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Effects of two different solutions used in pin site care on the development of infection

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Objective: The aim of this study was to compare the effects of two different solutions used for pin site care in patients with external fixators on the incidence of pin site infection.

Methods: The study included 133 pins of 18 patients. The patient identification form, pin site care application form and the pin tract infection assessment form developed by Checketts et al. were used as data collection tools. On the condition that it would be evenly applied on the number of pins available in a patient, a 10% povidone-iodine solution was used in the care of 68 pin sites and 2 mg/ml chlorhexidine was applied at 65 pin sites. Infections developing in the pin sites were graded and recorded. Pin site care was applied routinely on a daily basis until the patient was discharged.

Results: Infection was observed in 19 (27.9%) of the 68 pins of patients in the povidone-iodine group. Infection developed in only 6 (9.2%) of 65 pins in the chlorhexidine group.

Conclusion: Use of 2 mg/ml chlorhexidine in pin site care appears to decrease the prevalence of pin tract infection.

Key words: Care; external fixators; fracture; pin tract infection; solution.

External fixation involves fixation to the broken bone with pins made out of aluminum, metal, titanium or nylon.[1-5] In addition to fracture treatment, external fixation is also applied in extremity lengthening, deformity correction and the treatment of tumors and osteomyelitis.[2-9]

Objectives of external fixation include reducing mortality, allowing for early rehabilitation and minimizing complications.[10,11] The most important complication encountered with pins applied to the skeleton is pin site infection. The National Association of Orthopaedic Nurses (NAON) has emphasized that nurses bear tremendous responsibility for the prevention of bacterial entry into the pin site and as a result, the development of infection. Some studies have reported pin sites infection rates to be as high as 86.5%.[6-8,12] Therefore, pin site care is vital for the prevention of infections caused by microorganisms such as *Staphylococcus* resistant to antibiotics.[12]

Historically many solutions have been used for pin site care including water, saline, hydrogen peroxide, povidone-iodine, alcohol and alcoholic solution of chlorhexi-

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dine. In order to look at the effectiveness of the different solutions, each one needs to be considered individually.[1-3] No study is currently available in our country highlighting the responsibilities of nurses in pin site care. However, review papers have been published specifying the characteristics of care. NAON and the Royal College of Nursing, Society of Orthopaedic and Trauma Nursing in the UK have called for the increase in the number of studies regarding solutions used in the pin site care and frequency of the care.[2,12-14]

The aim of this study was to compare the effects of two different solutions used for pin site care in patients with external fixators on the incidence of pin site infection.

Patients and methods

Written permission was obtained from the Institutional Review Board of Ege University School of Nursing and from the Hospital Management to conduct the research. Patients were informed about objective of the study and its applications and verbal and written consent of the patients was received.

The study included 133 pins of 18 patients (age range: 18 to 65 years) treated with external fixators due to bone fractures between 15th January 2009 and 15th January 2010. Patients with no chronic disease, psychological or mental problems and who were non-smokers, not obese and did not develop infection during hospitalization were included in the study.

Sociodemographic characteristics, health status and properties related to the external fixator pin site of all patients were recorded in the patient identification form. In all patients, Orthofix fixators were used. On the condition that it would be evenly applied on the number of pins available in a patient, a 10% povidone-iodine solution was used in the care of 68 pin sites and 2 mg/ml chlorhexidine was applied at 65 pin sites through sterile applicators. Scabs were cleared off the external fixator pin site through the sterile applicator. After pin site care was carried out, the site was dried with a dry sterile applicator. Infections developing in the pin site were graded and recorded in the infection assessment form.

Antiseptic-impregnated (povidone-iodine) gauze tampons placed around the external fixator pin site at the end of operation were removed 48 to 72 hours after the operation and the external fixator pin site was observed for bleeding, discharge, drainage, and infection indications. As proposed in the literature, pin site care was begun 48 to 72 hours after the operation and continued on a daily basis until the patient was discharged.[12,14]

As a routine practice, a postoperative single-dose of cephalosporin in elective cases and cephalosporin, gentamicin and clindamycin in the triple treatment of open fracture cases were used for two weeks.

The patient identification form, pin site care application form and pin site infection assessment form developed by Checketts et al. were used in the collection of data.[13]

SPSS 15.0 (SPSS Inc., Chicago, IL, USA) software was used for statistical analyses. The Fisher's exact chi-square test was applied to examine the homogeneity of the experiment and control groups and patients' external fixator pin site complications. P values of less than 0.05 were considered significant.

Results

Mean age of patients in the povidone-iodine group was 35.44±12.99. 44.4% of these patients were 18-27 years of age, 55.6% were male, 77.8% were graduates of primary school, 33.3% were housewives and 66.7% had normal weight. In the chlorhexidine group mean age was 37.66±15.81. 44.4% of these patients were 18-27 and another 44.4% 48-57 years of age, 77.8% were female, 77.8% were primary school graduates, 66.7% were self-employed and 55.6% had normal weight. There were no statistically significant differences between groups in terms of age group, gender, education status, profession and body mass index ($p>0.05$) (Table 1).

