The care of pin sites with external fixation

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Two protocols for the operative technique and care of the pin-site with external fixation were compared prospectively. There was a total of 120 patients with 46 in group A and 74 in group B. Infection was defined as an episode of pain or inflammation at a pin site, accompanied by a discharge which was either positive on bacterial culture or responded to a course of antibiotics.

Patients in group B had a lower proportion of infected pin sites ($p = 0.003$) and the time to the first episode of infection was longer ($p < 0.001$). The risk of pin-site infection is lower if attention is paid to avoiding thermal injury and local formation of haematoma during surgery and if after-care includes the use of an alcoholic antiseptic and occlusive pressure dressings.

Infection at the pin-sites is commonly encountered with external fixation. Healing is prevented by the presence of the pin. It is necessary to maintain an environment which lessens the risk of infection. To this end, various protocols of care have been introduced but there is no conclusive information to support the use of any one method. We carried out a prospective study on two groups of patients who underwent different protocols for pin insertion and after-care.

Patients and Methods

In this prospective study, 120 patients had external fixation for either fracture or reconstruction of a limb. The first group of 46 patients had care of the pin-site according to local custom (group A) and the second group of 74 were managed by the technique used by the Russian Ilizarov Scientific Centre for Restorative Traumatology and Orthopaedics (group B) (Table I). The information recorded included the location and type of pin (tensioned wire or half-pin), the state of the site and the time of infection in relation to insertion of the pin. The last was diagnosed if the site was painful or inflamed and discharging, with either a positive culture or response to antibiotics even in the absence of positive cultures. Grading of the infected site was avoided since there is no valid classification system for this.

Deep sepsis was diagnosed if the infection of the pin site was not fully responsive to an

appropriate oral antibiotic and required either removal of the pin or intravenous therapy.

Results

There were no significant differences between the groups with regard to age, gender, nutritional status or reason for external fixation. Of the 46 patients in group A, 41 had pin-site infections compared with 48 of the 74 patients in group B. This was statistically significant (chi-squared test, $p = 0.003$), rejecting the null hypothesis that there was no difference in the numbers of patients with pin-site infections in the two groups (Table II). The difference in the proportions of patients was 0.24 with a 95% confidence interval between 0.10 and 0.38. The relative risk of a single infection was 37% greater in group A (relative risk 1.37, odds ratio 4.44).

Survival analysis of the time to pin-site infection showed a total of 89 failures with a time at risk of 1930 days in group A and 6540 days in group B. The survival time showed that there was a 50% chance of an infected pin site after 24 days in group A but only after 92 days in group B (Table III, Fig. 1). The log-rank test for equality of survivor functions was statistically highly significant ($p < 0.001$).

There were six cases (13%) of deep infections in group A and one (1.4%) in group B ($p < 0.05$ with Yates's correction).

Discussion

Techniques of survival analysis are appropriate for the study of pin-site infections. Patients can

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Table I. Comparison of protocols for groups A and B

Group A	Group B
Normal handling of wires/pins	Non-touch handling of wires/pins
Continuous drilling with irrigation	Pulsed drilling (stop-start) with irrigation
Bone swarf removal	Bone swarf removal
Dry dressings used for the pin-site at the completion of the operation	Immediate pin-site dressings in alcoholic solution of chlorhexidine (Hydrex; Adams Healthcare, Leeds, UK) with pressure to reduce haematoma; changed at completion of the operation if bloodstained
	Pin sites cleaned daily for three days to ensure blood removal; pin cleaning using a solution of 70% alcohol and dressings moistened with Hydrex
	Occlusive pressure dressing after the third day; pin cleaning and dressing changes repeated every seven to ten days using the same technique
Original theatre dressings left undisturbed for 48 hours	
Daily cleaning thereafter with normal saline, crust removal and simple non-adherent dressings only in the presence of exudates, otherwise left uncovered	

Table II. Comparison of proportions of patients with pin-site infection (numbers in parentheses refer to proportions)

Presence of infection	Group A	Group B
No	5 (0.109)	26 (0.351)
Yes	41 (0.891)	48 (0.649)
Total	46	74

Table III. Survival analysis of pin-site infection by protocol

Group	Time at risk (days)	Incidence rate	Number of subjects	Survival time (days)		
				25%	50%	75%
A	1930	0.0212	46	17	24	65
B	6540	0.00734	74	51	92	151
Total	8470	0.0105	120	24	63	135

Fig. 1

Kaplan-Meier survival estimates comparing protocols.

complete the period of fixation without infection, the risk of a pin-site infection increases with time and information would be missed if the data only described an overall incidence of infection. If the same pin sites became re-infected soon after a successful course of antibiotics the infection could be counted as one incompletely treated episode or as two separate infections. This problem is avoided if the first infected pin site for the entire period of treatment is the outcome of interest.

