Original Article

Comparison of early versus delayed debridement in open fractures

Hamid Reza Arti

ABSTRACT

Objective: Open fracture, a disruption of soft tissue and exposure of fractured bone to surrounding environment is a high risk condition for infection and is recommended to treat it by irrigation, surgical debridement and antibiotic therapy as soon as possible. Since the role of each of the above mentioned factors and the interval between admission and debridement is still in debate, the present study was designed to determine the difference between early and delayed debridement in open fracture and its effect on infection occurrence. Infected fracture was defined by either clinical evidence of infection or positive wound culture.

Methodology: A prospective, double blind study was performed on 379 patients with 381 open fractures. Location of fracture, interval (time between the injury and debridement) and Gustilo or Duncan classifications of open fractures were recorded. For all patients irrigation and antibiotic therapy was started with standard protocol. Early (less than 6 hours) and delayed (more than 6 hours after injury) debridements were done in group A with 289 and group B with 92 patients, respectively and all patients were followed up for early infection (onset within the 10 days after injury).

Results: Seven patients (2.4%) in group A and 4.3% (4 of 92) in group B had early infection and this difference was not significant (p=0.34).

Conclusion: The result of early and delayed debridement is almost the same in open fractures, if patients receive suitable antibiotic therapy.

KEY WORDS: Open fracture, Delayed debridement, Infection.

Pak J Med Sci October - December 2012 Vol. 28 No. 5 856-859

How to cite this article:

Arti HR. Comparison of early versus delayed debridement in open fractures. Pak J Med Sci 2012;28(5):856-859

INTRODUCTION

Open fracture is a common problem all over the world including Iran due to high road traffic accident. It is recommended for many years to be treated by irrigation, surgical debridement and antibiotic therapy.[1,2] In cases with serious and multiple trauma, crowded patients and also because of long distance between the scene of the trauma and medical centers, surgical debridement is delayed for hours despite early antibiotic therapy and irrigation.[3] Following the widespread use of early antibiotic therapy, some studies reported decreased infection rate for open fractures comparing with delayed debridement[4,5] but, the time of follow-up or the number of cases were not considerable. The purpose of the present study was to determine the effect of delayed debridement on the infection rate of open fractures.

1. Hamid Reza Arti
Associate Professor of Orthopaedic Surgery,
Ahvaz Jundishapur University of Medical Sciences,
Ahvaz Iran.

Correspondence:

Hamid Reza Arti,
Associate Professor of Orthopaedic Surgery,
Ahvaz Jundishapur University of Medical Sciences,
Ahvaz, Iran.
E-mail: hamidrezaarti@gmail.com

* Received for Publication: April 29, 2012
* Revision Received: July 18, 2012
* Revision Accepted: July 25, 2012

METHODOLOGY

In a prospective double blind study between 2008-2010, 391 patients with 392 open fractures were studied in Kashani University Hospital. Eleven patients died due to systemic problems, which were excluded. Other exclusion criteria were associated vascular injury, debilitating conditions such as malnutrition, diabetes mellitus, Gustilo or Duncan type I open fracture (because infection rate of this type of fracture is low) and admission after 72 hours of injury. Inclusion criteria were all open fractures not treated before admission at emergency department.

All fractures were classified based on Gustilo or Duncan classifications (type I: length of wound less than 1 cm, type II: length of wound more than 1 cm and less than 10 cm, type III: length of wound more than 10 cm, which is subclassified into type IIIA (with adequate soft tissues for bone coverage), type IIIB (with inadequate soft tissues for bone coverage and periosteal elevation or stripping) and type IIIC (requires arterial or soft tissue reconstruction procedure) and Duncan classification[6] for open hand fractures that is the modified system of Gustilo et al[7] by downscaling the wound size to apply to the hand. A type I open hand fracture has a laceration less than 1 cm in length without soiling, soft-tissue crush or loss. A type II has a tidy laceration less than 2 cm in length. A type IIIA open fracture consists of a laceration greater than 2 cm and includes a penetrating or puncturing projectile wound and any frankly soiled wound. A type IIIB injury is the same as type IIIA with any periosteal elevation or stripping. Type IIIC is the same as type IIIB plus neurovascular injury.[6] All patients received antibiotic in emergency room and irrigation in a standard protocol and narcotics as needed for pain relief.[8]

Intravenous cephalosporin (cephazolin) with an aminoglycoside (gentamycin) along with 6 liters saline solution irrigation in type II, intravenous cephalosporin with an aminoglycoside and penicillin with 9 liters saline solution irrigation in type III Gustilo or Duncan open fractures). All patients were divided into two groups based on the time for debridement, which was determined on the basis of their early (before 6 hours) or delayed (after 6 hours due to long distance referral center) arrival time in emergency department, general conditions and other problems such as multiple or head truma that precluded a safe anaesthesia. Group A underwent early (before 6 hours of injury) and group B, delay (after 6-72 hours of injury) debridement and delayed wound closure. By definition, infected fracture was defined by either clinical evidence of infection or positive wound culture.

