

Chlorhexidine Versus Povidone Iodine in Bacterial Contamination Rate of Needles Used for Spinal Anesthesia

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Background: Skin antisepsis prior to the induction of spinal anesthesia is important because infectious complications may occur. Povidone-iodine and chlorhexidine have been widely used as antiseptic solutions for skin preparation; however, no study has been carried out to evaluate the efficacies of these antiseptic solutions for skin disinfection for spinal anesthesia. The aim of this study was to compare the efficacy of povidone-iodine and chlorhexidine by monitoring needle contamination rates during spinal anesthesia.

Methods: One hundred patients were randomly assigned to receive either 0.5% chlorhexidine in 70% isopropyl alcohol solution or 10% povidone-iodine aqueous solution for skin preparation. Patients' skin was disinfected three times in the lumbar area using the designated antiseptic solution and then allowed to dry for 3 minutes. After the induction of spinal anesthesia, the spinal needle and trocar were kept in a sterile culture bottle containing 45 ml of tryptic soy broth. The needles and trocars were then incubated under aerobic conditions for 48 hours at 37°C, and contaminated microbes were identified by routine microbiological methods.

Results: Five of the 51-povidone-iodine treated patient group showed positive culture growth, while no contamination was observed in 46 chlorhexidine treated patients. The microbial organisms found in the povidone-iodine group were *Staphylococcus aureus*, *Escherichia coli*, *Acinetobacter lwoffii*, *Acinetobacter baumannii*, and G (+) *Bacillus* species.

Conclusions: 5% chlorhexidine in 70% isopropyl alcohol solution showed more potent anti-microbial effect than 10% povidone-iodine aqueous solution in terms of reducing the bacterial contamination rate of spinal needles. (Korean J Anesthesiol 2004; 47: S 1~S 4)

Key Words: chlorhexidine, infection, povidone-iodine, spinal needle.

INTRODUCTION

Skin antisepsis prior to the induction of spinal anesthesia is essential because of the potential for infectious complications.¹⁾ Povidone-iodine is a widely used antiseptic solution for skin preparation before spinal anesthesia, and chlorhexidine alcohol solution is a commonly used alternative to povidone-iodine. Previous studies have shown that chlorhexidine is more effective than povidone-iodine for skin preparation before intravascular catheter insertion²⁻⁴⁾ or blood culture collection.⁵⁾ The

bacterial contamination rate of needles used for spinal anesthesia disinfected with povidone-iodine has also been previously studied;⁶⁾ however, no study has been carried out to evaluate the comparative anti-microbial efficacies of povidone-iodine and chlorhexidine for skin disinfection prior to spinal anesthesia. The aim of this prospective trial was to determine if an alcoholic solution of 0.5% chlorhexidine is more effective than an aqueous solution of 10% povidone-iodine at reducing the bacterial contamination rate of spinal needles.

MATERIALS AND METHODS

After obtaining Ethics Committee approval and patient informed consent, we included 100 patients classified as American Society of Anesthesiologists physical status 1 or 2 who had elective lower extremities, low abdominal, or urologic surgery. Exclusion criteria include patients with a history of

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Table 1. Demographic Data

	Povidone-iodine group	Chlorhexidine group
Age (years)	54.7 ± 15.9	58.2 ± 15.9
Sex (M/F)	24/27	21/25
Risk factor (diabetes)	9	6

Values are mean ± SD.

allergy to one of the antiseptic solutions, the presence of coagulation abnormalities, neutropenia, neurologic disease, local or generalized infection, and those receiving immunosuppressive therapy. Patients were randomly assigned to receive either 0.5% chlorhexidine in 70% isopropyl alcohol solution or 10% povidone-iodine aqueous solution for skin preparation (n = 47 in the chlorhexidine group, n = 53 in the povidone-iodine group). Results were obtained from 97 needles used for spinal anesthesia (46 in the chlorhexidine group and 51 in povidone-iodine group). The remaining 3 needles were not cultured because they were accidentally contaminated before the culture was initiated. The two patient groups were similar in terms of sex, age, and the risk factors for infection (Table 1). Spinal needle insertions were performed in the operating room by staff anesthesiologists or residents wearing operating room dress, surgical mask, hat, and gloves. Patients' skin was cleaned 3 times using the designated antiseptic solution in the lumbar area and allowed to dry for 3 minutes. After the antiseptic solution had dried, a sterile drape was applied and the skin was punctured with a 25 G Quincke beveled spinal needle (Insung Medical Corp., Seoul, Korea) for the intrathecal injection of 0.5% bupivacaine. Immediate after the induction of spinal anesthesia, the spinal needle and trocar were transferred to a sterile culture bottle containing 45 ml of tryptic soy broth (Hankuk Media Ltd., Seoul, Korea) and incubated under aerobic condition at 37°C for 48 hours. After 48 hr of incubation, positive microbial growth was identified, and the microorganisms were identified by routine microbiological techniques. The difference in the incidence of positive cultures from the spinal needles was evaluated using the unpaired Student's t-test and Fisher's exact test, and probability values of less than 0.05 were considered statistically significant.

