Prevalence of Pin-Site Infection: The Comparison between Silver Sulfadiazine and Dry Dressing among Open Tibial Fracture Patients

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Objective: *Pin-site infection is one of the most troublesome complications of external fixation. The present study aimed to compare the rate of pin-site infection following silver sulfadiazine with dry dressing.*
Material and Method: *This was a prospective randomized controlled study among 30 clients that compared the outcome of pin dressing using silver sulfadiazine (study group = 15) with dry dressing (control = 15). All eligible subjects of open tibial fracture had an emergency debridement with external fixation. Pin tract infection was considered to be present if superficial inflammation (erythema, cellulitis), serous or purulent discharge occurred around a pin site and deep infection of osteolysis around the pin, and sequestrum.*
Results: *Seven subjects (46.7%) had pin-site infection in the present study group while six subjects (40.0%) had it in the control group, with comparable severity.*
Conclusion: *There was no significant difference in prevalence of pin-site infection between both groups (p = 0.97). Therefore, either silver sulfadiazine or dry dressing could be advocated.*

Keywords: *Pin-site infection, Silver sulfadiazine, Open tibial fracture*

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External fixation is a standard choice of fixation for open fracture. The main advantages include low risk of implant-associated infection and ease for wound care, but the main disadvantages of this type of fixation is the risk of pin-site infection. The prevalence of pin-site infection reports ranged from 10-42% depending on the study site, study subject and follow-up period[1-3]. The most common causative organism of pin-site infection is gram-positive bacteria such as *Staphylococcus aureus* and *Staphylococcus epidermidis*[3-5]. The consequence of pin-site infection is pain, pin loosening and increased risk of implant-associated infection. Currently, there has been no standard guideline for pin-site care. A number of methods for pin-site care have been studied such as dry dressing, chlorhexidine, hydrogen peroxide, normal saline with conflicting results[5-9]. However, no previous study evaluates the efficacy of silver sulfadiazine, which is an effective local antibiotic for burn wound and can eradicate most common causative organisms for pin-site infection[10-13]. The objective of the present study was to compare the efficacy of silver sulfadiazine with dry dressing for pin-site infection prevention.

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Material and Method

Permission to conduct the present study was granted by the Ethic Committee, Faculty of Medicine, Prince of Songkla University. The present study was done between September 2007 and June 2008. The patients who had open tibial fracture with requiring external fixation were candidates for inclusion in the present study. They were excluded if there was any immunocompromized condition (diabetes, and HIV) and malignancy. After emergency debridement and irrigation, the AO external fixator was used in each group. At day-3 post-operation, the subjects were randomized into two groups. The study group had daily pin-site dressing with normal saline and applied 0.5 ml

of 1% silver sulfadiazine. The control group had daily dry dressing and optionally removed dry scale by the patients. At home, the pin-site care was carried on by self-administered dressing.

The pin sites were monthly examined as outpatients for evidence of pin-site infection by an independent observer. Grade I-III according to the Checketts-Otterburns classification was classified as minor infection and Grade IV-V as major infections (Table 1). All of the subjects had monthly radiographic evaluation for the evidence of union.

Statistical analysis

The sample size required to detect the difference of prevalence equal to 30% of pin-site infection based on alpha and beta equal to 0.05 and 0.2, respectively was 40 pins in each group. The authors estimated the dropout rate was about 20%, so the total sample size was at least 15 patients per group. The authors analyzed the database on intention-to-treat analysis. Comparison between mean was analyzed using student t-test, while Chi-square was used to compare categorical data.

Results

Thirty open tibial fracture patients were included in this study. Fifteen cases were included in the present study group (sliver sulfadiazine) while the other 15 were in the control group (dry dressing). The patient characteristics were male in 12 and 13 cases, and mean age of 29.1 and 30.1 years, respectively. The majority cause of injury was motorcycle in 11 and 12 cases, and was a comminuted fracture pattern in 13 and 10 cases. The location of fracture was distributed into proximal in five and one cases, midshaft in five and eight cases and distal in six and six cases. At least 80% were Grade III Gustilo's classification[14] of open fracture in 13 and 12 cases. Four pins or less were mostly used in external fixation in 12 and 12 cases and about two-thirds required two surgical intervention of less. All variables had no statistically significant difference. The length of stay was 39.9 and 42.1 days, the mean duration of follow-up was 106.3 and 108.6 days, and the mean duration of parenteral antibiotic was 9.9 and 12 days, respectively.

