

# Respiratory Complications after Early versus Late Stabilization of Femoral Shaft Fracture

M.J. Emami, A.R. Khayer, F. Abdinejad

## Abstract

**Background:** Respiratory problems are common after long bone fractures. The objective of the present investigation is to evaluate the effect of early fixation of femoral shaft fracture on the incidence of respiratory problems.

**Methods:** The results of early and late stabilization of femoral shaft fractures were studied in 150 patients. The patients were divided into two groups according to the status of their fractures. Group I (n=123) had single and group II had multiple fractures including femoral fractures. The patients in each group were divided into two subgroups, depending on whether operated within 48 hours (early) or in a longer period (late) after injury. Serial arterial blood gas and chest radiographs were obtained to assess the acute respiratory distress syndrome, fat embolism syndrome, and abnormal blood gas values.

**Results:** Among 123 patients in group I, 63 were operated early after trauma, and the incidence of respiratory complications was 3.3% in comparison with 23.7% in the group II. Whereas, in group II, 14 patients were in early operated subgroup and 13 in late operated subgroup and the incidences of respiratory complication were 7.1% and 76.5% respectively. There was a significant difference in subclinical fat embolism between early and late operated subgroups in group II.

**Conclusion:** Early fixation of femoral shaft fracture in patients with femoral fractures greatly reduces pulmonary complications.

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**Keywords** • Early fixation • late fixation • femoral shaft fracture • fat embolism • ARDS

## Introduction

**P**atients with multiple fractures of long bones are distinct challenge to trauma surgeons. These patients are best prepared for immediate surgical treatment to prevent the deterioration of the optimal nutritional condition and reducing the possibility of hospital infection due to colonization of multiple resistant organisms.<sup>1-5</sup>

The main common complication of long bone fracture is fat embolism syndrome (FES),<sup>6</sup> followed by respiratory dysfunction and insufficiency.<sup>7,8</sup> Ashbaugh et al. described a series of patients who had respiratory insufficiency with uniform clinical, physiologic, radiographic, and pathologic abnormalities such as adult or acute respiratory distress syndrome (ARDS) not related to long bone fractures.<sup>9-11</sup> Retrospective studies performed

Department of Orthopaedic Surgery,  
Shahid Chamran Hospital,  
Shiraz University of Medical Sciences,  
Shiraz, Iran.

### Correspondence:

Mohammad Jafar Emami MD,  
Department of Orthopaedics,  
Shahid Chamran Hospital,  
Shiraz University of Medical Sciences,  
Shiraz, Iran.

**Tel:** +98 711 6270285

**Fax:** +98 711 6286552

**E-mail:** [emamimj92@yahoo.com](mailto:emamimj92@yahoo.com)

during the last three decades indicated that immediate operation of patients admitted for long bone fracture would greatly reduce the incidence of fat embolism.<sup>12-17</sup> In another prospective study, pulse oxymetry was recommended as an acceptable screening method.<sup>18</sup> The present study aimed to compare the incidence of respiratory problems in patients who had single femoral or multiple fractures, and having early or delayed stabilization.

## Patients and Methods

The present study comprised 150 patients with femoral bone fractures admitted to Chamran Hospital affiliated to Shiraz University of Medical Sciences. The main causes of injuries included road traffic accidents in 146 patients and gun shot injuries in four patients. The mean days of postoperative hospital stay for patients with single femoral fracture were 2.5 compared with 10.5 days for patients with multiple fractures.

The patients were divided into two groups (I and II) according to the following criteria.<sup>2,3,15,19-21</sup> Group I included those patients with single femoral shaft fracture. Group II consisted of patients with multiple fractures as well as femoral shaft fracture, and the injury severity score (ISS) of more than 18 points, or in conjunction with another long bone or pelvic fractures. The exclusion criteria consisted of patients with hemoglobinopathy, collagen diseases, osteomyelitis, diabetes mellitus, burns, severe infection, cardiovascular, and pulmonary diseases.

Both groups were further divided into two subgroups. Group A consisted of patients with early stabilization procedure (operative fixation of femoral fracture was done within the first 48 hours, preferably in the first 24 hours of the injury). Group B consisted of patients that had late stabilization procedure (operative fixation of femoral fracture performed at least 48 hours after the injury). All patients received intravenous dexamethasone 16 mg, as the stat dose, continued by 8 mg every 8 hours for 72 hours.

After urgent surgical procedures (e.g. primary debridement of open fractures, vascular and abdominal procedures, etc.) the patients with single femoral shaft fracture were randomly divided into two early and late groups. Patients

in the early group were transferred to the operation room, and their open fractures were carefully washed and immediately stabilized. Whereas, in the late group, after washing the fractures the fractured bones were stabilized by the traction.

