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Dr. K Thanigaimani
Professor, Department of Orthopaedics, M.G.R University Stanley Govt. Medical College Tamil Nadu, India

Dr. Gurumoorthy M
Associate Professor, Department of Orthopaedics, M.G.R University Stanley Govt. Medical College Tamil Nadu, India

Dr. Yogesh TC
Associate Professor, Department of Orthopaedics, M.G.R University Stanley Govt. Medical College Tamil Nadu, India

Corresponding Author:
Dr. K Thanigaimani
Professor, Department of Orthopaedics, M.G.R University Stanley Govt. Medical College Tamil Nadu, India

Fat embolism syndrome: Case study of a Clinical conundrum

Dr. K Thanigaimani, Dr. Gurumoorthy M and Dr. Yogesh TC

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Abstract
The effect of recent advances in critical care and the emphasis on current practice in early diagnosis in patient with fat embolism syndrome by conducting 2 year review of experiences at our trauma centre.18 patients with clinically apparent fat embolism syndrome were identified. The diagnosis of FES was made by clinical criteria including hypoxia (18 patients 100%), mental status changes (13 patients 72%), high temperature (13 patients 72%), tachycardia (18 patients 100%), thrombocytopenia (10 patients 55%).10 patients (55%) had multiple long bone fractures and 8 patients (45%) had single long bone fractures. 6 patients (33%) had open fractures remaining 12 patients (67%) had closed fractures. Manage the patients for early operative fixation was emphasized. There were 7 deaths with mortality of 39%. Conclusion: The fat embolism syndrome remains a diagnosis of exclusion and is based on clinical criteria. Clinically apparent FES is unusual but may be masked by associated injuries in more Severely injured patients. No association could be identified between FES and a specific fracture pattern or location. While FES seems to have a direct effect on survival, the management of FES remains primarily supportive and early operative stabilization should be done to reduce the mortality and morbidity.

Keywords: Fat embolism syndrome, Clinical conundrum, neurological

Introduction
Fat embolism which may be asymptomatic or symptomatic is defined as the circulation of fat droplets in the blood and presence of fat droplets in the lung parenchyma which is most commonly after a fracture of long bones or major trauma/ crush injury. Another term 'fat embolism syndrome' (FES) indicates a much severe manifestation involving multiple systems. Clinically apparent symptoms can start within 12 hrs of injury/inciting event; but most of the patients start experiencing symptoms 24-72 hrs later. Unpredictable presentation s many of the symptoms are subtle, patients are need to be evaluated with high degree of suspicion and watchful clinical monitoring. Gurd *et al*. described the classic clinical criteria with respiratory, neurological and cutaneous symptoms and signs for the diagnosis [1].

Gurd's criteria
Major Criteria
1. Respiratory insufficiency
2. Cerebral involvement
3. Petechial rash

Minor criteria
1. Fever
2. Tachycardia
3. Retinal changes
4. Jaundice
5. Renal changes
6. Anemia
7. Thrombocytopenia
8. Elevated ESR
9. Fat macroglobulinemia

At least 1 Major and 4 Minor criteria needed for Diagnosis

In our retrospective study of 18 patients in a tertiary trauma care centre analysis was done to know the clinical spectrum, incidence and prevention of Fat embolism syndrome and its treatment.

Background

The fractures of long bone and crush injury were the usual culprits thought to be causative for Fat embolism syndrome and to produce increased lipolysis of adipose tissue. Fat embolism subdivided into three grades according to the severity. Grades I and II are considered to be mild. Grade III is usually referred to as the clinical fat embolism syndrome, is a dangerous which may consume life if left untreated. Usual consensus is that best approach to prevent clinical fat embolism syndrome by early aggressive treatment through early operative fixation.

