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# EFFECT OF MEDICAL AND SURGICAL MANAGEMENT ON PREVENTION ACUTE RESPIRATORY DISTRESS SYNDROME IN POLYTRAUMA PATIENTS

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**ABSTRACT** **Objective:** The purpose of this study is to determine the role of low molecular weight heparin (LMWH) early and delayed surgical management in patients of fat embolism **Materials and methods:** A total of 127 poly trauma patients admitted in between November 2022 to September 2023 were studied. The treatment was given in a tertiary care hospital, Maharashtra. Prophylactically, LMWH was administered to all the patients. Then they were treated to either conservative, early or delayed surgery based on the need. **Results:** Out of 127 patients, 86 (67.7%) patients underwent conservative treatment. The rest 41 patients (32.2%) underwent surgical treatment by open reduction and internal fixation. We examined all the patients for the development of ARDS /Fat embolism during the entire treatment period and until discharge. Conservative therapy seemed not to be beneficial and then all these 86 patients were subjected to surgical therapy (delayed treatment). In delayed treatment group, fat embolism was seen in 80 patients (93%). Out of 41 patients, fat embolism was seen in 15 (36.5%) patients. In delayed treatment group, majority of the patients presented with grade 3 fat embolism and in early treatment group majority of the patients presented with grade 1 fat embolism. The mortality rate was 8.1% in delayed treatment group and 2.4% in early treatment group. **Conclusion:** Acute respiratory distress syndrome can be prevented by early surgical treatment of long bone fractures. Delaying surgery would enhance the chances of occurrence of fat embolism. LMWH provides only supportive aid and can be prophylactically given. But cannot be considered as a replacement of early surgical intervention

**KEYWORDS :** Fat embolism, Early surgical therapy, Delayed surgical therapy, Low molecular weight heparin,Acute respiratory distress syndrome

## INTRODUCTION

Von Bergman initially discovered fat embolism syndrome in 1873 while treating a patient who had suffered a femur fracture[1]. FES typically results from pelvic fractures and long bone fractures in the lower extremities. Complete knee and hip replacement, kidney transplantation, burns, severe infections, osteomyelitis, blood transfusions, diabetes mellitus, alcohol-related hepatic failure, high-dose corticosteroid therapy, chronic pancreatitis, parenteral lipid infusion, and liposuction are among the additional etiological factors[1-3].

The concomitant injury and other issues make the incidence and mortality rates uncertain[4]. The incidence of FES in individuals with bone fractures ranges widely, from 0% to 35%. Age, gender, and kind of bone involvement all contributes to incidence. The classic triad comprises symptoms related to the skin (petechiae), central nervous system (mental confusion), and lungs (dyspnea)[5].

The diagnosis depends on the patient's medical history and current symptoms. A clinical approach combining general patient assessment of the traumatic event, patient care coordination, active nutritional support, symptomatic therapy, and appropriate physical intervention is utilized with patients with FES [6].For FES, the recommended dosage and duration of steroid treatment are unknown[7]. Steroids do, however, have well-known positive effects that stabilize the pulmonary capillary membrane, inhibit the inflammatory response, reduce the interstitial edema, inhibits the complement system from activating, and even terminates the platelet activation[7]. When albumin is administered to individuals suffering from fat embolism syndrome, the levels of free fatty acids decrease [6, 7]. Many therapeutic approaches using drugs like ethanol, dextran, heparin, nonsteroidal anti-inflammatory drugs, and heparin-glucose infusion had been attempted; nevertheless, no reduction in morbidity or death had been documented. Consequently, none of these are taken into account in standard practice [6, 7]. No randomized, controlled trials or extensive retrospective data exist to support the routine use of heparin or other anticoagulants in FES.

