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ORIGINAL RESEARCH

Preventing fat embolism syndrome with prophylactic corticosteroids in isolated lower limb long bone fractures

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ABSTRACT

Background: Fat Embolism Syndrome is a severe complication, commonly seen in long bone fractures, particularly including that of the femur and the tibia. The study presents the efficacy of Methyl Prednisolone in terms of minimizing incident severity in patients experiencing closed femoral or tibial fractures and those experiencing closed femur tibial fractures.**Methods:**50 patients with closed tibia or femur fractures were randomly assigned to one of two groups in this study: Group A (Placebo, including 25 patients) or Group B (Methyl Prednisolone, including 25 patients). Age, sex, BMI, smoking status, diabetes, hypertension, and fracture type were among the baseline demographics that were noted. Clinical parameters for development related to FES were assessed such as axillary or subconjunctival petechiae, tachycardia, hypoxemia, pyrexia, pulmonary edema, retinal petechiae, urinary fat globules, high ESR, and CNS symptoms.**Results:** The incidence of FES was significantly lower in Group B than in Group A (12% vs. 60%, $p < 0.005$) in patients treated with Methyl Prednisolone; Group B also showed a significantly lower occurrence of hypoxemia (16% vs. 52%), pulmonary edema (8% vs. 44%), and CNS symptoms (16% vs. 48%) that are considered key symptoms of FES.**Conclusion:** Methyl Prednisolone significantly reduces the incidence of Fat Embolism Syndrome and its severity in patients with closed femur or tibia fractures. The authors recommend that further studies with larger populations be conducted to confirm these findings.

Key words: Fat embolism syndrome, methyl prednisolone, gurd's and wilson criteria

INTRODUCTION

A form of embolism called a fat embolism is frequently (though not always) caused by a physical trauma. It is the presence of fat globules that block circulation, typically due to burns, parturition, long bone fractures, or fatty liver degeneration [1]. The number of trauma victims has increased dramatically in this age of rapid industrial development, infrastructure expansion, and an increase in traffic. The number of trauma patients visiting hospitals has increased in part because of inadequate infrastructure and safety measures, particularly two-wheeler drivers [2]. The incidence of complications related to fractures and, consequently, fat embolism has increased along with the number of trauma patients throughout time.

Distinguishing between fat embolism and fat embolism syndrome is crucial. The term "fat embolism" describes the presence of fat globules in the peripheral circulation and lung parenchyma following a significant trauma or long-bone fracture [3]. Fat embolism syndrome is a severe form of fat embolism that typically appears 72 hours after the injury and includes thrombocytopenia, progressive respiratory insufficiency, and declining mental status1. More than 90% of patients with long-bone fractures have fat emboli, which are rather frequent and can be identified using a variety of methods [4]. Contrarily, Fat embolism syndrome is extremely uncommon and is estimated to occur in 0.5% to 2.0% of patients with single long-bone fractures and 5% to

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10% of patients with multiple long-bone fractures or concurrent pelvic fractures [5].

MATERIALS AND METHODS

STUDY PERIOD: April 2022 to March 2024.

PLACE OF STUDY: Karnataka Medical College and Research Institute, Hubli.

SAMPLE SIZE:50 cases.

INCLUSION CRITERIA

1. Age between 15 and 50 Years.
2. One or more than one long bone Closed fracture/s of lower limb.
3. Presentation within 24 hours of injury.

EXCLUSION CRITERIA

1. Thoracic/chest, Abdominal and Head injuryrequiringadmission/interventionunder concerned specialities.
2. Associated upper limb long bone fractures, pelvic fractures, vertebral fractures, ribfractures.
3. GCS <15 at presentation.
4. Age <15 yrs or more than 50 yrs.
5. Associated co morbidities-COPD, Bronchial asthma, cardiac disease
6. Patients with shock-haemorrhagic, septic, cardiogenic and neurogenic

All of the assessed patients were admitted to the orthopaedic department of the hospital. Their sex, age, and injury mechanism were noted. Records were also kept of any immobilization techniques utilized as patients were being transported to the hospital. At admission, digital x-rays of the cervical spine (lateral), chest (PA), pelvis and long bone fractures were taken. In order to rule out other injuries, cross-references were made between the specialties of general surgery, neurosurgery, and cardiothoracic surgery when needed.