Materials and Methods

A retrospective study analysis was done in our tertiary care trauma center government Stanley medical college, Chennai, after getting ethical committee approval for the medical record case sheets of patients whom had been diagnosed with Fat embolism syndrome using Gurd *et al*. criteria from May 2017 to May 2019. We have collected data regarding demographics, injury severity scores (ISS), clinical presentation, onset time of symptoms of FES, lab investigations, management and outcomes. We have also compared the data between various criterias.

Eighteen patients with multiple injuries and fractures of the long bones and pelvic boneswere treated emergently using operative and conservative methods in first stage. The main outcome studied was clinical fat embolism syndrome (grade III fat embolism).

Results

Of the total 3577 patients with long bone and pelvic fracture admitted to the zero delay emergency wards, 18 patients were identified with fat embolism syndrome during the study period. Fractures of the long bone femur was the main contributor 55.6% (10), next major contributor was fracture both bone leg and crush injury at 33% (6) and pelvic fractures contributed around 11.1% (2).

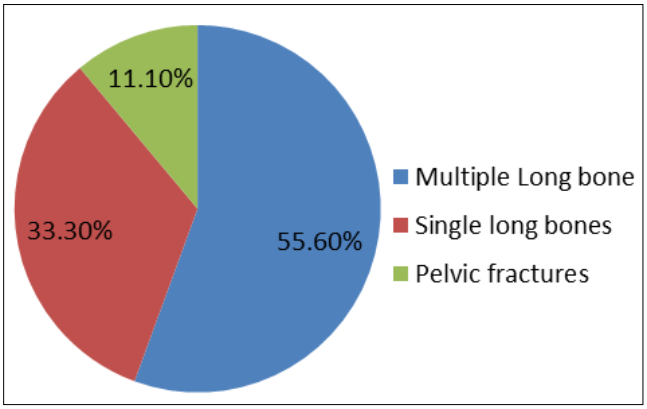
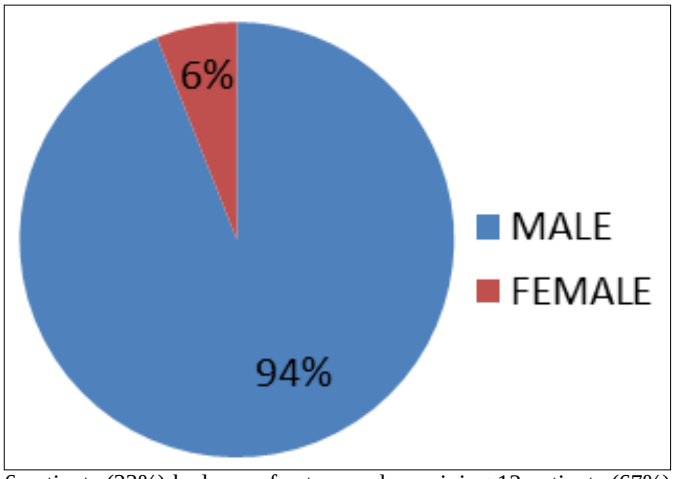


Fig 1: Fractures contributing to Fes

These patients were diagnosed to have Fat Embolism Syndrome as per Gurd *et al*. criteria with incidence around 0.5%. 4 of the total 18 patients with fat embolism syndrome had multiple bone fracture (22%). The ratio of the affected patients in terms of male to female was 17:1.



6 patients (33%) had open fracture and remaining 12 patients (67%) had closed fractures.