In the present study and control group, the prevalence of pin-site infection was seven (43.7%) and six (40.0%), the minor infection (Grade I- III) was six of 15 (40.0%) and five of six (83.3%), the major infection (Grade IV or more) each had only one subject, and the number of two episodes or less was seven of seven subjects (100%) and five of six subjects (83.3%). These variables showed no statistical significance. One of seven subjects and one of six subjects needed to have premature external fixation performed.

Discussion

The present study showed that the silver sulfadiazine was not associated with a low prevalence of pin-site infection, which compared to the dry dressing. Nevertheless, the pin-site infection rate was 46.7 in the study group and 40% in the control group, which was relatively high when compared with the average rate in previous studies[15-19].

Pin-site infection usually starts from the pin-skin interface and then progresses to subcutaneous tissue and may advance further to cause osteomyelitis. It is necessary to assess pin-site treatment methods or their modifications in order to determine their effectiveness in reducing of pin-site infection. The present study demonstrates that local decontamination using silver sulfadiazine cannot minimize the risk of pin-site infection. Other strategies to prevent pin-site infection such as silver-coated pins[20] should be further evaluated with sound methodological study in the future.

Despite using a randomized controlled study, the authors noted some limitations in the present study.

Table 1. Checketts-Otterburns classification

Grading	Skin around the pin	Drainage from pin site	Radiographic findings
0	Normal	None	Normal
I	Minimally inflamed	None	Normal
II	Inflammation	Serous	Normal
III	Inflammation	Pus	Normal
IV	Inflammation	Pus	Osteolysis around the pin
V	Inflammation	Flank pus	Sequestrum

Firstly, the authors did not blind the assessor, since the authors believe the present outcome might not be bias from treatment. Secondly, the one-month follow-up period might too long to early detect pin-site infection, Nevertheless, the authors informed the sign and symptom of infection to the patients to come back before the appointment in case of suspected infection.

The authors recommend only dry dressing for pin site care without local application of any antiseptic and antibiotic. In addition, the recent trend of minimizing the duration period of external fixation can minimize the risk of pin site infection.

In conclusion, local application of silver sulfadiazine does not minimize the prevalence of pin-site infection in open tibial fracture compared to dry dressings.

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Potential conflicts of interest

None.

References

1. Court-Brown CM, Wheelwright EF, Christie J, McQueen MM. External fixation for type III open tibial fractures. J Bone Joint Surg Br 1990; 72: 801-4.
2. Sisk TD. External fixation. Historic review, advantages, disadvantages, complications, and indications. Clin Orthop Relat Res 1983; 15-22.
3. Ahlborg HG, Josefsson PO. Pin-tract complications in external fixation of fractures of the distal radius. Acta Orthop Scand 1999; 70: 116-8.
4. Edwards CC, Simmons SC, Browner BD, Weigel MC. Severe open tibial fractures. Results treating 202 injuries with external fixation. Clin Orthop Relat Res 1988; 98-115.
5. Gordon JE, Kelly-Hahn J, Carpenter CJ, Schoenecker PL. Pin site care during external fixation in children: results of a nihilistic approach. J Pediatr Orthop 2000; 20: 163-5.
6. W-Dahl A, Toksvig-Larsen S, Lindstrand A. No difference between daily and weekly pin site care: a randomized study of 50 patients with external fixation. Acta Orthop Scand 2003; 74: 704-8.
7. Henry C. Pin sites: Do we need to clean them? Practice Nursing 1996; 7: 12-7.
8. W-Dahl A, Toksvig - Larsen S. Pin site care in external fixation sodium chloride or chlorhexidine solution as a cleansing agent. Arch Orthop Trauma Surg 2004; 124: 555-8.
9. Schalamon J, Petnehazy T, Ainoedhofer H, Zwick EB, Singer G, Hoellwarth ME. Pin tract infection with external fixation of pediatric fractures. J Pediatr Surg 2007; 42: 1584-7.
10. Moyer CA, Brentano L, Gravens DL, Margraf HW, Monafo WW Jr. Treatment of large human burns with 0.5 per cent silver nitrate solution. Arch Surg 1965; 90: 812-67.
11. Klasen HJ. A historical review of the use of silver in the treatment of burns. II. Renewed interest for silver. Burns 2000; 26: 131-8.
12. Fox CL Jr. Silver sulfadiazine—a new topical therapy for Pseudomonas in burns. Therapy of Pseudomonas infection in burns. Arch Surg 1968; 96: 184-8.
13. Carr HS, Wlodkowski TJ, Rosenkranz HS. Silver sulfadiazine: in vitro antibacterial activity. Antimicrob Agents Chemother 1973; 4: 585-7.
14. Gustilo RB, Mendoza RM, Williams DN. Problems in the management of type III (severe) open fractures: a new classification of type III open fractures. J Trauma 1984; 24: 742-6.
15. Sims M, Saleh M. External fixation-the incidence of pin site infection: a prospective audit. J Orthop Nursing 2000; 4: 59-63.
16. Mjoberg B, Karlstrom G, Larsson S. Treatment of closed tibial shaft fractures with unilateral external fixation. Injury 1995; 26: 299-303.
17. Egol KA, Paksima N, Puopolo S, Klugman J, Hiebert R, Koval KJ. Treatment of external fixation pins about the wrist: a prospective, randomized trial. J Bone Joint Surg Am 2006; 88: 349-54.
18. Behrens F, Searls K. External fixation of the tibia. Basic concepts and prospective evaluation. J Bone Joint Surg Br 1986; 68: 246-54.
19. Moroni A, Vannini F, Mosca M, Giannini S. State of the art review: techniques to avoid pin loosening and infection in external fixation. J Orthop Trauma 2002; 16: 189-95.
20. Masse A, Bruno A, Bosetti M, Biasibetti A, Cannas M, Gallinaro P. Prevention of pin track infection in external fixation with silver coated pins: clinical and microbiological results. J Biomed Mater Res 2000; 53: 600-4.