Daily arterial blood gases (ABG) were measured routinely from the time of admission until two days post operation or having a stable arterial O<sub>2</sub> tension (PaO<sub>2</sub>) of about 75 mmHg to obtain the conditions of the respiratory system. ABG was considered abnormal if, in a patient without lung parenchymal injury or requiring intubation and breathing room air, the level of PaO<sub>2</sub> was less than 65mmHg. The patients with diffused infiltrative changes in their chest radiographs, accompanied with abnormal ABG were considered as having ARDS, and those with severe respiratory dysfunction requiring intubation accompanied by mental deterioration, without fever or an obvious chest or head trauma were considered as being FES.

During the study, the patients who developed ARDS were intubated and admitted to the intensive care unit for mechanical ventilation support.

## Results

The present study was performed over a period of 20 months and comprised 150 patients with the age range of 11 to 50-years. They were 133 males and 27 females. Of the 123 patients of group I (early group), 63 patients were operated as early as the first 24 hours after the injury (group A) and 60 patients who operated after 48 hours (group B). Among the 27 patients of group II (late group), 14 patients were assigned to group A (early) and 13 patients to group B. The incidences of respiratory complications in each group are shown in Table 1.

*Group I-A (single femoral shaft fracture with early fixation):*

Of the 63 patients, arterial blood gases were normal in two (3.2%) cases throughout the hospital stay (PaO<sub>2</sub>>85 mmHg) with no respiratory symptoms. In 59 patients (93.6%), considered to have subclinical fat embolism, there was a rapid decline in PaO<sub>2</sub> (between 65-85 mmHg) mostly on the 2<sup>nd</sup> day of injury without any respiratory symptoms.

**Table 1:** Incidence of respiratory complications in patients with early and late femoral fixation

GROUP	ARDS&FES	Pao <sub>2</sub> ≤65 (mmHg)	Subclinical Fat Embolism	Normal PaO <sub>2</sub>	Total
	No (%)	No (%)	No (%)	No (%)	No (%)
I A	-	2 (3.2)	59 (93.6)	2 (3.2)	63 (100)
I B	2 (4)	13 (20)	45 (76)	-	60 (100)
II A	-	1 (7)	13 (93)	-	14 (100)
II B	3 (23)	7 (54)	3 (23)	-	13 (100)

Two other patients had abnormal arterial blood gases (PaO<sub>2</sub><65 mmHg) with mild respiratory symptoms possibly because of milder forms of fat embolism. They needed a prolonged hospitalization with nasal O<sub>2</sub> to relieve the symptoms. Both patients developed respiratory symptoms in the 2<sup>nd</sup> post operation day. None of them developed ARDS including severe form of fat embolism and respiratory dysfunction. The incidence of respiratory complications in group I-A was 3.2%.

*Group I-B (single femoral fracture with late stabilization):*

This group consisted of 60 patients, with abnormal PaO<sub>2</sub> (<85mmHg) throughout the hospital course. In 45 (76.3%) patients there was a rapid decline in PaO<sub>2</sub> (between 65-85 mmHg) mostly after the 2<sup>nd</sup> day of admission without any respiratory symptoms. A mild form of ARDS defined by abnormal arterial blood gases with PaO<sub>2</sub> <65 mmHg was observed in 13 (20%) patients who did not require intubation but needed prolonged hospitalization. Moreover, two patients developed ARDS including fat embolism and respiratory dysfunction (sudden onset of respiratory distress, decreased level of consciousness, diffuse infiltrations in chest radiographs and PaO<sub>2</sub><40mmHg).

The results in this group are summarized in Table 1. As indicated, the incidence of respiratory complications was 23.7%. This represented the sum of ARDS and abnormal blood gas results.

*Group II-A (early stabilization of multiple fractures):*

Of the 14 patients in this group with injury severity score (ISS) >18 points and femoral shaft fracture with either another major long bone or pelvic fracture, none of the patients had normal PaO<sub>2</sub> level (>85 mmHg) during the hospital course.

Thirteen patients had low PaO<sub>2</sub> levels (between 65-85 mmHg) beginning from the first day of injury with rapid decline on the 2<sup>nd</sup> day without any respiratory symptoms. Only a 25-year-old male patient with right subtrochanteric fracture of the femur and open book fracture of pelvis with PaO<sub>2</sub> level of 60 mmHg on the 2<sup>nd</sup> day of injury was operated within 24 hours of the injury. He developed mild respiratory symptoms, but did not require intubation. He was hospitalized for 3 days longer than average. None of the patients developed ARDS including fat embolism and respiratory dysfunction. The results are summarized in Table 1. 85% of patients were operated within 24 hours of injury and the incidence of respiratory complications was 7.1%.