66.7% of all patients were treated with external fixators due to closed fractures, with 44.4% inserted in the tibia. Schanz pins were used in 55.6% of patients in the povidone-iodine group and in 66.7% in the chlorhexidine group. The mean number of pins used was 7.22±2.43 (range: 4 to 11). Mean length of hospital stay o 7.55±1.66 (range: 5 to 10) days. No statistically significant difference was found between two groups in terms of fracture type, location of the external fixator, pin type, pin number and length of hospital stay ($p>0.05$) (Table 2).

Povidone-iodine solution was applied to 68 (50.7%) pins and chlorhexidine solution to 65 (48.5%). Pin site infection developed in 19 (27.9%) of the 68 pins treated with povidone-iodine solution. However, only 6 (9.2%) of the 65 pins of patients in the chlorhexidine group developed pin site infection. In the povidone-iodine group, 17 (89.4%) of the 19 infected pin site were located in the tibia. Of the 6 infections in the chlorhexidine group, 3 (50%) were in the tibia and 3 (50%) in the femur. There were no statistically significant differences between groups in terms of number of pins treated with care

Table 1. Sociodemographics of patients.

		Povidone-iodine group		Chlorhexidine group	
		n	%	n	%
Age group					
18–27		4	44.4	4	44.4
28–37		1	11.1		
38–47		1	11.1	1	11.1
48–65		3	33.3	4	44.4
	X^2=1.143	**p=0.767**		**p>0.05**	
Gender					
Female		5	55.6	7	77.8
Male		4	44.4	2	22.2
	Fisher's exact chi-square test	**p=0.335**		**p>0.05**	
Level of education					
Primary school		7	77.8	7	77.8
High school		2	22.2	1	11.1
University		–	–	1	11.1
	X^2=1.333	**p=0.513**		**p>0.05**	
Profession					
Housewife		3	33.3	1	11.1
Retired		2	22.2	1	11.1
Worker		2	22.2	1	11.1
Self-employed		2	22.2	6	66.7
	X^2=3.667	**p=0.300**		**p>0.05**	
Body mass index					
Normal weighted (18.5-24.9 kg)		6	66.7	5	55.6
Slightly overweight (25-29.9 kg)		3	33.3	4	44.4
	Fisher's exact chi-square test	**p=1.000**		**p>0.05**	
Total		9	100.0	9	100.0

solutions, infection development status, number of infected pins and location of infection (p>0.05) (Table 3).

While there were 13 (68.4%) first degree and 6 (31.5%) second degree infections in the povidone-iodine, all 6 infected pin sites in the chlorhexidine group were first degree infections.

Discussion

There was no statistically significant difference between patients of two groups in terms of age group, gender, education status, profession or body mass index (p>0.05) (Table 1).

In both groups, 66.7% of patients had closed fractures. In a study including 18 patients with external fixators, Grant et al. reported 87.5% with closed fractures and 12.5% open fractures, in line with our results.[15]

In the literature, pin site infection prevalence is higher in open fractures.[16,17] However, in the present study, 2 of 4 pin site infections in the povidone-iodine group developed in open fractures. Likewise, one of the two patients who developed pin site infections in the chlorhexidine group had open fracture.

Of the 68 pins in the povidone-iodine group, 9 were inserted in the wrist, 42 in the tibia and 17 in the femur. In the 65 pins in the chlorhexidine group, 5, 9, 36 and 15 pins were inserted in the humerus, wrist, tibia and femur, respectively. Grant et al. compared povidone-iodine solution and white soft paraffin ointment in 116 pin sites of 18 patients and reported that 86 pins were inserted in the femur and tibia, 24 pins in the wrist and 6 around the pelvis.[15] In our study, the mean number of pins in both groups was 7.22±2.43 (Table 2). A correlation was not established between pin number and incidence of pin site infection (p>0.05). In line with our findings, Grant et al. had a mean pin number of 6.5 and were unable to find a correlation between pin number and pin site infection.[15]

Daily pin site care was provided to both groups during their hospital stay (mean hospital stay: 7.55±1.66 days). Pin site care should be given on a daily basis for

Table 2. Factors related to the external fixator.

		Povidone-iodine group		Chlorhexidine group	
		n	%	n	%
Fracture type					
Open fracture		3	33.3	3	33.3
Closed fracture		6	66.7	6	66.7
	Fisher's exact chi-square test	**p=1.000**		**p>0.05**	
Location of the external fixator					
Wrist		2	22.2	2	22.2
Humerus		–	–	1	11.1
Tibia		4	44.4	4	44.4
Femur		3	33.3	2	22.2
	X^2=1.200	**p=0.753**		**p>0.05**	
Pin type of the external fixator					
Schanz pin		5	55.6	6	66.7
Kirschner wire		4	44.4	3	33.3
	Fisher's exact chi-square test	**p=1.000**		**p>0.05**	
Number of pins in the external fixator					
4-7 pins		5	55.6	5	55.6
8-11 pins		4	44.4	4	44.4
	Fisher's exact chi-square test	**p=1.000**		**p>0.05**	
Length of hospital stay					
6-8 days		7	77.8	6	66.7
9-11 days		2	22.2	3	33.3
	Fisher's exact chi-square test	**p=1.000**		**p>0.05**	
Total		9	100.0	9	100.0

Table 3. Data regarding the development of pin-based infection in patients.