Standard care is at the level of a supportive intensive care unit. The majority of patients need fluid resuscitation because they are significantly hypovolemic. While the patient heals, supportive correction of hypoxemia with extra oxygen or mechanical ventilation is frequently required. If there is central nervous system malfunction, intracranial pressure monitoring should be taken into consideration along with regular neurological tests[8]. Vasopressors might be necessary. Case reports involving patients with severe FES resulting in refractory systemic arterial hypotension and shock have indicated success with both mechanical support devices and extracorporeal membrane oxygenation as a bridge to recovery [9, 10]

Additionally, it has been demonstrated that surgical technique and timing affect FES. FES is less common with early surgical fixation (within 24 hours of trauma) than with delayed fixation[11]. External fixation is an example of an intermediate technique or delayed approach that may be tried on patients whose early surgical risk is prohibitive[12]For long bone fractures, early open reduction and internal fixation are strongly advised. Patients who receive conservative care for long bone fractures have a higher prevalence of fat embolism syndrome

Therefore the aim of our study was to assess the effect of early medical treatment by the use of low molecular weight heparin (LMWH) along with early o delayed surgical treatment.

## METHODOLOGY

A total of 127 poly-traumatized patients with various body injuries associated with femoral/ and or tibial fractures or pelvic fractures treated in our hospital were studied. Prophylactically, low molecular weight heparin was introduced subcutaneously to all the patients, in order to prevent fat embolism. Out of 127 patients, 41 patients were scheduled for early internal fixation of fractures, and the rest of 86 patients underwent conservative management and they were later scheduled for surgical procedure. So, the surgical procedure was delayed in these patients. Patients were assessed for the development of fat embolism regularly during the course of treatment by certain diagnostic criteria mentioned below.

## CRITERIA FOR DIAGNOSIS OF FAT EMBOLISM

Post-traumatic respiratory distress manifests as tachypnoea and the typical snowstorm infiltrations in the chest X-ray films were considered important criteria[13, 14], but disturbance of consciousness, skin petechiae, low arterial oxygen content and pyrexia were also considered important[14]. The development of anaemia and thrombocytopaenia were often noted [15], but they also occur in injured subjects without fat embolism. The distribution of these diagnostic features is considered to have clinical fat embolism is shown It should be stressed that respiratory assistance was instituted in allpatients from the beginning of the treatment, which in many cases prevented the arterial oxygen pressure from falling below 60 mm Hg.

Three different grades of fat embolism were distinguished. The first grade fat embolization which appears soon after the injury, is signaled by skin petechiae and one or two additional mild signs. The second grade fat embolism is recognizable because of the presence of skin petechaie and other characteristic features as grade 1, but the symptoms are harmless. The 3rd grade is the clinical fat embolism, characterized by the presence of several typical diagnostic criteria and is a severe condition needing respiratory assistance.

The relative values of the various criteria used were tested by finding a correlation matrix between the criteria and all variables involved.

The demographics characteristics of the patients, other associated injuries, $PaO_2$, and the signs and symptoms of fat embolism were recorded. All injuries were classified and ISS (injury severity score) was calculated. Chest x-rays were taken in order to confirm the diagnosis.

All data were analyzed using SPSS software (SPSS 11.5, Chicago, IL). A p value <0.005 was considered to be statistically significant between both the groups.

## RESULTS

A total of 127 patients with multiple fractures including femoral shaft fractures, pelvic fractures and other associated injuries were studied during the study period. A LMWH was introduced subcutaneously as a prophylactic measure in all the patients to prevent the occurrence of fat embolism. 41 patients were treated by early surgical procedure involving open reduction and internal fixation. The rest 86 were initially treated conservatively and then later on were subjected to surgical procedure. The patient groups (Delayed and early treatment) were comparableregarding age, gender, mechanism of injury and injury severity score (ISS). Demographic characteristics are presented in table 1