*Group II-B (late fixation of multiple fractures):*

This group included 13 patients with femoral shaft fracture combined with another long bone or pelvic fracture, and had ISS>18 points but PaO<sub>2</sub> < 85 mmHg. Three (23.7%) patients had subclinical fat embolism characterized by PaO<sub>2</sub>= 65-85 mmHg without respiratory symptoms. Abnormal PaO<sub>2</sub> (<65 mmHg) was noted in seven patients (53.8%) who had respiratory symptoms and required, on the average, 4 days longer hospitalization but no need for intubation. The remaining three patients developed ARDS involving fat embolism and respiratory dysfunction.

## Discussion

The episodes of hypoxia and acute respiratory insufficiency can occur after trauma. This pattern of unexplained refractory hypoxemia was described using both terms of fat embolism syndrome and acute or adult respiratory distress syndrome.<sup>3,6,10</sup> FES coincides with the recognition of ARDS or as a discrete entity in the critically ill patients. It is now claimed that embolism occurs in more than 90% of patients after fractures. However, it is uncertain whether the degree of fat embolus correlates with the severity of injury to the lung or the risk of ARDS.<sup>1,3,6,7,10,15</sup>

Despite the development of medical and anesthetic management, evidence indicates that early treatment of the fractures in a multiply injured patient has a profound effect in reducing the risk of subsequent respiratory complications.<sup>3,7,10,22,23</sup> There are numerous studies showing that early fixation of femoral fractures can decrease the incidence of ARDS and multiple organ failure (MOF).<sup>14-17,22,24-26</sup> Over the last decade the beneficial effects of early stabilization of femoral shaft fractures by intramedullary nailing have been challenged. The association between early femoral fixation with reamed nailing and a higher risk of ARDS/MOF has been suggested.<sup>3,17,25-28</sup>

Some studies showed the effect of femoral reaming on the inflammatory process, which is an important factor in the pathogenesis of ARDS and MOF.<sup>29-31</sup> ARDS seen after multiple fractures is associated with high mortality rate (50%) and considerable morbidity survivors.<sup>1,3</sup> The etiology and pathophysiology of the condition are poorly understood and its early clinical signs are subtle and easily missed, which often results in delayed diagnosis.<sup>1-3</sup> There is a considerable clinical overlap between ARDS and fat embolism syndrome.<sup>1-3,10, 20, 21, 30,31</sup> It was classically described that there is an association between long bone fracture and respiratory insufficiency of FES.<sup>7,8</sup> Since that time,

this syndrome has been described as contributing source of ARDS.

According to some reports, the incidence rate of FES in patients who were stabilized late was much higher (22%) compared with those having early stabilization (4.5%).<sup>12,13</sup> Another retrospective study showed that there was a considerable decrease in the incidence of ARDS from 75 % in patients with multiple fracture treated by traction to 11% in those undergoing early fixation.<sup>14</sup>

The first prospective study on this subject showed that among 178 patients, the incidence of pulmonary complications was significantly higher in those with late stabilized fracture.<sup>17</sup> In patients with single fracture, the complication rate after late fixation was 22% in comparison with 4% after early stabilization. In multiple fractures, these rates the traction were 100% and 32%, respectively.<sup>15,16</sup> These findings were consistent with another retrospective study.<sup>26</sup>

Our prospective randomized study was designed to determine whether early stabilization of long bone fracture appreciably decreased the incidence of respiratory complications. The two subgroups of patients with multiple fractures were matched regarding age, type of injury, and injury severity score of more than 18 points. All hospital managements were also similar in these groups except for the time of stabilization.

The results of patients with single or multiple femoral fractures indicated that early stabilization significantly reduced pulmonary morbidity and the length of hospital stay. The range of postoperative hospital stay of group I-A of single or multiple femoral fractures were 2.5 to 5 days and in group II-B this was 3.5 to 10.5 days. The results of this study also demonstrated that although most patients of both groups had subclinical fat embolism, but respiratory complications were mostly observed in group B, which was similar to others' observations.<sup>6,8,9,19, 22, 23, 26,29,31</sup>

Although, some previous studies did not report ARDS in single femoral fracture following early or late fixation,<sup>8</sup> our results showed two cases of ARDS after late fixation of single femoral fracture.

Furthermore, a significant reduction in the incidence of respiratory complications was observed in those patients having early fixation of their femoral multiple fractures. This is said in part to be due to the optimum nutritional condition of the patients during this period.<sup>3,20,25</sup> Early fixation can lead to the prevention of thrombosis, subsequent bed ulcers, and decreased the needs for analgesics.<sup>20,22,30</sup> Furthermore, early stabilization eliminates the need for supine position for skeletal traction, it

improves pulmonary function and prevents atelectasis.<sup>3,20,22,25,30,31</sup>

## Conclusion

The present study indicated that early fixation of the femoral fracture will greatly diminish pulmonary complications and the length of hospital stays.

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