Blood pressure, pulse rate, respiration rate, and GCS values over 24 hours, 48 hours, and 72 hours were noted. Ophthalmology references were made for fundoscopic examinations to check for retinal emboli at 24, 48, and 72 hours. The presence or absence of skin/conjunctiva petechiae in 24, 48, and 72 hours was also noted. ABG examinations were performed on each patient within 12 hours of admission and thereafter every 24 hours for three days. For ABG analysis, the radial artery was chosen, and room air ABG measurements were noted. After being put on oxygen through a mask at a rate of 4 L per minute, hypoxemic patients were moved to the intensive care unit for monitoring and treatment.

STATISTICAL ANALYSIS

The variables were tested for normal distribution using the Kolmogorov-Smirnov test following the analysis of exploratory data. Non-parametric tests were employed since not all variables satisfied the requirements for a normal distribution. The Mann-Whitney-U test was used to compare continuous variables between groups, while the chi-square test was used to compare dichotomous variables. P-values were considered statistically significant if they were less than 0.05, IBM SPSS software was utilised for data recording and analysis.

Table 1: Gurd's and Wilson Criteria

Major Criteria	Minor Criteria
Axillary or Sub conjunctival petechiae	Tachycardia > 110/minute
Hypoxemia PaO2 <60 mm Hg	Pyrexia > 38.5
Pulmonary edema	Retinal fat or petechiae
Sudden drop of Hb level >20%	Urinary fat globules
Central Nervous system depression disproportionate to hypoxemia	Oligoanuria
	Thrombocytopenia > 50%
	High ESR >71 mm/ hour

Table 2: Demographic details

Patient Demographics Table

Variable	Group A (Placebo) (n=25)	Group B (Methyl Prednisolone) (n=25)
Age (years)	32.5 ± 8.4	34.2 ± 7.9
Sex (M/F)	18/7	17/8
BMI (kg/m²)	26.8 ± 3.5	27.2 ± 3.2
Smokers (%)	40% (10/25)	36% (9/25)
Diabetes (%)	12% (3/25)	8% (2/25)
Hypertension (%)	16% (4/25)	20% (5/25)
Fracture Type (Femur/Tibia)	14/11	15/10

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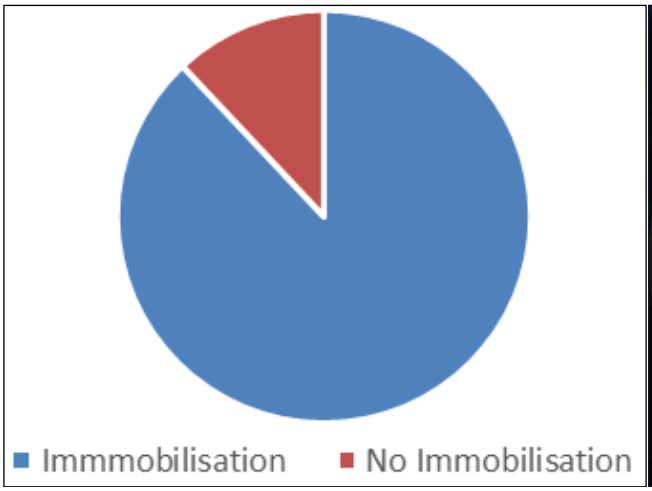