**Table 1:** Demographic characteristics

| | Delayed (n=86) | Early (n=41) | P value |
|---|---|---|---|
| Age (Mean, yr) | 38.4 | 37.9 | NS |
| Males | 60 (69.7%) | 33 (80.4%) | NS |
| Females | 26 (30.2%) | 8 (19.5%) | NS |
| Mean ISS | 29 | 31.2 | |
| Mode of injury: | | | |
| Motor vehicle crash | 59 (68.6%) | 21 (51.2%) | NS |
| Pedestrian | 8 (9.3%) | 7 (17%) | NS |
| Motorcyclist | 7 (8.1%) | 6 (14.6%) | NS |
| Fall | 9 (10.4%) | 5 (12.1%) | NS |
| Other | 3 (3.4%) | 2 (4.8%) | NS |

A total of 95 patients (74.8%) presented with fat embolism. The criteria for the clinical diagnosis of fat embolism were recorded. The distribution of these diagnostic features are presented in in table 2. It should be stressed that respiratory assistance was instituted in all patients from thebeginning of the treatment, which in many cases prevented the arterial oxygen pressure from falling below 60 mm Hg. Nevertheless a PaO2 below 60 mm Hg was noted in 52 out of 95 cases.

The analysis showed no particularly high correlation between individual criteria or between the criteria and other variables, indicating that the criteria are statistically almost independent of each other

**Table 2:** Criteria for the clinical diagnosis of ARDS in patients

| | No of cases (out of 95) |
|---|---|
| Positive chest X-ray films | 56 (58.9%) |
| Disturbance of consciousness | 78 (82.1%) |
| Skin petechiae | 75 (78.9%) |
| Tachypnoea | 73 (76.8%) |
| Arterial PO2 below 60 mm Hg | 52 (54.7%) |
| Pyrexia | 93 (97.8%) |
| Diagnosis within 5 days of the accident | 75 (78.9%) |

Fat embolism was diagnosed increasingly in delayed treatment group when compared to early treatment group (93% vs 36.5%) and this difference was statistically significant. The mortality rate was also significantly more in delayed treatment group, when compared to early treatment group (8.1% vs 2.4%). This difference was also statistically significant. One patient who died in early treatment group presented with multiple injuries with many long bones broken.

**Table 3:** ARDS and mortality in delayed and early surgical treatment

| | Delayed treatment | Early treatment | P value |
|---|---|---|---|
| Total patients | 86 (67.7%) | 41 (32.2%) | <0.005 |
| Fat embolism | 80 (93%) | 15 (36.5%) | <0.005 |
| No fat embolism | 6 (6.9%) | 26 (63.4%) | <0.005 |
| Mortality rate | 7 (8.1%) | 1 (2.4%) | <0.005 |

Table 4 shows the grading of fat embolism. Delayed treatment group presented with more number of patients with increased severity, when compared to early treatment group. Grade 2 patients were more in delayed treatment group when compared to early treatment group (11.6% vs 4.8%). Similar findings were seen with grade 3 severity (81.3% vs 2.4%). Early treatment presented more cases with grade 0 severity (29.2%). These differences were statistically significant.

**Table 4:** Grading of fat embolism

| | Delayed treatment | Early treatment | P value |
|---|---|---|---|
| Grade 1 | 0 | 12 (29.2%) | <0.005 |
| Grade 2 | 10 (11.6%) | 2 (4.8%) | <0.005 |
| Grade 3 | 70 (81.3%) | 1 (2.4%) | <0.005 |

## DISCUSSION

FES is most commonly associated with orthopedic trauma, with highest incidence in closed, long bone fractures of the lower extremities, particularly the femur [16].The risk of FES complicating orthopedic trauma is highest in ages 10 to 40 years and occurs in men more frequently than women[17]. Nonorthopedic causes of FES are exceedingly rare and include pancreatitis, sickle cell crisis, alcoholic liver disease, bone marrow harvest or transplant, and liposuction [18].