Fig 2: Total no of cases

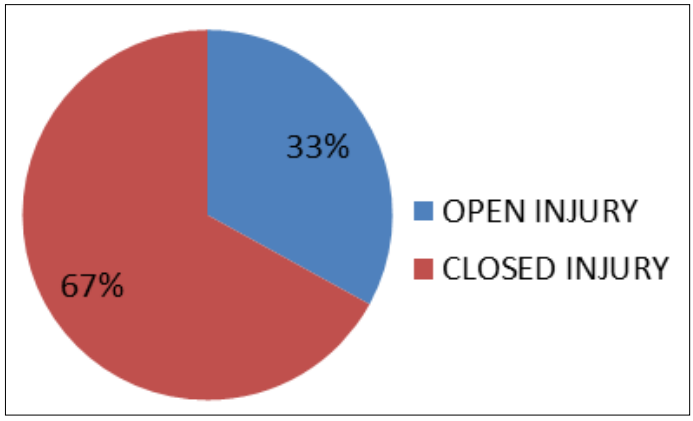


Fig 3: Type of injury

All of the admitted patients to the zerodelay emergency ward suffered fractures and crush injuries due to motor vehicle accidents. Affected patient's age ranging from 15 years to70 years with average of 42 years. The symptoms started appearing from 2nd day in 7 patients, from 3rd day in 6 patients and from 4th day in 5 patients.

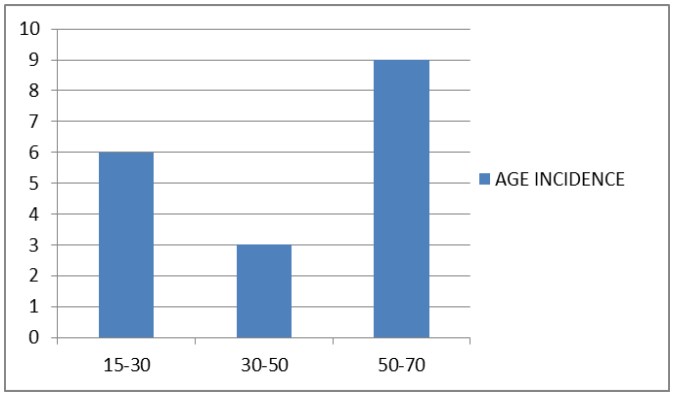


Fig 4: Age Incidence

All patients displayed at least two of the three major signs described by Gurd *et al*. And patients who have diagnosed with fat embolism syndrome clinically we have taken CT pulmonary angiography to confirm the findings and 7 patients out of 18(38) showed typical pulmonary changes. We hadn't done MRI brain to document cerebral findings as the diagnosis had been well established clinically [3].

We mainly managed all 18 patients with fat embolism

syndrome, conservatively with steroid as supportive care in the initial period to control inflammatory responses and we have managed the fractures with early fixation either internal fixation or external fixation within 3days in 27% of the patients (5) and for the next 27% patients (5) within 5th day after improvement in patient's clinical status. 7 patients died due to ARDS, Multi organ dysfunction syndrome, septicemia and the associated complications within the supportive care period (39%) mortality. As the respiratory parameters deteriorated, we have put 8 patients on ventilator. The mean stay in ventilator was 6.5 days (standard deviation 3.1 days). All the patients who have been undergone early surgery had very less complications and the patients who haven't been undergone any stabilization succumbed to the complications. We haven't encountered any post operative mortality.

Discussion

Fat droplet embolises into the blood vessels in every long bone and pelvic fractures inevitably. In 1974 Gurd *et al*. published a landmark study which explained the pathophysiology and clinical signs and criteria for the diagnosis of fat embolism syndrome [1].

The studies published earlier which are mainly retrospective studies, the incidence of fat embolism syndrome has been marked ranging from 0.5% to 35% in prospective studies. But clinically diagnosable fat embolism according to Gurd *et al*. criteria in our study is 0.5% as our study included patients from all age groups ranging from 15 years to 70 years eliminating the major bias.

Even though diagnosis is mainly through clinical signs and symptoms, confirmation with demonstration of fat droplets in blood/urine with broncho- alveolar lavage fluid is necessary to prevent further morbidity and mortality. We have done fat droplets demonstration in blood, retina and urine but we have not tested for broncho alveolar fluid. And we have also found hypocalcemia, hypoalbunemia in 72%, 66% of the patients respectively. It may be due to free binding of free fatty acids (FFA) which are formed from hydrolysis of fat droplets, to ionized calcium and free albumin respectively. We have found thrombocytopenia and anemia in almost all the patients which may be due to inflammatory changes induced by fat droplets in various organs.

