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EPIDURAL CATHETERS; PREVENTION OF COLONIZATION

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ABSTRACT... drshaukatrz@yahoo.com **Objectives:** 1) To determine if an alcoholic solution of 0.5% chlorhexidine is more effective than an aqueous solution of 10% povidone-iodine in reducing skin colonization associated with epidural catheter placement. 2) To determine the above two solutions is more effective in reducing epidural catheter tip bacterial colonization. **Design:** Randomized observational study. **Setting:** Department of Anaesthesiology in Combined Military Hospital, Rawalpindi. **Period:** April 2001 to September 2001. **Material and Methods:** One hundred adults who were planned to receive epidural analgesia using epidural catheter for postoperative pain relief were randomly divided into two groups, one to receive an aqueous solution of 10% povidone iodine and the other to receive chlorhexidine as cutaneous antiseptic before catheter insertion. The insertion sites were cultured qualitatively just before epidural catheter removal. After their removal, the catheter tips were quantitatively cultured. Catheters were classified as colonized when their tips yielded 1,000 or more colony forming units/ml in cultures. **Results:** A total of 100 patients were included in the trial, 96 were evaluable. Overall among 96 catheters 32 catheter insertion sites showed positive bacteriological cultures, 20 in povidone iodine group and 12 in chlorhexidine group (p value 0.03). Cultures of catheter tips in the chlorhexidine group were significantly less to yield microorganism on removal (five events) than were catheter tips in the povidone iodine group (15 events) p value 0.002. The bacterial species isolated from culture of catheter tips were coagulase negative staphylococci in 19 cases and Enterococcus faecalis in one case. Six, out of the 20 catheters tips were considered as colonized, catheter colonization occurred less frequently when chlorhexidine was used for skin preparation (1 events) than when povidone iodine was used (5 event) p value 0.001. **Conclusion:** An alcoholic solution of 0.5% chlorhexidine is more effective than an aqueous solution of 10% povidone-iodine in reducing skin colonization associated with epidural catheter placement, moreover it is also more effective in reducing epidural catheter tip bacterial colonization.

Key words: Chlorhexidine, Povidone-iodine, Epidural Catheter, Skin Colonization.

INTRODUCTION

The general characteristics and complications of epidural techniques have been well defined. The most important complication, which is though rarely seen but may lead to life threatening condition; meningitis or even death is an epidural abscess, this may occur with the use of temporary epidural catheters¹. The incidence of spinal epidural abscess lies probably in the area of 1:5000 catheterizations². Both Gram-positive and Gram-negative colonization can occur³. Initial symptoms include back pain, fever and leukocytosis⁴. The presence of infection can be confirmed by either computed tomographic scan, epidurogram, or sonogram⁵.

Intraspinal infections (meningitis, epidural abscess) may occur spontaneously or present as a complication of epidural analgesia⁶. In order to shorten the interval from symptoms to treatment, and to lower the incidence of neurological sequelae, the index of suspicion for this complication must be increased among anaesthesiologists, other physicians, and nurses taking care of patients with epidural catheters.

Most studies have shown that it is generally the skin flora, which is responsible for colonization of catheters kept in place for a short time, contamination occurring during the catheter placement⁷. In a case control study it has been shown that infections were commoner in the summer months and associated with analgesia infused by syringes rather than pumps⁸. Colonization risk increases after a threshold level of skin colonization occurs⁹; therefore if one wants to reduce the risk of colonization, it is mandatory to use effective antisepsis before catheter insertion. Epidural catheter colonization is defined as the growth of 1000 or more colony forming units/ml in cultures from catheter tips. It is fairly common and its incidence varies from 12-35%. The organism which are seen most commonly are coagulase-negative staphylococci, though enterococcus faecalis may be a chance finding.

The French society of anaesthesiologists recommends the use of either povidone iodine or chlorhexidine for skin preparation before epidural catheter placement. Although chlorhexidine has been found to be superior to povidone

iodine for skin preparation before intravascular catheter insertion or blood culture collection¹⁰, its value in preventing epidural catheter colonization remains unknown. The goal of this prospective trial therefore was to determine if an alcoholic solution of 0.5% chlorhexidine is more effective than an aqueous solution of 10% povidone iodine in reducing skin and catheter tip colonization associated with short term epidural catheter placement in adults.

