Comparison of 1% Silver Sulphadiazine and Chlorhexidine Dressing Combined Versus 5% Chlorhexidine Dressing Alone in Preventing Pin Tract Infection in External Fixators

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ABSTRACT

Objective: To determine the efficacy of 1% Silver Sulphadiazine and Chlorhexidine dressing combined versus 5% Chlorhexidine dressing alone in preventing pin tract infection in external fixators.

Methods: This was a comparative study done in the Orthopedic Department Hayatabad Medical Complex (HMC) from March 2015 to March 2018 on 198 patients with external fixator in tibia. This study compares the frequency of pin tract infection (PTI) in patients treated with 1 % Silver Sulphadiazine and 5% Chlorhexidine combine (group A) and 5% Chlorhexidine alone (group B). Patients were labelled to have pin tract infection if signs of infection(redness, tenderness, discharge) were noted at pin sites.

Result: The total number of patients in our study were 198 and equally divided into group A and group B. Treatment in group A was effective in 90 (90.9%) patients while group B was effective in 71(71.7%). The difference was statistically significant (*p* value 0.001).

Conclusion: Combined 1% Silver Sulphadiazine and 5% Chlorhexidine was effective in preventing pin tract infection in majority of patients with external fixators than 5% Chlorhexidine dressing alone.

Key words: Chlorhexidine, External Fixator, Pin tract Infection, Silver Sulphadiazine vascularized bone grafts.

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INTRODUCTION

External fixation is mostly used by orthopedic surgeon in damage control surgery.[1, 2] This type of fixation is used in open wound or sometime in close fracture when it need spanning but the disadvantage of external fixator is pin tract infection (PTI). Literature show pin-site infection rate 10-42% which depends on the site, patient and follow-up period.[3] The commonest causative agent of pin tract infection is Staphylococcus aureus and Staphylococcus epidermidis. [4]

The cardinal symptoms and signs of pin tract infection is pain, infection and pin loosening.[3] It is imperative avoid infection that causes loosening of the pins and ultimate failure of surgery. The proper protocol of pin insertion has to be followed with proper design of external fixator and pin tract care in the post-operative period. The primary aim of fixator is to achieve a stable construct that can withhold the weight of the patient.[5] There are multiple ways for pin tract care such as dry sterile gauze dressing, normal saline wash dressing, Chlorohexidine dressing, silver sulphadizine dressing and pyodine dressing. Some surgeon uses antimicrobial coated pins, alcohol antiseptic occlusive pressure dressing, titanium pins and Silver coated pins to avoid PTI, however no single techniques is beneficial for elimination PTI. It almost always starts from interface of pin-skin and then spread to other soft tissue which eventually leads to bone causing osteomyelititis.[4] Povidone-iodine loses its effect when come in contact with blood or exudates and has adverse interaction when comes in contact with stainless steel pins. Hydrogen peroxide damages

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healthy tissues while chlorhexidind gluconate has antimicrobial potential and causes membrane disruption of microorganism. It is less toxic with low propensity for skin sensitization as compare to other local antimicrobials.[6] It is also effective active against gram-negative bacteria. Chlorhexidine can also work against Pseudomonas when applied on skin for upto ten minutes. [7] Some researchers are of the opinion that Chlorhexidine 2 mg per milliliter has strong cleansing properties.[6]

PTI seems to be a minor problem but sometime it leads to disaster. Pin track infection loses the pin that leads to instability of the pin–bone interface and loosening of construct.[9] Although multiple factors can affect the stability of external fixator [10],[11] and it appears that there is a competition between fracture healing and failure of pin bone interface.[12] That is why it is pertinent to keep in mind the fracture configuration in the decision of the type external fixator to use. A fixator that is not properly applied can create environment that is not suitable for optimal bone healing that leads to pin site irritation, infection and loosening.[13] Literature shows that unilateral and hybrid fixators had higher frequency of pin tract infection than Ilizarov apparatus.[14] Hydroxyapatite (HA) coated wires and pins has the ability of osseointegration which decreases motion of the pins.[15,16] Infection can be minimized by highly effective topical antimicrobial agent named as Silver Sulphadiazine (SS). It has the capacity to reduce infection rate in burns wound.[7,8] Silver ions are slowly released from Silver Sulphadiazine and binds to DNA of many gram positive and gram-negative bacteria thus inhibiting their growth.[8]

The objective of this study was to determine the efficacy of 1% Silver Sulphadiazine and Chlorhexidine dressing combined versus 5% Chlorhexidine dressing alone in preventing pin tract infection in external fixators. Since there is no universally recommended dressing for pin tract care and each surgeon uses dressing of his own choice depending upon his personal experience. Therefore, the results of this study will help us in formulating standard protocols for pin tract care for patients treated in our hospital.

