

# THE TREATMENT OF SYSTEMIC FAT EMBOLISM

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Fat embolism is a common condition following injury. An incidence of fat embolism of up to 75% has been reported in various series of injuries with fractures.

The prognosis of the condition varies greatly from series to series. In some the mortality is formidable, while in others it is low. This apparent incongruity is due to different interpretations of the pathology of fat embolism. It may be subdivided into 2 pathological types, namely (1) pulmonary fat embolism and (2) systemic fat embolism.

## 1. Pulmonary Fat Embolism

The significance of pulmonary fat embolism has been overestimated in the past. Experimentally, the intravenous injection of fat can produce respiratory distress and even death, but the lungs then show a far greater degree of embolism than is ever seen in man.<sup>1</sup>

The dose required to produce these effects is high. Armin and Grant<sup>2</sup> showed that the fat extractable from the lungs of patients dying from gross embolism is only a fraction of what would be required to produce death experimentally. The pathological, clinical and experimental evidence now indicates that even gross embolism is unlikely to be important. It seems reasonable to conclude that pulmonary fat embolism does not cause significant symptoms or produce serious lung changes in previously healthy subjects, and that it is not responsible for death. The lack of serious effects is presumably related to the large respiratory functional reserves, the enormous capillary bed within the lungs, and the fluid nature of the emboli at body temperature.<sup>3</sup>

## 2. Systemic Embolization

Although much less common after injuries than pulmonary embolism, systemic fat embolism is of much greater significance. In Sevitt's series of 100 necropsy cases, only 24% had systemic emboli compared with 89% with pulmonary emboli.

Cerebral embolism with deep coma has a serious prognosis. The following are reports of 3 patients with cerebral fat embolism with coma, who were successfully treated on the regime outlined in case 1.

### CASE 1

The patient, C.F., was a 20-year-old male who was admitted to the Johannesburg General Hospital on 9 March 1961, having been involved in a scooter accident, in which he sustained closed fractures of the lower third of the right femur

and the midshaft of the right tibia. He had no other injuries and was fully conscious. On examination his blood pressure was 110/70 mm. Hg. There was a large haematoma in the thigh and calf muscles, and his ankle pulses were absent.

A Steinman's pin was inserted under local anaesthesia and, as soon as the fracture was reduced, the pulses returned to the ankle. He was placed in balanced traction in a Thomas' splint. His general condition was good and his haemoglobin level was 13.5 G. per 100 ml. The following day was uneventful. On the morning of 11 March he was confused, irrational, and incontinent of urine. His temperature had risen suddenly to 100°F.

On examination he had neck stiffness and all his limbs were spastic; positive Babinski reflexes were present. There were no eye signs, and papilloedema was not found. No petechial haemorrhages were present at this stage. Lumbar puncture was performed because of the neck stiffness, but the fluid was normal in all respects. A specimen of urine sent to the laboratory contained fat globules, and the diagnosis of fat embolism was made.

He lapsed into coma during that day and developed petechiae in the conjunctivae and in the skin of his chest, abdomen and thighs.

### Treatment

The following scheme of treatment was instituted:

1. Two pints of blood were transfused.
2. Soluble cortisone, 300 mg., was given intravenously in divided doses in 24 hours, and this was repeated daily.
3. One litre of 5% dextrose water containing 5% alcohol was given intravenously over an 8-hour period, followed by 2 litres of maintenance fluids containing the cortisone.
4. Antibiotics, in the form of penicillin, 500,000 units 6 hourly, and streptomycin, 0.5 G., *b.d.*, were administered.
5. The patient's temperature was kept at subnormal levels by draping him with sheets soaked in ice water with fans playing over his body. Shivering was prevented by the administration of a combination of pethidine, 50 mg., 'largactil', 25 mg., and 'phenergan', 25 mg., 6- or 8-hourly as required. His temperature was measured half-hourly by means of a thermocouple placed in the rectum, and was maintained between 95 and 97°F.
6. Oxygen was given through a mask, and an indwelling catheter was introduced into the bladder.
7. Nourishment was given in fluid form through a nasogastric tube.

On this regime he showed signs of regaining consciousness on the fourth day, and the intravenous alcohol and hypothermia were discontinued. The cortisone was tailed off gradually. Urinary incontinence persisted for a further 3 weeks, but he then regained control of his sphincters.

The patient's present condition is very satisfactory. Both his fractures have united and there are no apparent mental or neurological sequelae.

### CASE 2

The patient, M.L., a 21-year-old male, was admitted to this hospital on 7 May 1961, after falling from the 2nd floor of a building and sustaining closed fractures of his mandible,

right wrist, left elbow and the midshaft of his right femur. He was fully conscious, and on X-ray his skull was normal.

His fractures were reduced under general anaesthesia and immobilized in plaster of Paris. The fractured femur was treated by means of balanced traction. Forty-eight hours after admission he lapsed into coma.