Pin-site infections usually begin as a cellulitis. Most are due to *Staphylococcus aureus* and respond readily to oral antibiotics. Occasionally, the infection involves deeper tissues and bone and may persist despite the use of appropriate antibiotics. The stability of the fixation is thereby impaired. Deep infections may also persist after removal of the wire or pin if there is a ring sequestrum.

Although superficial infections are more common than deep sepsis they cause pain and interfere with rehabilitation. Protocols for the care of pin-sites are often derived from the preference of the surgeon or nurse, habit, consensus or inappropriate conclusions from the basic principles of wound care. However, where complete healing is not the objective, standard techniques of wound care may be inappropriate.

Previous studies describe rates of infection¹⁻⁴ which vary if expressed as a percentage of the number of pin sites or of

the number of patients. A transfixing wire has two pin sites and therefore tensioned wires have twice as many such sites as half pins. If the number of infected sites is used as the outcome measure, studies using tensioned wires would have only half the infection rate of those using half-pin devices, even if the number of infected sites was equal for both types. Conversely, if pin-site infection is expressed as a fraction of the number of patients, a single infected pin site in every patient would be reported as an incidence of infection of 100%, even if all other remaining pin sites on each patient remained free from infection. Clearly both methods do not address some of the inherent difficulties in reporting this type of problem.

A review of the literature on pin-site care confirms that opinions differ on the most appropriate management.^{2,5,6} There is little scientific evidence to support one technique over another with some even justifying a nihilistic approach.⁷ Protocol A was derived from the published practice of major users of external fixators^{1,2} and adopted in this unit by consensus. It leaves the pin sites free from crusts and avoids antiseptic lotions and large occlusive dressings. The Russian protocol uses a strong antiseptic solution which imparts a drying effect to the skin and bulky pressure dressings to restrict movement between the skin and pin (Fig. 2). Pin sites nearer joints are particularly prone to sepsis since they are subject to greater move-

Fig. 2a

Fig. 2b

Fig. 2c

Fig. 2d

Fig. 2e

Photographs of the technique of pin-site care (adapted from the Russian Ilizarov Scientific Centre for Restorative Traumatology and Orthopaedics) showing a) exposed pin sites before cleaning; b) pin sites cleaned with alcoholic solution of chlorhexidine; c) dressing gauze moistened with alcoholic solution of chlorhexidine, held in place with rubber stops; d) occlusive bandaging and e) the completed dressing.

ment.^{8,9} The contributory effect on the development of infection of the accumulation of fluid at the interface of the pin has also been described.¹⁰

In group B prolonged skin contact with a strong antiseptic solution produced hypersensitivity reactions in 13 patients (17.6%). These were treated successfully with a cream of betamethasone 0.1% and fusidic acid 2% (Fucibet; Leo Pharma, Dublin, Ireland). The substitution of alcoholic chlorhexidine with normal saline in these patients resolved the local hypersensitivity but was followed by the development of pin-site infection in 12 patients. These were included among the failures of protocol B.

It should be emphasised that any strategy for reducing infections begins in the operating theatre. Protocols A and B differed in the management of the placement of pins in theatre and the outcomes are a reflection of the operating technique and the after-care. Stop-start drilling with cooling reduces thermal damage and lessens the risk of ring sequestra. Immediate use of pressure dressings and removal of any visible blood from the skin, especially around the pin site, also lessens the proliferation of bacteria within a haematoma.

In this study, our definition of an infected pin site was associated with a situation in which intervention was nor-

mally required. The time from application of the fixator to the occurrence of the first episode of infection was recorded because the possibility of infection increases with time.^{3,11}

While our data represent strong evidence that protocols for handling pins or wires have an impact on infection, randomised, control trials are needed for firmer guidance. Survival analysis or time-series analysis need to be included in such trials.

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