METHODS

We conducted this comparative study in Orthopaedic Department Hayatabad Medical Complex from March 2015 to March 2018 on 198 patients with external fixator in tibia. We followed the Consolidated Standards of Reporting Trials(CONSORT) 2010 guidelines for reporting of our trial. The Ethical committee of the hospital approved our study protocols before commencement of the study. We included all patients of any age and gender with open fracture tibia (Gustilo Anderson type II, IIIA). Only patients providing informed consent were included in the study. All diabetic patients, poly trauma patients with multiple fractures requiring surgical interventions or those needing surgical interventions from general surgery, neurosurgery, vascular, and thoracic surgery and patients with external fixators applied in other centers were excluded from the study.

All the admitted patients in whom external fixator is applied in our department, qualifying inclusion and exclusion criteria were inducted for the study after obtaining written and informed consent. Patients were thoroughly examined for life threatening conditions and after full evaluation and stabilization, a detailed history was obtained in each case. Before application of external fixator two groups (A &B) were created and in each group, patient was allocated by lottery method. The standard technique of external fixator was adopted in each case. Patients were operated under general or spinal anaesthesia. Tourniquet was applied in all cases. Slow and controlled pre drilling with a sharp drill bit followed by insertion of Schanz screw in proper places and with a hand chuck was done. A proper size and diameter of AO external fixator was used and applied in proper configuration depending upon the fracture type. The wound was thoroughly debrided and washed and either closed or left open depending upon the degree of contamination. Regular debridements were done under anaesthesia in cases of extensive wounds. All the procedure was done by an Orthopaedic surgeon with a minimum of five years post fellow ship experience. Post operatively in group A, pin sites were dressed with a gauze soaked with 1% Silver Sulphadiazine and 5% Chlorhexidine combine while in group B only 5% Chlorhexidine was used for dressing.

The first postoperative dressing was removed after 72 hours and fresh dressing was applied in the same manner. The patient and the attendant was instructed to apply the dressing at the pin site daily at home. All the patients were given intravenous ceftriaxone for five day. The patients were followed every fortnightly till 12 weeks. During follow up the pin sites were examined by an orthopaedic surgeon(not the operating surgeon) with minimum of five years post fellow ship experience for any pin tract infection

clinically like presence of erythema, purulent discharge, pin loosening and radiologically bone translucency around the pin. We analyzed our data with SPSS version 20. Quantitative variables were represented as mean while qualitative as frequencies and percentages. Data presented in table where necessary.

RESULTS

A total of 198 patients with external fixator equally divided into group A and B were examined. The aetiology of fractures were road traffic accidents in 65(65.6%), gunshot in 20(20.2%), fall in 9(9%) and fall of heavy object in 5(5%) patients in group A. The group B patients had road traffic accidents in 59(59.5%), gunshot in 25(25.2%), fall in 12(12.1%) and heavy object in 3(3%). Gustilo Anderson type IIIA were found in 62(62.6%) and 73(73.7%) patients in group A and B respectively. Type II fractures were present in 37(37.3%) patients in group A and 26(26.2%) in group B. Group A patients were dressed with 1 % Silver Sulphadiazine and 5% Chlorhexidine combine while group B with 5% Chlorhexidine alone. Male patients were 60(60.6%) and female 39(39.4%) in group A (male female ratio 1.54:1) while group B had 65(65.7%) male and 34(34.3%) female(male female ratio 1.91:1).The overall male to female ratio was 1.71:1.The gender difference between the two groups were statistically insignificant with p value 0.461.