Early infection appears during the first 10 days and delayed infection between 10-21 days after injury. Patients with more than 72 hours interval and Gustilo and Duncan type I fractures were excluded and remainder (type II and III) were evaluated by second physician for age, presence of infection, location of fractures, classification of fractures and interval between injury and debridement. After data collection they were analyzed by SPSS software version 17. Chi-square and Fisher›s exact tests were used to evaluate the presence of infection (by either clinical evidence of infection or positive wound culture) and intervals in groups A and B. Chi-square test also was used to determine if the site of infection was a confounding factor. $P<0.05$ was considered significant.

RESULTS

Three hundred and eighty one open fractures in 379 patients were included in the study. There was no difference between demographic data of open fractures. The mean age was 23±1.5 years; 277 (73%) fractures were classified as type II and 104 (27%) ones as type III Gustilo or Duncan open fractures. The interval between injury and debridement was six hours or less for 289 (76%) fractures (group A), seven to twenty-four hours for 87 (23%) fractures and twenty-five hours or more for five (1%) fractures (group B) (Table-I). The overall infection

Table-I: Distribution Type of Fractures and Gustilo or Duncan Classification.

TIME		*Number of Fractures*					
Delay before debridement		*Type II*	*Infection*	*Type III*	*Infection*	*Total*	*Infection*
Group A	0-6 hours	200	4	89	3	289	7
Group B	7-24hours	73	0	14	1	87	1
	25-72 hours	4	2	1	1	5	3
Total		277	6	104	5	381	11

Table-II: Location of Fractures.

Location	*Bone*							
	Tibia	*Tibia & Fibula*	*Femur*	*Radius & Ulnar*	*Humerus*	*Metacarpus*	*Phalanges*	*Calcaneus*
Proximal third	7	7	5	-	-	2	1	1
Middle third	19	70	1	6	3	2	2	1
Distal third	20	185	21	4	11	8	4	1
Total	46	262	27	10	14	12	7	3

rate was 2.9% (11 of 381), with 2.4% (7 of 289) for group A and 4.3% (4 of 92) for group B. This difference was not significant (p=0.34). In type II, the infection rate was 2% (4 of 200) in group A and 2.6% (2 of 77) in group B. There was no significant difference between the infection rates in the two groups (p=0.67). In type III, the infection rate was 3.4% (3 of 89) in group A and 1.3% (2 of 15) in group B. There was no significant difference between the infection rates in the two groups (p=0.15). Infection developed in 4 tibial, one fibular, one femoral, one radial and ulnar, one humeral, one metacarpal, one foot phalangeal and one calcaneal fractures. The upper extremity vs. the lower extremity was determined not to be a confounding factor affecting the rate of infection (p=0.22).

DISCUSSION

Traditional recommendation states that open fractures require surgical debridement for preservation of soft tissue viability and prevention of infection. Gustilo reported that urgent surgical irrigation and debridement minimize the risk of acute infection[1], this conclusion is not supported by the data in our study. In open fractures treated with delayed debridment and administration of antibiotics before surgery, acute infection rate decreased from 10 to 5 percent.[1,9] Subsequent clinical studies in the antibiotic era have indicated that the timing of surgical debridement of open fractures may not play a critical role in the prevention of acute infection.[5,10,11]

A study of seventy patients with open fractures revealed that the time between injury and treatment in the emergency room was not correlated with infection rate.[12] According to another study eighty-two patients with open fractures of the lower extremities secondary to blunt trauma in adults, 76% were debrided seven to twenty-four hours after the injury with an overall 5% rate of infection without any increase in rate of infection with delayed surgery.[1]

A review of fifty open tibial fractures in children, concluded that delay in surgical treatment of seven hours or more was associated with an infection rate of 25% whereas delay with less than six hours, the infection rate was 12%, this high rate infection was due to delayed administration of antibiotic . [5] In a retrospective study of 104 children with treated open fractures, the infection rate was 3% for fractures treated within six hours after the injury and 2% for those who treated at least seven hours after the injury.[13] This difference was not significant (p=0.52). Clinical studies have demonstrated that the timing of antibiotic administration influences the risk of infection[13,14] In a review of 125 open fractures, the infection rate was 4.7% if antibiotics started within three hours after the injury and 7.4% when started four hours or more after the injury.[15,16] They concluded that the single most important factor in reducing the infection rate was the early administration of antibiotic.[15-17]

In our country, because of transferring the patients to referral centers, delay in surgical intervention is a common event. The present study concluded that there are no differences between the infection rates of fractures treated within six hours after the injury and those treated after seven hours. We would like to state clearly that the present study was focused mainly on the effect of surgical delay on the rate of infection following open fractures, which is one of the factors that may be influenced by the timing of surgery. Open fractures may require emergent surgical treatment for reasons other than preventing infection, such as preservation of soft-tissue viability or vascular status.[18-20]

The findings of the present study suggest that early antibiotic therapy following an open fracture especially in multiple trauma injuries is very important. When the patient's general condition is not suitable for general anesthesia or distant referral center, surgical debridement can be delayed. In this situation debridment within six hours after the injury offers little benefit over debridement within twenty-four hours after the injury with regard to the prevention of acute infection.

ACKNOWLEDGMENT

We appreciate the Vice Chancellor for research of Ahvaz Jundishapur University of Medical Sciences for supporting this research.

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