MULTIPLE INJURIES: THE MANAGEMENT OF THE PATIENT WITH A FRACTURED FEMUR AND A HEAD INJURY

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The treatment of patients with multiple injuries presents a frequent problem which has been the subject of recent attention in this country (Lewin 1953) and in America (Wade 1952, Glenn 1953, Mathews 1954). Lewin emphasised the importance of multiple injuries in relation to the mortality of head injuries, and discussed the difficulties of treatment, the order of precedence in treatment, and the necessity for compromise. It is the purpose of this paper to discuss the management of the patient with a fracture of the shaft of the femur combined with a head injury. Such combined injuries are common, and they present problems of sufficient complexity to merit separate analysis and discussion. At the same time they illustrate the general problems of multiple injuries.

GENERAL CONSIDERATIONS

The problems involved arise out of the conflicting demands of two major injuries. An unconscious patient requires mobilisation; a fractured femur requires immobilisation. A head injury often needs a period of observation; a compound fracture demands early wound toilet. A head injury requires cautious fluid replacement; multiple injuries require copious fluid replacement. In the presence of a head injury general anaesthesia is better avoided; in the presence of a compound fracture and multiple injuries its use may be essential.

The complications of one injury may interfere with the treatment of the other. The patient with a head injury may be very restless, jeopardising treatment of the femur, or he may remain in coma, when the fractured femur jeopardises treatment of the unconscious patient. A fracture of the femur may be followed by fat embolism, which may complicate assessment of the head injury. Deterioration in the level of consciousness with a fractured femur and multiple injuries may be due to causes other than the head injury.

MATERIAL

During the years 1949–56 fifty-nine patients with a fracture of the shaft of the femur and a head injury were admitted to the Oxford Accident Service; they form the basis of this study. In the same period 4,000 head injuries and 263 fractures of the shaft of the femur were treated.

All but three of these injuries were the result of road accidents, and the relationship between age and type of accident showed a familiar pattern. Fifty per cent of the patients were young or middle-aged motor-cyclists, and 25 per cent were children who had been knocked down by vehicles.

TREATMENT

The following description of the treatment of these injuries is based in the methods used in the Oxford Accident Service. Immediate treatment and assessment—The immediate treatment consisted of clearance and maintenance of the airway, assessment of the degree of shock, and resuscitation. A general and neurological examination was then carried out, the former to allow an accurate assessment
of the extent and nature of the injuries, and the latter to form a basis for judging subsequent progress of the head injury. A neurological examination was always possible in spite of the other injuries, although sometimes it had to be modified in extent.

The pulse, blood pressure, respiration rate, temperature, and state of the pupils were recorded on arrival and at half-hourly intervals thereafter; this chart was an important guide in the treatment of shock and in the diagnosis of cerebral compression.

A Thomas's splint with fixed traction was applied temporarily to immobilise the femur*, and simple plaster splints were applied to the other limbs when necessary.

Essential radiographs were then taken without moving the patient from his trolley. An attempt was usually made at this stage to obtain antero-posterior and lateral views of the skull, because, once immobilised in balanced traction, the patient was out of reach of good skull radiographs.

Careful and repeated observation of the patient in the first few hours allowed an assessment of the head injury concurrently with the treatment of shock, and it became apparent, both while treating the patients and in retrospect, that they could be divided into two groups—those with a mild or rapidly improving head injury, and those with a severe head injury.

Patients with mild or rapidly improving head injuries—This group consisted of eight children and twenty-one adults; it contained only three of the compound fractures of the femur. After a few hours' observation these patients were considered fit for general anaesthesia, and they then ceased to present a special problem. Their treatment and progress thereafter did not differ from that of patients with uncomplicated fractures of the femur. Thus, a short period of observation before definitive treatment was decided upon simplified the further management for many patients.

Patients with severe head injuries—This group consisted of seven children and twenty-three adults. The incidence of other injuries was higher than in the series as a whole, and this group contained most of the compound fractures of the femur.

The main problems in the treatment of this group, which are the chief concern of this paper, are described below.

DEFINITIVE TREATMENT OF THE FRACTURED FEMUR

Method used—In all adult patients except three it was possible to treat the fractured femur by immobilisation in balanced traction in a Thomas's splint with a knee-flexion piece; either skin traction or skeletal traction by a Steinmann pin through the tibial tubercle was used. Excision and primary suture of compound wounds were carried out, and the fracture was manipulated if necessary, before the balanced traction was set up. Young children were treated in gallow's traction, and the older ones in the same way as the adults.

Timing of the definitive treatment—The main consideration in timing the definitive treatment was the state of the head injury; the other consideration was the type of fracture, whether simple or compound. From observation of the patient in the first few hours it became apparent whether the patient with a severe head injury had improved from a "bad risk" to a "justifiable risk" for further treatment. Only then was a decision made about the definitive treatment of the femur.

Local anaesthesia was preferred to general anaesthesia because of the head injury, but in certain circumstances outlined below general anaesthesia was considered necessary. When general anaesthesia was used, cerebral anoxia was carefully avoided, and the length of the anaesthesia was reduced to a minimum.