Table 2. Number of Spinal Needles that Microorganisms were Isolated

	Povidone-iodine group	Chlorhexidine group
<i>S. aureus</i>	1	0
<i>A. lwoffii</i>	1	0
<i>A. baumannii</i>	1	0
<i>E. coli</i>	1	0
G (+) Bacillus species	1	0

RESULTS

Neither of the antiseptic solutions caused local or systemic hypersensitivity reactions in patients. Of the 97 needles subjected to microbiologic evaluation, 5 of the 51 povidone-iodine group yielded positive cultures, whereas none of 46 chlorhexidine group showed bacterial contamination. Statistical analysis showed that the proportion of contaminated needles was significantly higher in the povidone-iodine group (P value = 0.036). The organisms that grew in the povidone-iodine group were; *Staphylococcus aureus*, *Acinetobacter lwoffii*, *Acinetobacter baumannii*, *Escherichia coli*, and G (+) Bacillus species. No multiple bacterial species contamination was observed for any needle (Table 2), and no patient developed any infectious complication after spinal anesthesia.

DISCUSSION

Infections in the epidural space and in the central nervous system are serious complications of spinal anesthesia, although their incidences are rare.^{7,8)} Puncture of the skin during the induction of spinal anesthesia damages arguably the most important barrier in the human body against infection, and many studies have identified the skin surrounding the needle puncture site as the origin of colonizing microorganisms.^{9,10)} Thus adequate skin disinfection before spinal anesthesia is of great concern.

Povidone-iodine contains a synthetic polymer povidone (polyvinylpyrrolidone) and iodine,¹¹⁾ and is sold commercially as a 10% solution in water in Korea. On the other hand, chlorhexidine is a potent broad spectrum germicide, which is effective against nearly all nosocomial bacteria and yeasts.^{2,3,5)} Chlorhexidine also has low skin irritancy and sensitization

potential, and bacterial resistance to chlorhexidine is rare.^{10,12} A number of studies have compared the antimicrobial efficacies of chlorhexidine and povidone-iodine for skin disinfection. Sato and colleagues⁹ found that skin specimens that had been disinfected with 10% povidone-iodine were more likely to grow bacteria than specimens disinfected with 0.5% chlorhexidine. Kinirons and colleagues¹⁰ investigated epidural catheter tips and found that catheters inserted after preparing skin with 0.5% chlorhexidine were one sixth as likely to be colonized. Moreover, an *in vitro* investigation of the bactericidal activities of 10% povidone-iodine and 0.5% chlorhexidine in 80% ethanol showed that chlorhexidine is both more potent and more rapid in onset than povidone-iodine.¹³ The present study supports these previous findings concerning the greater antimicrobial effect of chlorhexidine, as spinal needles inserted after skin preparation with chlorhexidine were significantly less contaminated with bacteria than needles inserted after povidone-iodine preparation. There are several possibilities for the apparent superiority of chlorhexidine over povidone-iodine. First, the presence of organic substances on the skin reduces the bactericidal effect of povidone iodine¹⁴ but not of chlorhexidine.¹⁵ Second, chlorhexidine penetrates hair follicles and the stratum corneum better due to its alcohol content.⁹ Finally, povidone-iodine solution from previously opened bottles is less effective than solution from newly opened bottles.¹⁶ We used previously opened multiple-use-bottles of both bactericides because single-use bottles were not available.

The isolated organisms from the needle cultures were *S. aureus*, *Acinetobacter lwoffii*, *Acinetobacter baumannii*, *E. coli*, and *G (+) Bacillus* species, which are all common. *Acinetobacter* species were most frequently found in the present study. These species are widespread environmental gram-negative coccobacilli, and are associated with nosocomial infections and community acquired meningitis.¹⁷ No report is available on their association with meningitis after spinal or epidural anesthesia.

One potential disadvantage of this study is that the needles were incubated in tryptic soy broth for 48 hours, which allows only the qualitative identification of contaminating bacteria. This method is sensitive at detecting contaminating organisms by growth amplification, but it does not allow the quantitation of bacterial inoculums present at culture, as both low and high initial bacterial counts could result in the same positive broth culture results. Thus the results obtained may not represent initial needle contamination levels. However, determined needle

contamination rates are unlikely to be affected by culture conditions and identification procedures. In addition, although it was not possible to blind the anesthesiologist, who performed the needle insertions, to the antiseptic agents used, the microbiologist who processed all cultures and microorganism identifications was unaware of sample histories.

Though, we found that several needles were contaminated during spinal anesthesia, no contamination developed into a clinical infection. This may have been due to the integrity of patient immune systems, the antimicrobial properties of local anesthetics,¹⁸ and to the concomitant use of antibiotics. However, despite the lack of any infectious complication, our findings clearly demonstrate that chlorhexidine has the superior bactericidal effect during spinal anesthesia. Although, the complete eradication of indigenous bacteria is impossible by currently available skin disinfecting methods,⁴ thorough skin disinfection is key for reducing the risk of infection, and thus every effort should be made to minimize the potential of infection.

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