		Povidone-iodine group		Chlorhexidine group	
		n	%	n	%
Number of pins cleaned with the specified solution		68	50.7	65	48.5
	X^2=4.000	**p=0.780**		**p>0.05**	
Number of pins that develop pin tract infection		19	27.9	6	9.2
	X^2=6.000	**p=0.199**		**p>0.05**	
Location of pin tract infection					
Wrist		2	10.6	–	–
Tibia		17	89.4	3	50.0
Femur		–	–	3	50.0
	X^2=2.625	**p=0.269**		**p>0.05**	

48 to 72 hours after surgery.[12,14] In the current study, daily pin site care was begun on the 2nd postoperative day. In a study by W-Dahl et al. of 50 patients comparing daily and weekly external fixator pin site care, 2nd degree pin site infection rates were 4% in the 27 patients who received daily pin site and 3% in the 23 patients who received weekly pin site care.[18] Other studies supporting our findings indicate that pin site care should be provided daily.[6,7,9,14,19-21]

Four patients (44.4%) in the povidone-iodine group and 2 (22.2%) in the chlorhexidine group developed infection (Table 3).

Pin site infection is considered the most common complication of external fixation. Infection is usually associated with surgical technique when appearing immediately following operation or with postoperative patient care when it develops as a late complication. Prevalence of pin tract infection was determined as 24.1% by Grant

et al.,[15] 28.4% by Oçgüder et al.,[22] 37.5% by Altay et al.,[11] 8.3% by Yılmaz,[23] 26% by W-Dahl and Toksvig-Larsen,[24] 40% by Ozdemir et al.,[25] 21% by Arazi et al.,[26] 11.3% by Kesemenli et al.,[27] 20% by Arazi and Kutlu,[28] and 10.9% by Hay et al.[29] In the current study, 17 (89.5%) of 19 infected pins in the povidone-iodine group and 3 (50%) of the 6 infected pins in the chlorhexidine group were located in the tibia. In a study carried out with 116 pin sites of 18 patients, Grant et al. reported pin site infections in 28 pins (24.1%), 22 of which developed in the tibia and 6 in the pelvis.[15] Sims and Saleh reported infection rates of 87% in pins located at the femur, 82% in pins located around the knee and in 70% located at the tibia.[9] Henry found higher infection incidence rates in the pins around the pelvis than in other locations.[30] Our results are consistent with the literature. However, a significant relationship was not established between the location of the external fixator and the development of pin site infection ($p>0.05$).

Pin site infection was observed in 19 (27.9%) of 68 pins in the povidone-iodine group and 6 (9.2%) of 65 pins in the chlorhexidine group. There was no significant difference between groups in terms of infection prevalence rate ($p>0.05$). In a study comparing three different practices, Henry determined prevalence rates of pin site infection as 7.5% in the group in which no solution was applied, 25% in the group treated with 0.9% sodium chloride and 17.5% in the group treated with 70% alcohol.[30]

Grant et al. compared the use of povidone-iodine and white soft paraffin in the pin site care of 116 pin sites of 18 patients. Povidone-iodine solution was applied to 72 pin sites (62.1%) and white soft paraffin to 44 pin sites (37.9%) and infection developed in 13 (18.1%) and 15 (34.1%) pin sites, respectively.[15]

Sims and Saleh performed the care of 279 pin sites using saline solution or warm boiling water and reported infection rates of 71%, mainly 2nd degree infections.[9]

In comparing 2 mg/ml chlorhexidine and normal saline solution, W-Dahl and Toksvig-Larsen reported infection rates of 0.5% in the chlorhexidine group and 3% in the group treated with saline solution.[24]

Pin site infection rates were three times higher in the povidone-iodine group (27.9%) than the chlorhexidine group (9.2%) in the present study. First degree infections developed in 13 (68.4%) of 19 infected pins in the povidone-iodine group and 6 (31.5%) developed 2nd degree infections. In the chlorhexidine group, all 6 infected pins developed 1st degree pin site infections.

W-Dahl and Toksvig-Larsen[24] reported 2nd degree infections in the chlorhexidine group. In the present study, infections in the chlorhexidine group were 1st degree. Therefore, it can be concluded that our results are not consistent with the findings of W-Dahl and Toksvig-Larsen.

In conclusion, while a statistically significant difference was not determined, only 6 (9.2%) of 65 pins of patients in the chlorhexidine group developed infection compared to 19 (27.9%) of 68 pins in the povidone-iodine group. The use of 2 mg/ml chlorhexidine in the care of pin site appears to reduce the prevalence of pin site infection.

Conflicts of Interest: No conflicts declared.

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