In simple fractures requiring manipulation, when there was doubt about the fitness of the patient for a general anaesthetic, a Steinmann pin was inserted under local anaesthesia, traction applied and manipulation delayed until the patient improved. This sometimes meant

* Sorbo rubber pads attached to a spreader by orthopaedic strapping and held in place on the leg by crepe bandages have been found useful for temporary traction.
waiting for several days, usually without serious consequences, but in one ill patient four weeks
passed before manipulation was considered safe, and by that time the deformity was irreducible.
Compound fractures required more urgent attention, and as soon as the general condition
of the patient improved excision and suture of the wound were carried out quickly under
general anaesthesia. It was found that all the patients with compound fractures who recovered
sufficiently to justify having their wounds treated under general anaesthesia (six patients out
of ten) did so within eight hours of admission. Any delay in recovery from the head injury
as a result of the anaesthetic was accepted as a reasonable price for achieving adequate
treatment of the compound fracture.
Later treatment—As patients with severe head injuries improve, many of them pass through
a phase of extreme restlessness and confusion. Several of our patients repeatedly dismantled
their splints, and two of them were put into plaster spicas three weeks after admission on
this account.

Prolonged coma resulting from the head injury may complicate the treatment. Four of
our patients were in coma for twenty-four hours, five days, eight days, and 142 days respectively.
The last of these patients, an elderly woman, was treated in Hamilton Russell traction, and
the femur united in an acceptable position before she died. The other three were treated in
Thomas's splints.

TREATMENT OF THE HEAD INJURY

The problem of these combined injuries was most evident in the care of the unconscious
patient. Regular turning, which is the basis of the care of the skin and chest, had to be
somewhat restricted. Reduction of the fracture of the femur was deliberately delayed in some
patients to allow frequent turning, which, with nursing care, prevented bedsores.

Frequent aspiration of the respiratory tract was an essential supplement to turning and
postural drainage to keep the airway clear. In most unconscious patients these measures
were adequate, but in two tracheostomy was necessary to allow more efficient aspiration and to
maintain a clear airway.

Case 1—A young motor-cyclist riding without a crash helmet was admitted forty-five minutes after
a head-on collision; he was in coma and cyanosed, his airway was obstructed, and he was bleeding
from the lips and nose. He had a fractured femur and other extensive injuries but no chest injury.
His colour improved after suction and the insertion of an airway. After forty-eight hours he remained
in coma, petechiae appeared in the skin, and a diagnosis of fat embolism was made. The respiratory
rate rose to 40 per minute and there were widespread moist sounds in the chest. A tracheostomy was
done under local anaesthesia at forty-eight hours; immediately his breathing became quieter and
within a few hours the respiration rate came down to 20 per minute. Thereafter the chest did not
give rise to concern, and the tracheostomy tube was removed eighteen days later, when the level of
consciousness had improved.

In the other patient tracheostomy was performed on the third day with temporary
improvement but he died on the sixth day from a chest infection; in retrospect (this case
occurred in 1949) it seems likely that tracheostomy was withheld for too long.

Operative treatment was necessary in one patient for cerebral compression (Case 2. see
overleaf) and in two patients for a compound depressed fracture. The latter were children,
neither of whom had lost consciousness; in one the skull fracture was elevated six hours
after admission and the femur dealt with at the same time, but in the other elevation was
deferred for forty-eight hours, because a mid-thigh amputation had been necessary one hour
after admission for gross injury including division of the popliteal vessels and sciatic nerve.
Three adults had compound fractures, but died from multiple injuries before their fractures
could be treated.
Deterioration in level of consciousness—In a patient with multiple injuries deterioration in
the level of consciousness may be due to one of several causes, some of which are extracranial.
The following causes were seen.
Cerebral compression—One of the most important signs of cerebral compression is a deterioration in the level of consciousness. In only one patient in this series was the deterioration due solely to cerebral compression.

Case 2—A child aged ten was admitted in coma following a car accident. He had a right parietal scalp haematoma, compound fractures of the left tibia and fibula, and a fracture of the left femur. His pupils were equal and reacting. He improved to the stage of opening his eyes and moving his limbs on painful stimuli; there was a suspicion of a left hemiparesis. At twenty-six hours the compound wound was treated and the fractures were reduced under a short general anaesthetic. He appeared to recover from this, but four hours later he suddenly stopped breathing. Emergency bitemporal and bifrontal burr-holes were made and the brain was found to be slack. His condition deteriorated and he died forty-eight hours after admission. At necropsy a localised subdural haematoma was found beneath the tentorium cerebelli.

Cerebro-vascular accidents—Cerebral thrombosis or embolism may interfere with the level of consciousness. In one patient a period of aphasia accompanied by deterioration in the level of consciousness was ascribed to thrombosis of an internal carotid artery.