MATERIALS AND METHODS

After approval from the Armed Forces Advisor in Anaesthesiology and the Commanding Officer of the hospital, this comparative study was conducted at the main operating theatre of Combined Military Hospital Rawalpindi, between April 2001 to September 2001. The patients were briefed about the study and their informed consent were also taken. The patients were more than 15 yrs of age, of either sex, receiving epidural catheters into either the lumbar or thoracic epidural space based on preferences of the anaesthesia team, clinical indication or both. Patients with history of allergy to one of the antiseptic solutions, presence of a clotting defect or neuropathies, patients with neurological disease, local or generalized infections, or those receiving immunosuppressive therapy were excluded from the study.

A total of 100 patients were selected for the study, they were randomized to receive either 0.5% chlorhexidine gluconate or 10% povidone iodine for cutaneous antisepsis before epidural catheter insertion using computerized randomization lists. (Group A). The skin of this group was prepared by 0.5% alcohol solution of Chlorhexidine. (Group B) 10% aqueous solution of povidone iodine was used as antiseptic to prepare the skin before inserting epidural catheter.

Pre-operative assessment of every patient was done on preceding evening of surgery. They were reassured and an informed consent was taken. They were thoroughly examined and investigated accordingly.

After thorough surgical scrubbing and using full aseptic protocol, fellow or resident anaesthesiologists cleaned

the epidural catheterization site twice (before and after the placement of sterile, disposable drapes) by vigorously applying the designed antiseptic solution on an area more than 300 cm² for at least 30 seconds and allowing the area to dry between each application.

Epidural space was identified using the loss of resistance technique, with either saline solution or air with the help of Touhy needle. A 22-gauge polyamide epidural catheter was advanced 3-4 cm into the epidural space to ensure secure placement without subcutaneous tunneling. All catheters were fixed in place with a sterile occlusive dressing. The proximal portion of the catheter was directed cephalad and fixed on the back using tape.

Continuous infusions of 0.1% bupivacaine was administered through the catheters using an antimicrobial filter. The anaesthetic solutions were changed at least every 24 hours and the connections were manipulated with 70% isopropyl alcohol. Topical antibiotic or antiseptic ointments were not used on any catheter. The dressings were not changed until the catheter was removed to avoid catheter migration out of epidural space.

The insertion site and dressing were inspected daily by the nursing staff and patient's physician who were blind to antiseptic solution used, to search for the signs of infection (pus), inflammation (erythema heat, tenderness), or cutaneous allergic events to the disinfectant (edema, erythema). The decision to remove the catheter was made solely by the patient's physician, who kept the catheter in place until it was no longer required or until an adverse event like catheter infection or catheter migration out of the epidural space necessitated its removal. Infection was suspected in a patient who became febrile without any other cause.

After removal of the occlusive dressing dry swabs were taken at the site surrounding catheter insertion and at the catheter hub to help identify the source of microorganisms that may colonize catheters. The skin was cleaned using 70% isopropyl, alcohol. It was allowed to dry and catheter was removed aseptically, the tip (3-4 cms distal segment) was cut and cultured quantitatively

by a method described for vascular catheters. The laboratory technicians were unaware of the antiseptic solution used for skin preparation. Standard microbiologic methods and criteria identified recovered microorganisms.

The results were analyzed using Statistical Package for Social Sciences (SPSS vs 8.0). Using the student's t-test and the chi-square test. A p value <0.05 was considered statistically significant. The data design (Ordinal/Nominal) in the study is presented in tabular form.

RESULTS

A total of 100 patients requiring an epidural catheter were enrolled in the trial and randomly assigned 50 in the povidone iodine group and 50 in the chlorhexidine group.

