

Comparing the Results of Prevention of Fat Emboli in Femoral Shaft Fractures

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Article information	Abstract
<p>Article history: Received: 21 Jan 2011 Accepted: 26 Apr 2012 Available online: 28 Oct 2012 ZJRMS 2013; 15(2): 36-39</p> <p>Keywords: Fat Emboli Prevention Femoral fracture</p> <p>*Corresponding author at: Department of Orthopaedic Surgery, Jundishapur University of Medical Sciences, Ahwaz, Iran. E-mail: hamidrezaarti@gmail.com</p>	<p>Background: Fat embolism syndrome symptoms is due to the presence of free fat globules originates from bone marrow and deposit in parenchyma of the lung, brain, and other organs and in most cases is particularly due to long bones, or pelvic fractures and can be accompanied by considerable complications and mortality. The aim of this research is to evaluate effect of early fixation of femoral fractures on preventing of fat emboli. Materials and Methods: In a double blind nonrandomized clinical trial study 174 patients with femoral fractures enrolled in four groups and in the first 12 hours after fracture occurrence were treated as below Group I: included 53 patients were treated by means of open reduction and internal fixation with screws and plate. Group II: included 46 patients were treated by means of skeletal traction. Group III: included 33 patients that were not treated by means of any methods of fracture fixation. Group IV: included 42 patients were treated by means of interlocking intramedullary nailing. With use of Chi-square, ANOVA and Tukey post hoc test there were significant differences among groups ($p=0.003$). Results: 11 patients in all groups and in Group A, any patients, in Group B, four patients (7.8%) in group three, six patients (18.1 %) in group four, one patient had fat embolism syndrome (4.2%).</p> <p>Conclusion: The main point in the prevention of fat embolism syndrome is stabilization of fracture site of long bones as soon as possible.</p> <p>Copyright © 2013 Zahedan University of Medical Sciences. All rights reserved.</p>

Introduction

Fat embolism syndrome is a triad of clinical symptoms including respiratory distress, subcutaneous petechiae and decreased consciousness without a brain injury or other circumstances, such as poisoning. This syndrome is associated with entrance of bone marrow fat into the systemic circulation after trauma and is often associated with long bone fracture and high rate mortality.

Ninety percent of all bone fractures are associated with detectable pulmonary fat embolism [1, 2], however, only a small portion of these patients will have clinical fat embolism syndrome. There is 130 ml of liquid fat in femoral or tibial bones of adults [3] and if only 20 ml of this fat dissolved evenly, it convert to 40 billion microemboli with diameter of 10 μm , which is enough sufficient to obstruction pulmonary capillaries [4] After a suddenly increases in pressure of fractured bone, marrow fat emerge into venous circulation and then go to lungs and from there will be sent to other organs. Fat embolism syndromes always do not need to a broken bone and in many instances, fatal fat embolism syndrome after bone contusion have been reported [4].

Neutral fat in bone marrow is not harmful, but by passing 12 to 72 hours after entrance into the various organs especially the lungs, it will be hydrolyzed into glycerol and free fatty acids [4-6]. Fatty acids, especially highly toxic to lung tissue, resulting in impaired basement membrane permeability of alveolar capillary of pulmonary tissues, and is associated with hemorrhagic

pulmonary edema in the lungs and decrease surfactant activity. Then these particles disseminated into various organs through the circulatory system including the brain, skin, kidneys. Meanwhile coagulation system is activated and leads to diminish of platelets and hemoglobin [7]. Clinical diagnosis of fat embolism syndrome is based on Guard and Wilson's criteria [8-10], but now today measurement of serum IL-6 and Elastase levels in equipped and modern laboratory and research centers are used to detect and even predict the likelihood occurrence of this syndrome [11]. Because of high rate mortality of this syndrome (10% to 20%), even in the equipped centers of the world [5, 8, 12], prediction the likelihood of occurring of fat embolism syndrome in traumatic patients and its prevention is the most important.