On examination at that stage he had a temperature of 101.2°F. His pupils were equal and reacted to light. There was no neck stiffness, but all 4 limbs were spastic and bilateral Babinski reflexes were present. In addition there was urinary incontinence. On careful examination it was observed that there were small petechiae in the conjunctivae and over the upper chest. No fat globules could be found in the urine.

A diagnosis of systemic fat embolism was made, and the same regime of treatment that was used in case 1 was instituted. This patient received a bottle of 5% dextrose water containing 5% alcohol on each of 4 consecutive days. Hypothermia was maintained for 5 days.

The patient regained consciousness on the fifth day and made a complete recovery. His fractured femur was not in satisfactory position, and 3 weeks after he had recovered, a Küntscher nailing was performed without any untoward effect.

#### CASE 3

The patient, N.M., a 20-year-old male, was admitted to this hospital on 1 June 1961, after a car had reversed into him, breaking his right leg. On examination he had a closed comminuted fracture of the middle third of his right tibia. This was the only injury sustained and, apart from this, he was in good health.

Two hours later, before his fracture could be reduced, he became drowsy, confused and incontinent of urine. The following day he lapsed into deep coma and his breathing became stertorous and frothy. On neurological examination he had no neck stiffness, his pupils were equal and reacted to light, and he had no papilloedema. He was spastic with bilateral extensor plantar reflexes. He had petechiae in his conjunctivae, but not on his body. No fat globules could be found in his urine.

A diagnosis of systemic fat embolism was made, and the full regime of treatment was again started. This patient received 5 bottles of 5% dextrose water containing 5% alcohol, and hypothermia was maintained up to the sixth day, when he regained consciousness. He was aphasic for almost a week after recovering consciousness, but the aphasia improved gradually.

Since the post-reduction position of the fractured tibia was unsatisfactory, an open reduction and plating was carried out 3 weeks after he recovered. At present he is completely normal mentally and neurologically.

#### DISCUSSION

It is important to remember that fat embolism is a common complication of bone injuries. Speed's adage is helpful: '2nd hour shock, 2nd day fat embolism, 2nd week pulmonary embolism'.

In the clinical diagnosis 3 features are important:

1. A spike in the temperature chart.
2. Incontinence of urine.
3. Petechiae — best seen in the conjunctivae.

As a diagnostic feature, fat globules in the urine are of limited value, since they are only present in about half the cases. In the present series (3 cases) they were demonstrated in only 1 patient. According to Sevitt a more reliable diagnostic procedure is a Vim-Silverman needle

biopsy of the kidney, in which fat emboli may be seen in the glomeruli on frozen section.

#### Treatment

**Prophylaxis.** Avoid excessive handling of the fractures and do not operate on the fractures if the haemoglobin level is dropping and the temperature is rising.

**Alcohol.** The use of alcohol was suggested in 1931 by Herman, as quoted by Pipkin.<sup>4</sup> His rationale for the use of alcohol was: (1) Alcohol is a solvent mobilizing fat for excretion *via* the kidneys, lungs and sputum; and (2) alcohol is an excellent sedative, often controlling restless patients more effectively than narcotics would.

**Cortisone.** Cortisone was used for its supportive effect in the accompanying severe stress, and also as possible replacement therapy in the event of embolization of the adrenals.

**Hypothermia.** This is used to lower the metabolism of the deprived neurological tissue in the face of an increasing pyrexia.

**Heparin.** Heparin has been used by Pipkin in doses of 10,000 units a day for its 'fat-clearing' properties. Sage and Tudor<sup>5</sup> reported gross haematomas at the fracture sites followed by non-union in their cases. In experimentally produced fat embolism, heparin was not found to be useful by Gardner and Harrison.<sup>6</sup> We did not use heparin in our cases.

#### SUMMARY

Fat embolism is common following injuries, especially those in which fractures have occurred. The 2 pathological types are pulmonary fat embolism and systemic fat embolism. Pulmonary fat embolism is not a serious condition, but systemic fat embolism, especially when there is cerebral embolization, has a bad prognosis.

Three cases are presented in which cerebral embolism followed traumatic fractures. All the patients recovered after a special regime of treatment was instituted. This consisted of:

Blood transfusion, cortisone administration, intravenous infusion of 5% alcohol solution, antibiotic therapy, mild hypothermia, administration of oxygen, bladder catheterization, and feeding by nasogastric tube.

The clinical diagnosis of systemic fat embolism has the following 3 important features: a spike in the temperature chart, incontinence of urine, and petechiae. In cerebral embolization, confusion or coma and signs of upper-motor-neurone involvement are present.

I wish to thank Mr. M. K. Tucker, under whose care these patients were admitted, and Dr. F. K. Mills, Superintendent of the Johannesburg General Hospital, for permission to publish.

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