Radio Diagnosis

Though chest x-ray findings are mostly less sensitive and less specific when compared to CT pulmonary angiogram, recognition ground glass opacity pattern in chest x-ray as a primary evaluation will pave the way to rule out pulmonary fat embolism from other lung conditions like pneumothorax and hemothorax. Being a better diagnostic imaging than chest x-ray, CT chest will not add much to the diagnosis other than showing minor chest infiltrates in the acute stage. Even better investigative modality is CT pulmonary angiography to find out the level of vessel occlusion and inflammatory changes [17].

Magnetic resonance imaging (MRI) of brain does contribute to the diagnosis in an effective way as it is easy to diagnose the cerebral fat embolism through MRI brain. As cerebral fat embolism is An less frequent, but most serious complication of fat embolism syndrome in terms of mortality figures, necessary light should be thrown on the poly trauma patients with signs and symptoms of head injury. CT brain is an inferior study when compared to MRI brain but it can be used to rule out other causes of brain dysfunction in the acute setting. With MRI we can diagnose cerebral fat embolism where patient presents with typical MRI findings in the absence of head injury. We have lost 3 of our patients out of 18 due to cerebral fat embolism even with continued supportive management. 5 patients (28%) other than the 3 died due to cerebral fat embolism were recovered well without any focal lesion with supportive care and early stabilization of fractures.

Management

The treating Orthopaedician must bear the differential diagnosis in mind by looking for other pathological conditions of the lung in the setting of trauma before making the diagnosis of fat embolism syndrome. We used the usual medical supportive care which is by providing adequate ventilation either through mask or ventilator, hydration, oxygenation, and maintain the stable hemodynamics of the patient by using necessary blood products accordingly. Though some studies say use of steroid prophylaxis is unnecessary with no proven role, some studies show reduced severity of symptoms and reduction in mortality [11].

We have utilized resources in our centre and did early operative fixation (both internal (28%) and external fixation (28%) according to the Patients general medical conditions in 10 patients (53%). All the patients recoverd without any major complications and mortality postoperatively. Sometimes perioperative morbidity/mortality may be due to intraoperative reaming of long bones which may aggravate the fat embolism syndrome but we haven't encountered any such complication as we have opted for unreamed nailing to stabilize the long bone fractures. Earlier studies advice against the surgery in acute setting of fat embolism syndrome but recent studies shows that early stabilization of fractures will retard further progression of fat embolism syndrome if patient's general condition permits. None of the operated patients deteriorated in our study.

Outcome

The FES mortality is ranging from 5% to 15% in various published studies. In our study we have encountered 39% this much high mortality may be related to high velocity trauma and late presentation to tertiary care centre. Even then almost the entire patient population responded well to the adequate supportive care provided. In 1995 Bulger *et al.* published a ten year review study which reported mortality rate of 7% [2]. The usual determinant of mortality in fat embolism syndrome is progressive type 1 respiratory failure due to evolution of Acute respiratory distress syndrome. In our study we did post mortem for the all 7 patients and confirmed our diagnosis. Studies conducted on poly trauma patients reported mortality rates as high as 85% in various studies. Early operative stabilization of long bone fractures are the one which described in studies to mitigate the complications in the fat embolism syndrome along with advanced supportive care.

Conclusion

Based on our observations in this study we would like to recommend the following.

1. Early diagnosis and advanced supportive care will do wonders in the management of fat embolism syndrome.
2. Poly trauma which associated with high velocity injuries is adversely affecting the prognosis and leads to mortality.
3. Early operative stabilization is a bankable option in case of fat embolism syndrome which reduces hospital stay and reduces morbidity and mortality. But operative

intervention should be decided on case to case basis according to the Patients general medical conditions.
4. Unreamed nailing and external fixations avoids the perioperative morbidity and mortality.

Limitations

More volume of cases must be studied to come to a concrete conclusion.

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