According to various prevention and treatment methods of this complication, such as drugs administration including alcohol, corticosteroids, anticoagulants and supportive treatment including respiratory support by means of mechanical ventilation and early fixation of fractured bone and much controversies about them, and thus in Iran fixation of long bone fracture do not performed as a early method, and due to large number of traumatic patients in different parts of Iran, this study was designed to compare different fixation methods and their efficacy in prevention of fat embolism syndrome and emphasizes on as soon as possible fracture fixation of long bones [13].

Materials and Methods

A double blind nonrandomized clinical trial study was performed on femoral bone fracture patients' that admitted in Kashani hospital of Shahrekord from May 2004 to April 2007. Sample size was as convenience sampling. Inclusion criteria were: 1- patients with isolated femoral fracture 2- more than 12-24 hours did not pass after fracture occurrence 3- before arrival in emergency department patients did not undergo any treatment 4- patient was conscious 5- signing informed consent. Exclusion criteria were: 1- presence of systemic or chronic disease 2- presence of any disease that involved bone marrow 3- presence of pathological fractures 4- pregnancy 5- history of treatment with steroid 6- fractures associated with compartment syndrome 7- presence of fracture with chest or abdominal trauma or head injury 8- presence of open fractures.

One hundred seventy four patients in a double blind nonrandomized clinical trial study and based on fracture time occurrence to surgery time or other management in hospital (these time were based on transferring time of patient from distant center, preparation of equipments or operating room, general condition of patients and allowance of anesthesiologist) were divided into four groups as follows: Group I: included 53 patients with metaphyseal or metaphyseal-diaphyseal femoral fractures that treated less than 12 hours after the occurrence of fracture by means of open reduction and internal fixation with screws and plate. Group II: included 46 patients with femoral fracture were treated by means of skeletal traction less than 12 hours after the fracture occurrence. Group III: included 33 patients with femoral fractures that up to 12 hours after the occurrence of fractures deprived from any permanent or temporary fracture fixation methods. Group IV: included 42 patients with femoral fracture were treated less than 12 hours after the occurrence of fractures by means of undreamed interlocking intramedullary nailing.

For all patient's vital signs were recorded every hour and arterial blood gas (ABG) was checked daily. If a patient had established fat embolism syndrome ABG was checked more than once a day based on the severity of respiratory failure. Hemoglobin, platelets count, ESR, renal function tests, bilirubin, and the patient's heart and respiratory rate per minute and temperature were recorded. For all patients funduscopy examination was done and respiratory rate and chest radiograph were evaluated. Presence or absence of consciousness unrelated

to brain trauma and other conditions such as poisoning and skin petechiae were also recorded.

All data based on fat embolism syndrome diagnostic criteria of Guard and Wilson's for 7 days collected and recorded by a physician in a checklist and re-examination and reevaluation of recorded symptoms was done by second physician. Collected data were analyzed by SPSS-17 Software with ANOVA and Tukey statistical tests and $p < 0.05$ was considered significant. Comparison of different methods of prevention of fat embolism syndrome, by using of ANOVA or Chi-square tests showed significant differences ($p < 0.05$) and when ANOVA or Chi-square tests showed significant differences among groups, Tukey test was used to show better intergroup differences.

Results

Patients' age ranges were between 15 to 52 years old with a mean and standard deviation of 28 ± 4.8 years old. 122 patients (70%) were male and 52 (30%) were female. Mechanism of injuries were collision of motorcycle with a car in 64%, collision of two cars or car turn-over accident in 30%, pedestrian vehicle accident in 4%, falling from a height in 2% of cases. There were not statistically significant differences about age, sex, and fracture pattern among four groups ($p < 0.05$). Eleven patients, in all groups had fat embolism syndrome. In Group I, there was not any fat embolism syndrome; while in Group II there were 4 patients (8.7%) in group III, 6 patients (18.1%) and in group IV, one patient (2.4%) had fat embolism syndrome respectively.

