tests. Statistical significance was considered at $P < 0.05$.

The number of bacteria colonies present on ICU medical staff before hand washing was 118.1 ± 26.5 CFU in those using the FWE method, 94.9 ± 32.0 CFU in those using the alcohol method, and 126.1 ± 44.5 CFU in those using the water method. There were no significant variations in these values. The FWE method demonstrated an excellent antiseptic effect; the bacterial removal rate was 93.2 ± 2.0%, which is equivalent to that of the conventional, alcohol lotion showed significantly higher rates of bacterial removal than that of hand-washing with tap water (52.1 ± 11.3%; $P < 0.05$).

Nosocomial infections are a major sources of morbidity and mortality for patients in ICUs [1,7]. Important risk factors for such infections include life-threatening medical or surgical conditions, the immunocompromised state, alterations in flora due to exposure to multiple antibiotics, and the disruption of skin and mucus memberane due to the use of invasive devices. Most endemic infections were transmitted by the hands of medical personnel [1-5,7]. The Association for Professional in Infection Control and Epidemiology, Inc (APIC) has recommended that hand washing be performed after every contact with a patient to prevent nosocomial infection [8].

Several agents including alcohols, chlorhexidine, and iodine have been designed for hand-washing under clinical conditions and are available commercially. In this study, we made use of a newly developed apparatus which electrolyses saline and supplies antiseptic water ranging from neutral to acidic, whose major active constituents are hypochlorous acid (HOCI) and active oxygen [6], both of which have a strong bactericidal action. This antiseptic water is used immediately after electrolysis, so the bactericidal effect of the oxygen produced at the positive electrode probably contributes to its bactericidal effect. The disinfectant water produced by the system is reportedly effective even at low concentrations (eg 5 ppm) and eradicates methicillin-resistant *Staphlococcus aureus* IN 5 s *in vitro* [6]. Moreover the flow of water enhances the antiseptic effects of this system by washing away bacterial contamination and organic material, which would otherwise reduce the bactericidal effect. In general, the results obtained in this study demonstrated that this flow-water hand-washing method using electrolytic products of sodium chloride showed very effective antiseptic results in a clinical setting. The antiseptic effects of this solution were not significantly different to those of the more troublesome, conventional alcohol-based hand-disinfection regimen (two-stage use alcohol lotion after plain soap hand washing). Thus, this flow-water system has advantages in providing the combined effects of the physical removal of microbes and the antiseptic property of hypochlorous acid and active oxygen in a single cleansing process.

This flow-water hand-washing system using electrolytic products of sodium chloride might be an effective measure for the prevention of nosocomial infection. However, further clinical investigation concerning compliance and costs of the system would be required to finally conclude this.

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