อุบัติการณ์ของการติดเชื้อตำแหน่งหมุดตรึงกระดูก: การเปรียบเทียบระหว่างยาซิลเวอร์ซัลฟาไดอะไซด์กับการเปลี่ยนแผลแบบแห้งในผู้ป่วยกระดูกทิเบียหักแบบเปิด

วราห์ ยืนยงวิวัฒน์, บุญสิน ตั้งตระกูลวนิช

วัตถุประสงค์: *การติดเชื้อตำแหน่งหมุดตรึงกระดูก (pin-site infection) เป็นหนึ่งในภาวะแทรกซ้อนที่เป็นปัญหาของการตรึงกระดูกภายนอก (external fixator) การศึกษานี้มุ่งหมายศึกษาประสิทธิผลของยาซิลเวอร์ซัลฟาไดอะไซด์เปรียบเทียบกับการเปลี่ยนแผลแบบแห้ง (dry dressing) ในการป้องกันการติดเชื้อตำแหน่งหมุดตรึงกระดูก*

วัสดุและวิธีการ: *เป็นการศึกษาแบบสุ่มมีกลุ่มควบคุม (randomized control study) ในผู้ป่วยกระดูกทิเบียหัก แบบเปิด จำนวน 30 ราย แบ่งผู้ป่วยเป็น 2 กลุ่ม โดยวิธีสุ่ม กลุ่มแรกทำแผลด้วยยาซิลเวอร์ซัลฟาไดอะไซด์ และกลุ่มที่สองทำแผลด้วยผ้าก๊อซแห้ง กลุ่มละ 15 คน ผู้ป่วยทุกรายได้รับการรักษาโดยวิธีผ่าตัดล้างแผลและตรึงกระดูกภายนอก ให้การวินิจฉัยมีการติดเชื้อรอบหมุดตรึงกระดูกเมื่อมีการอักเสบ หนอง หรือ การละลาย (osteolysis) ของกระดูกรอบหมุดตรึงกระดูก*

ผลการศึกษา: *ผู้ป่วย 7 ราย (46.7%) มีการติดเชื้อรอบหมุดตรึงในกลุ่มทำแผลด้วยยาซิลเวอร์ซัลฟาไดอะไซด์ และ 6 ราย (40.0%) ในกลุ่มเปลี่ยนแผลแบบแห้ง โดยทั้งสองกลุ่มมีความรุนแรงของการติดเชื้อไม่แตกต่างกัน*

สรุป: *อุบัติการณ์การติดเชื้อตำแหน่งหมุดตรึงกระดูกของทั้งสองกลุ่มไม่มีความแตกต่างอย่างมีนัยสำคัญ (p = 0.97) ดังนั้น สนับสนุนให้ใช้ได้ทั้งยาซิลเวอร์ซัลฟาไดอะไซด์ และการเปลี่ยนแผลแบบแห้ง*