Image 1: Immobilization at time of presentation

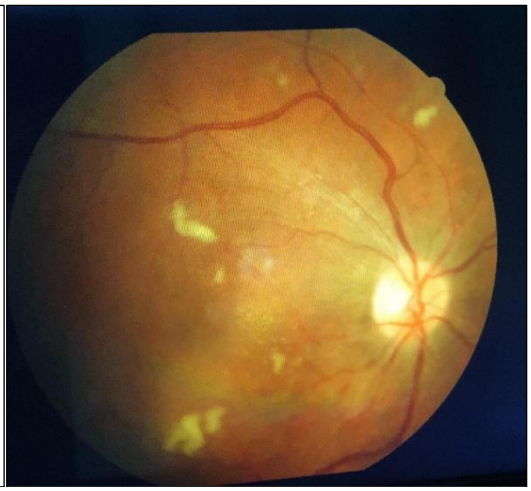

Image 2: Fundus image of FES

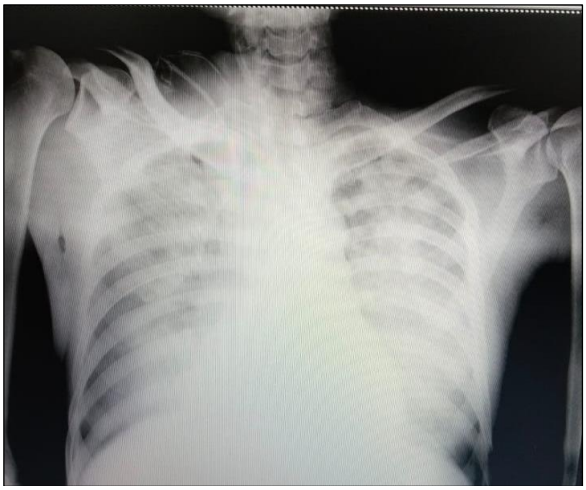

Image 3: Chest Radiograph showing Pulmonary edema

Table 3: Comparison of Clinical feature between groups

Variable	Group A (n=25)	Group B (Methyl Prednisolone) (n=25)
Axillary or Subconjunctival Petechiae (%)	48% (12/25)	12% (3/25)
Tachycardia >110/min (%)	56% (14/25)	20% (5/25)
Hypoxemia (PaO_2 <60 mmHg) (%)	52% (13/25)	16% (4/25)
Pyrexia >38.5°C (%)	60% (15/25)	24% (6/25)
Pulmonary Edema (%)	44% (11/25)	8% (2/25)
Retinal Fat or Petechiae (%)	40% (10/25)	12% (3/25)
Urinary Fat Globules (%)	36% (9/25)	8% (2/25)
High ESR (>71 mm/h) (%)	64% (16/25)	28% (7/25)
CNS Symptoms (Confusion, Agitation) (%)	48% (12/25)	16% (4/25)

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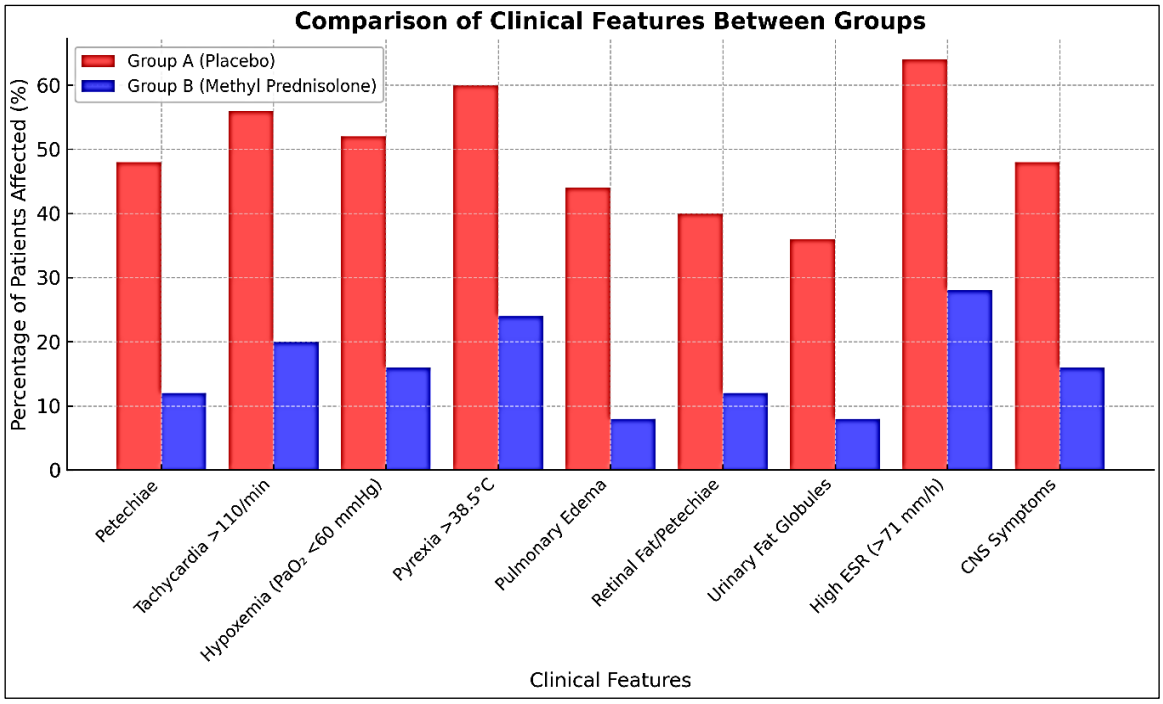

Graph 1: Comparison of Clinical feature between groups

Table 4: Treatment Outcome Table

	Normal	Developed FES	Total
Group A	10	15	25
Group B (Methyl prednisolone)	22	3	25

Fisher's exact test gives a p-value of 0.00045, which is well below 0.005. This means the difference in disease occurrence between the placebo and drug groups is highly statistically significant.