Complete data could be evaluated for 96 catheters 46 in the povidone iodine group and 50 in the chlorhexidine group. The remaining four catheters sited after povidone iodine skin preparation were not cultured (three were not inserted as a result of failure to catheterize the epidural space and one migrated outside the skin and was grossly contaminated before catheter culture). The two groups of catheters were similar with respect to characteristics of patients and catheters, the duration of surgery was not significantly higher in the chlorhexidine group (table I). Neither local nor systemic hypersensitivity reactions were observed with the use of either antiseptic solution.

Twenty cultures of catheter tips yielded microorganisms (table II). The bacterial species isolated were coagulase negative staphylococci (mainly methicillin resistant) in 19 cases and *Enterococcus faecalis* in one case. Cultures of catheter tips in the chlorhexidine group were significantly less to yield microorganism on removal (five events [4.3 per 100 catheter days]) than were catheter tips in the povidone iodine group (15 events [16.7 per 100 catheter days]); relative risk, 0.2 [95% confidence interval, 0.1-0.7]; P = 0.002.

Six of the 20 catheters tips yielding microorganisms in culture yielded more than 1,000 colony-forming units/ml, and the corresponding catheters were considered as colonized (table II), catheter colonization occurred less

frequently and less quickly when chlorhexidine was used for skin preparation (1 event) than when povidone iodine was used (5 events) p value 0.001. Methicillin-resistant coagulase-negative staphylococci were the only

colonizing microorganisms recovered. In no patient did an epidural abscess, meningitis, or any serious local or systemic infection developed.

Table I Characteristics of the patients and epidural catheter

	POVIDONE IODINE GP	CHLORHEXIDINE GP	p VALUE
No of Patients (n)	46	50	
Age(years)	46 (15-55)	46 (15-58)	0.54
Male Sex n (%)	21 (45.6)	30 (60)	0.11
Weight (Kg)	68 (40-100)	72 (42-100)	0.79
ASA Status n (%)			
I	10 (22)	18 (36)	0.71
II	34 (74)	27 (54)	0.58
III	2 (4.3)	5 (10)	0.69
Duration of Surgery (min)	180 (80-550)	240 (90-840)	0.12
Duration of Catheter Placement (hrs)	50 (21-74)	50 (24-100)	0.59
Antibiotic Prophylaxis	42 (91)	50 (100)	0.26
Penicillins	25 (54)	26 (52)	0.29
Cephalosporins	7 (15)	9 (18)	0.57
Aminoglycocides	10 (22)	15 (30)	0.58
Reason for Catheter Removal n (%)			
Catheter Displaced	3 (6.5)	2 (4)	0.53
Catheter No Longer Needed	43 (94)	48 (96)	0.54

Table II Positive Bacteriological Culture

	POVIDONE IODINE GP n (%)	CHLORHEXIDINE GP n (%)	p Value
Catheter Tip	15 (33)	5 (10)	0.002
Catheter Tip Colonization \geq 1,000 cfu/m	5 (11)	1 (2)	0.001
Insertion Site	20 (44)	12 (24)	0.03

Cfu = Colony Forming Units

Cultures of the sites surrounding catheter insertion in the chlorhexidine group were less likely to yield microorganisms at catheter removal than were insertion sites in the povidone iodine group (table II). The skin

surrounding the catheter insertion site was the origin of all colonizing microorganism.

DISCUSSION

The use of epidural catheters to infuse analgesic agents for pain relief is becoming an increasingly popular method. However, catheters kept in place for a short time are generally colonized by skin flora on the insertion site, mostly during catheter placement. Colonization risk increases after a threshold level of skin colonization occurs. Epidural abscess is a recognized complication of the use of such catheters. Although rare, epidural abscess can rapidly progress to meningitis, paralysis or death^{11,12,13}.

Chlorhexidine and povidone-iodine is frequently used in various fields of medicine and surgery, especially in oral surgery. Shiraishi et al¹⁴ conducted a study to compare the bactericidal activity of a povidone-iodine gargle with those of other commercially available preparations. Povidone-iodine gargles showed the highest bactericidal rate and highest reduction in oral bacterial count. Similarly Facchinetti et al¹⁵ investigated the efficacy of intrapartum vaginal flushings with chlorhexidine compared with ampicillin in preventing group B streptococcus transmission to the neonates. They concluded that the rate of neonatal *E. coli* colonization was reduced by chlorhexidine.