In the orthopedic and trauma literature, the incidence of FES has ranged from <1% to >30% of cases. Treatment of FES consists of ensuring good arterial oxygenation. High flow rate oxygen is given to maintain the arterial oxygen tension in the normal range. Additionally, maintenance of intravascular volume is important, because shock can exacerbate the lung injury caused by FES. Albumin has been recommended for volume resuscitation in addition to balanced electrolyte solution, because it not only restores blood volume but also binds with the fatty acids and may thus decrease the extent of lung injury. Mechanical ventilation and PEEP may be required to maintain arterial oxygenation [19]. Medications, including steroids, heparin, alcohol, and dextran, have been found to be ineffective [20].

The early fixation of long-bone fracture is important to prevent or to decrease the severity of FES[21.]

In our study, we administered low molecular weight heparin prophylactically in order to prevent the occurrence of fat embolism in all the patients, irrespective of whether they were subjected to conservative or surgical therapy. A total of 86 patients underwent conservative therapy, since they presented with closed and stable fractures involving long bones like femur and pelvic and at certain times with other associated injuries, these patients were later subjected to surgical procedure, owing to the fact that conservative therapy failed in them. The rest 41 patients underwent open surgical procedure with early internal fixation as the preliminary treatment. These patients presented with multiple long bone fractures. During the course of therapy, we evaluated all the patients for fat embolism. We found 93% of the patients to be presenting with fat embolism in thedelayed treatment group and 36.5% of the patients in the early treatment group to be presenting with fat embolism. So early surgical intervention with early internal fixation reduced the occurrence of fat embolism in our study. Early fixation minimizes the inflammation and hypovolemic state of patient, which may contribute to FES.

According to a study by El-Shazly et al16, early fixation of long bone fractures within 24 hours of injury was associated with a lower incidence of FES than delayed fixation after 24 hours. The study also found that prophylactic use of methylprednisolone, a steroid drug, reduced the risk of FES in patients with long bone fractures[22]

Svenningsen et al[23] conducted a study in 1980 on 220 patients with femoral fractures to explore the impact of early versus late fixation on the prevention of fat embolism among patients. They stated that the incidence of fat embolism in patients who had an early fixation of their femur fractures was 1.8%, whereas the incidence among those who had delayed fixation was significantly higher, with a figure of (10.4%).

The timing of fixation of long bone fracture seemed to be a major contributor to the outcome[24] Furthermore, Korhan et al[4] in their review article reported that early surgical fixation and immobilization of long fractures had reduced the incidence of pulmonary complications significantly. Overall, the incidence of fat embolism after long fracture fixation ranged from 2.7% [25] and 11%[26]. More specifically, the incidence among long bone fracture patients who were operated early (within the first 24 hours after injury) ranged from zero% in some studies to 1.8% in others. As regards late operation, after 24 hour of bone fracture, the incidence of fat embolism syndrome (FES) ranged from 3.5% to 10.4% [27-29]Mortality rates from fat embolism is high ranging from 5 – 10% [30,31]. In our study, we found 8.1% of mortality rate in delayed treatment and 2.4% in early treatment.

According to a study published in Clinical Epidemiology, the mortality rate of fat embolism syndrome (FES) due to delayed surgical treatment is estimated to be between 5% and 30% 32 . The study also found that patients with delayed care reported increased rates of complications including fat embolism, acute respiratory distress syndrome, pneumonia, as well as intensive-care unit (ICU) admissions, and length of stay (LOS) were all greater among the cohort with delayed treatment [32] .

## CONCLUSION

The frequency of the development of fat embolism after fractures of long bones seems to be reduced by early internal fixation of long bone and pelvic fractures. This may operate through a reduction in marrow fat release from the fracture following its stabilization by surgery. LMWH may provide only supportive treatment. It can be prophylactically given along with early internal fixation to enhance the outcomes. Therefore, based on the available evidence, it seems that conservative management of fractured long bone may not be the best choice to avoid fat embolism and its complications. LMWH may add up to the outcome when given prophylactically, along with early internal fixation. Preventive effect of early internal fixation of fractures in patients with multiple injuries is strongly advised.

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