RESULTS

The average age of Group B (Methyl Prednisolone) was 34.2 years, whereas the average age of Group A (Placebo) was 32.5 years. There were 17 males and 8 females in Group B, compared to 18 males and 7 females in Group A. Group A and Group B exhibited comparable weight distributions, with Group A's average BMI being 26.8 and Group B's being 27.2. Compared to 36% (9/25) of Group B, 40% (10/25) of Group A smoked. Group B contained 8% (2/25) diabetic patients, compared to 12% (3/25) in Group A.Of the patients with hypertension, 16% (4/25) were in Group A, and 20% (5/25) were in Group B. There were 14 femur and 11 tibia fractures in Group A and 15 femur and 10 tibia fractures in Group B. The demographic parameters between both groups were well balanced, ensuring comparability in outcomes.

In Group A, axillary or subconjunctival petechiae are more prevalent (48% compared to 12% in Group B). High heartbeat (>110/min): compared to 20% of Group B, observed in 56% of Group A. 52% of Group A had hypoxemia (PaO_2 <60 mmHg), compared to 16% of Group B. 60% of Group A had pyrexia (>38.5°C), compared to 24% of Group B. Compared to 8% of Group B, 44% of Group A experienced pulmonary edema. 40% of Group A and 12% of Group B had retinal fat or petechiae. Compared to 8% of Group B, 36% of Group A had urinary fat globules. High ESR (>71 mm/h): 64% of Group A had an elevated ESR, compared to 28% of Group B.

FES was developed by 15 out of 25 (60%) in Group A (Placebo). Methyl Prednisolone Group B: Just 3 out of 25 (12%) experienced FES. Methyl Prednisolone's potential preventive impact in high-risk fracture patients was confirmed by the considerable reduction in the incidence of FES. The majority of patients (88%, or 44 patients) who were brought to our hospital were immobilized in some way upon arrival (e.g., splints, back slabs, Thomas splints, etc.), while 6% (6 patients) were not immobilized at all.

DISCUSSION

FES is such a serious disorder, usually arising after long bone fractures, orthopaedic surgery, or acute soft tissue injury, that fat globules should be present in the pulmonary and systemic circulation [6].

Pathophysiology involves metabolic and mechanical mechanisms. According to the mechanical theory, the fat globules from bone marrow travel through the venous system into the pulmonary circulation and, in the most severe cases, via a patent foramen ovale into the systemic circulation [7]. On the other hand, the biochemical theory proposes that free fatty acids released from triglyceride hydrolysis interact with cell membranes damaging the endothelium and following

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this inflammatory events and platelet aggregation act, furthermore, augmenting the leakage from the capillaries and dysfunction of the organs [8]. Most of the time clinical manifestations appear between 24-72 hours later and include a wide-ranging triad of respiratory distress, altered mental status (disorientation to coma) and a petechial rash characteristically on the anterior upper body [9].

The diagnosis is made clinically based on Schonfeld's or Gurd and Wilson's criteria; CT, MRI, or chest X-ray displaying diffuse infiltrates or cerebral compromise, however, confirm the diagnosis. Common laboratory findings include anaemia, thrombocytopenia, hypoxemia, and raised serum lipase [10]. Supportive therapy is the level of assessment and treatment, including fluid resuscitation for hemodynamic stability, oxygen therapy, and mechanical ventilation for severe cases. The role of steroids in the prophylaxis of fat embolism remains unclarified but still bears research evidence of lowered FES incidences when methylprednisolone is employed for the shielding of endothelial membranes, dampening inflammation and minimizing lung damage [11]. Corticosteroids may be used in such conditions where patients are at high risk and performed major orthopaedic surgeries, even though the use thereof is still arguable. Prompt treatment for stabilization concerning the fracture especially through intramedullary nailing will continue as a timely intervention [12].

CONCLUSION

Methyl Prednisolone significantly reduces the incidence of Fat Embolism Syndrome and its severity in patients with closed femur or tibia fractures. The authors recommend that further studies with larger populations be conducted to confirm these findings.

CONFLICT OF INTEREST

The author declares no conflict of interest.

ETHICAL APPROVAL

Approved.

CONSENT FORM

Written informed consent was obtained from the patient.

FINANCIAL SUPPORT

Not available.

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