Kramer et al¹⁶ studied new aspects of tolerance of povidone iodine in different ex vivo models after application to the eye. They showed that povidone-iodine is more effective than silver nitrate or erythromycin, meaning a possible alternative for prevention of ophthalmia neonatorum. Povidone-iodine is more active against methicillin-resistant *Staphylococcus aureus* in a human ex vivo model.

Bloodstream infections related to use of catheters, particularly central line catheters, are an important cause of patient morbidity, mortality, and increased health care costs. Chaiakunapruk et al¹⁷ evaluated the efficacy of skin disinfection with chlorhexidine gluconate compared with povidone-iodine solution in preventing catheter related bloodstream infections. Their results suggested that incidence of blood stream infections is significantly reduced in patients with central vascular lines who receive chlorhexidine gluconate versus povidone iodine

for insertion site skin disinfection. Use of chlorhexidine gluconate is a simple and effective means of reducing vascular catheter related infections.

Although the precise mechanism of epidural space infection associated with epidural block has yet to be defined, several possible mechanisms have been proposed. Contamination of drug or material may be a factor. Raedler et al¹⁸ assessed bacterial contamination of 114 spinal and 20 epidural needles after subarachnoid or epidural block performed under strict aseptic guidelines. Bacterial contamination occurred in 18% of the needles, suggesting that even when following strict aseptic guidelines, needle contamination by skin pathogens is common. Similarly, skin flora introduced either at the time of puncture or as a result of bacterial migration along a catheter or needle tract has been implicated as a potential source of epidural abscess. Sato et al⁸ assessed 69 paired skin specimens that had been excised from the incisional site (laminectomies) after disinfection with 10% povidone iodine or an alcoholic solution of 0.5% chlorhexidine. They found viable microorganisms in 13 biopsies, mainly in the povidone iodine group. They explained the superior performance of chlorhexidine by its more potent bactericidal activity and its high permeability into hair follicles.

Finally, catheter colonization can arise from clinician and nurses handling of syringes and solutions, via the catheter hub. Shapiro et al¹⁹ demonstrated that use of a chlorhexidine dressing reduced microbial colonization of epidural catheters. The chlorhexidine group was one seventh as likely to be colonized as those in the control group.

Our study supports these findings. Catheters inserted after skin preparation with chlorhexidine were one sixth as likely and less quickly colonized as catheters inserted after skin preparation with povidone iodine. Our results are in accordance with those from the previously quoted study of Sato et al, indicating that fewer viable microorganisms were cultured from skin biopsies after cutaneous disinfection with chlorhexidine. Chlorhexidine gluconate is a potent broadspectrum germicide, which is

effective against nearly all nosocomial bacteria and yeasts.¹⁰ In addition, chlorhexidine has a low skin irritancy and sensitization potential. It has a strong affinity for skin and demonstrates a prolonged duration of antimicrobial effect. In contrast to iodine-containing compounds, chlorhexidine is not neutralized by contact with proteinous solutions. Iodine-containing compounds lack persistence and may induce allergic reactions in sensitive individuals. Finally, bacterial resistance to chlorhexidine is rare.

Coagulase-negative staphylococci were the only colonizing microorganisms recovered in our study. This concurred with previous studies indicating that coagulase negative staphylococci, the predominant species on the human skin, are the most common agents of cannula-related infections²⁰. The superiority of chlorhexidine over povidone iodine in preventing catheter colonization and catheter-related sepsis as a result of gram-positive bacteria has been mentioned in various studies²¹. And was reported to be the result of a more prolonged activity of chlorhexidine against staphylococci. This superiority may explain the lower epidural catheter colonization rate that we observed after chlorhexidine disinfection.

CONCLUSION

The use of chlorhexidine solution rather than povidone iodine may be a better choice for cutaneous antisepsis before short-term epidural catheter placement in adults. Whether this antiseptic agent reduces colonization for longer lumbar catheterization or of caudal catheters requires further investigation.

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