Comparison of different methods of prevention of fat embolism syndrome, by using of ANOVA or χ^2 tests showed significant differences ($p < 0.05$) and when ANOVA or χ^2 tests showed significant differences between groups, Tukey test was used to show better intergroup differences.

Discussion

Fat embolism syndrome is associated with high mortality rate, so prevention of it, is very important. The most important factor in preventing of fat embolism syndrome is early fracture fixation as soon as possible and then adequate fluid therapy, oxygen therapy for ventilation support and patient sedation [14]. The Most suitable time for fracture stabilization of long bones in question requires a study on patients with the similar long

Table 1. The fat embolism syndrome incidence, different methods of prevention, time of treatment and the p -Value in groups

Treatment groups	Number of patients	Fat embolism syndrome	Fracture Fixation Method	Beginins treatment	p -Value
Group I	53	0 (0%)	Screws and plates	Less than 12 hours	0.0003
Group II	46	4 (8.7%)	Skeletal traction	Less than 12 hours	0.09
Group III	33	6 (18.1%)	Untreated	More than 12 hours	0.19
Group IV	42	1 (2.4%)	Undreamed intramedullary nailing	Less than 12 hours	0.017
Total	174	11 (6.3%)			

fat embolism syndrome is associated with high mortality rate, so prevention of it, is very important. The most important factor in preventing of fat embolism syndrome is early fracture fixation as soon as possible and then adequate fluid therapy, oxygen therapy for ventilation support and patient sedation [14]. The most suitable time for fracture stabilization of long bones in question requires a study on patients with the similar long bones fracture, as in this study was performed. Goris and colleagues in a study conducted on two groups of patients showed that the most important factor in the prevention of fat embolism syndrome is early fracture bone stabilization as soon as possible [15]. The results of this study is similar to that of the current study because in two groups that fracture treated less 12 hours by means of screws and plate or intramedullary nailing, there were significant differences among these two groups and groups treated more than 12 hours after fracture occurrence. In a study conducted by Bone and colleagues that performed on two groups of patients were treated by means of screws and plate and intramedullary nailing less than 48 hours after fracture occurrence revealed early fracture fixation is very important role in preventing of fat embolism syndrome and respiratory failure. The result of this study are similar to that of the current study, but in current study fracture fixation time was less than Bone's study (less than 12 hours) and the number of patients were more than Bone's study [16]. Pinney and his colleague in a study that performed on two groups of patients were treated by means of intramedullary nailing and plating less than 48 hours after fracture occurrence early fracture fixation led to decrease of fat embolism syndrome. The result of this study is similar to that of the current study but in Pinney's study fracture fixation time was more than current study [17]. White and colleagues in a study conducted on two groups of patients were treated by means of screws and plate and external fixation less than 36 hours after fracture occurrence, showed that the incidence of fat embolism syndrome was reduced and only one case of fat embolism

was seen in 48 patients. The result of this study is similar to that of the current study, but in White's study, fracture fixation method in one group was external fixator that was not used in current study [18]. Stein and colleagues in a study conducted on two groups of patients were one group treated with administration of corticosteroids and early fractures fixation and another group treated with only early fracture fixation showed, fat embolism syndrome was diminished significantly in both groups and there were no significant differences between two groups. The result of this study is similar to that of the current study [19]. Robinson and colleagues in a study on two groups of patients with long bone fractures showed the most important things in treatment of fat embolism syndrome were prevention by early fractures fixation and treatment of other associated injuries. The result of this study is similar to that of the current study [20]. For prevention of fat embolism syndrome, long bone fractures must be stabilized as soon as possible as an orthopedic emergency. Orthopedic operating room should be also equipped for treating of such patients by necessary equipment and personal. For surgeon encourage medical charges of these patients must be revised so, orthopedic surgeons are interested to operate these patients as an emergency condition.

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Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest

The authors declare no conflict of interest.

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