The average age of group A patients were 35.27 years ±11.80SD with majority(48.5%,n=48) of patients in the age range of 30 or below followed by 38(38.4%) patients in the age range 31 to 45 years, 9(9.1%) patients in 46 to 60 years and 4(4.0%) patients were above 60 years of age. The average age of group B patients were 36.05 years +13.39±SD with 50(50.5%) patients having the age of 30 years or below, 32(32.3%) patients were in the age range 31 to 45 years, 9(9.1%) in 46 to 60 years and 8(8.1%) patients were more than 60 years of age. The average age of all of our study participants were 35.66years±12.60SD. The distribution of age between the two groups were found to be insignificant statistically with p value 0.596. Similarly, the side of injury between the two groups were also found insignificant (p value 0.57Group A had right sided surgery in 50(25.25%) patients while group B had right sided involvement in 45(22.73%) patients. Efficacy in terms of absence of infection revealed that 90(90.9%) patients had no pin site infection while only 9(9.1%) patients had infection in group A. On the other hand, 71(71.7%) patients had no pin site infection and 28(28.3%) patients had infection in group B. A comparison pin tract infection in both groups showed that this difference was statistically significant with p value of 0.001. (Table I)

Table 1: Comparison of pin tract infection in both groups.

		Groups		Total	*P* value
		A	B		
Efficacy	PTI Absent	90	71	161	0.001
		90.9%	71.7%	81.3%	
	PTI Present	9	28	37	
		9.1%	28.3%	18.7%	
Total		99	99	198	
		100.0%	100.0%	100.0%	

DISCUSSION

The essence of damage control surgery is external fixation. External fixator can be used anywhere either temporarily or permanently for bone fixation. The main drawback of the fixator is not suitable for most patients and can cause pin tract infection. Egol[17] studied 118 patients of unstable displaced distal radial fractures treated with external fixator, were divided into three groups: (1) dry gauze dressing, (2) daily cleansing with diluted hydrogen peroxide and (3) Chlorhexidine dressing every week. He showed only 5 % difference in infection rate but that was not found to be statistically significant. A prospective randomized controlled trial done by W-Dahl [18] on the efficacy of 70 % isopropyl alcohol versus 0.9 % sodium chloride solution for cleansing of pins reported pin tract infection in 18% and 25% respectively.(p value ≥ 0.05) while pin site

infection in current study with combination of Silver Sulphadiazine and Chlorhexadine was only 9.1%. Patterson[19] studied 92 patients with fracture that has been managed with external fixator. He found no significant difference in PTI rate amongst the three dressing: (1) soap with water; (2) 0.9 % saline; and (3) diluted hydrogen peroxide (45, 30, and 27 % incidence of pin site infection, respectively), while current study by dressing of Silver Sulphadiazine and Chlorhexadine shows pin tract infection only 9.1%. Lethaby[20] divided the patients into two groups i.e. patients receiving any antiseptic solution to clean the pin sites versus no antiseptic solution at all. It was evident from this study that antiseptic solution did not reduce pin tract infection. A study by Toksvig-Larsen and Lindstrand [21] on 49 patients(196 pins) treated with Chlorhexadine 2 milligram per milliliter or 0.9% sodium chloride reported more positive pin site bacterial cultures, and more antibiotics use in patients using normal saline than Chlorhexadine but the frequency and grading of pin tract infection between the two cleaning agents were not statistically significant. Ogbemudia[4] study showed that Chlorhexidine dressing alone has pin tract infection rate of 20.1%, while combined Chlorhexidine solution and Silver Sulphadiazine cream has pin tract infection rate of 7.9%. Yuenyongviwat [3] in his research has used a combination of 1% Silver Sulphadiazine with normal saline and found the PTI rate of 46.7 % while the current study of combined silver Sulphadiazine and chlorhexidine shows pin tract infection only 9.1%.

We could not analyze the possible effects of smoking, medications and other comorbid conditions on PTI. Furthermore, the frequency of infection rate per pin of external fixator and relation to its location or fracture type and aetiology was not assessed. We recommend further studies preferably registered with national or international registration agencies on this topic to fill all such gaps.

CONCLUSION

Combined 1% Silver Sulphadiazine and 5% Chlorhexidine was effective in preventing pin tract infection in majority of patients with external fixators than 5% Chlorhexidine dressing alone. We therefore recommend that pin sites of external fixator should preferably be cleaned with combination of 1% Silver Sulphadiazine and 5% Chlorhexidine.

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Authorship and contribution Declaration

Muhammad Shabir, Conception and design of the study
Hafeez Ullah Afridi, acquisition of data
Muhammad Inam, interpreted the data, Final approval of the version for publication
Mian Amjad Ali, Revised the manuscript critically for important intellectual content
Feroz Shah, Drafted the manuscript