Case 3—A young motor-cyclist wearing a crash helmet was admitted twenty minutes after an accident. He was in coma, his pupils were dilated and reacted sluggish, he had compound fractures of the right femur, tibia and fibula, and a traction injury of the left brachial plexus with an open wound on that side of the neck. Primary excision and suture of the wounds were carried out under general anaesthesia five hours after admission. By the third day he was speaking and obeying commands. He improved slowly until the eleventh day, when he relapsed into a deeper level of consciousness associated with aphasia and a right facial weakness. As his pupils were equal and reacting and his chart showed no changes to suggest compression, a diagnosis of left carotid artery thrombosis associated with the open wound in the neck was made. His speech returned three days later, but he remained disorientated in time and space for eight weeks. He eventually made a full recovery except from the brachial plexus lesion.

Fat embolism—This is a complication of severe injury, which was recognised in eight patients. In four the effects were predominantly cerebral, leading to a deterioration in the level of consciousness on the second or third day, which usually lasted for about twenty-four hours. The diagnosis was difficult to confirm, but the absence of signs of cerebral compression and the presence of skin petechiae supported it. In the other four patients the effects were mainly in the lungs, the diagnosis being proved at necropsy in three. In one patient fat embolism was the cause of death; this was a patient with a mild head injury in whom a cerebral embolism followed manipulation of the femur.

Case 4—A twenty-five-year-old motor-cyclist with a fractured femur, haematuria, and abdominal pain was fully conscious on admission with a post-traumatic amnesia of five minutes. His femur was manipulated under general anaesthesia twenty-four hours after admission. Five hours after operation he had a haemoptysis; twelve hours after operation a radiograph of the chest suggested fat embolism and petechiae had appeared in the skin. Thirty-four hours after operation he became very dyspnoeic, cyanosed, and almost unrousable. He improved, became fully orientated, but again relapsed and died sixty hours after operation. Necropsy confirmed the diagnosis of fat embolism.

Drugs—Care is necessary in the administration of sedatives and analgesics to patients with head injuries. The delayed effect of morphine given intramuscularly to a shocked patient is well known, but there is added risk when it is given to a patient with a head injury because of the enhanced effects of small doses in such patients.

Case 5—A young woman motor-cyclist was admitted half an hour after an accident, following which she had been unconscious for a few minutes. She had a fractured skull, a comminuted fracture of the right femur, a compound fracture-dislocation of the left elbow, a pelvic haematoma, and a fractured rib with a small pneumothorax; she was cold, pale, pulseless, and talking hysterically. Morphine, ½ grain, was given intramuscularly, and four pints of blood were transfused. Two hours later the blood pressure was restored to normal, and she was much quieter, but after four hours she was in coma. There were no localising neurological signs and the chart showed no changes to suggest cerebral
compression. The pupils were constricted. After some hours she improved to the stage of restlessness, and thereafter recovered slowly. On the fourth day the femur was manipulated and an open reduction of the dislocated elbow was carried out under general anaesthesia. She made good progress after the operation, and was able to leave hospital after fifteen weeks.

**Shock**—Any cause of cerebral anoxia, such as a chest injury, anaemia, and low blood pressure will impair the level of consciousness. One or all of these factors may be present in a patient with multiple injuries. Shock alone was the cause of deterioration in two patients, in whom the blood pressure remained low and the rate of resuscitation was not sufficiently quick. Shock was distinguished from other causes of deterioration by the absence of neurological changes and by the evidence of the shock chart.

**General anaesthesia**—The danger in using a general anaesthetic in the early stages is that it may mask a deterioration in condition; also it may itself cause some deterioration in the level of consciousness. Most patients with a severe head injury, who had a general anaesthetic at an early stage, stood it well; two died, but in neither case was the anaesthetic directly responsible. In one of these (Case 2) the patient died of a subdural haematoma, but the anaesthetic probably masked some of the signs of an impending crisis; this was a warning that the fewer extraneous factors there are to affect the patient's level of consciousness and reactions, the better.

**Fluid replacement**—Caution in giving intravenous fluids to patients with head injuries is always necessary. When the patient has other serious injuries, adequate blood replacement is essential to maintain the circulating volume, but in the administration of electrolyte solutions particular care should be taken to avoid overdosage. In this series most patients required a blood transfusion in the initial stages, twelve pints being the largest quantity given to one patient during resuscitation. The clinical picture of the patient who arrives soon after the accident with a normal or even elevated blood pressure and deteriorates after a few hours has been recognised and anticipated by judicious blood transfusion. Inadequate resuscitation has already been mentioned as a cause of deterioration in the level of consciousness.

**Other injuries**—In addition to a severe head injury and a fractured femur 85 per cent of the patients had another injury (fracture or major soft-tissue injury) and 60 per cent had three or more other injuries. These other injuries were an important contributory factor to the problems of treating this group of patients, and to the mortality rate resulting from this combination of injuries.

**RESULTS**

There were twelve deaths in the series of fifty-nine patients, a mortality rate of 20.3 per cent. All but one of the deaths occurred in the patients with severe head injuries. Eight patients died within ten hours of admission from severe multiple injuries without responding to resuscitation; in addition to a severe head injury and a fractured femur six of these had gross intra-abdominal or intrathoracic haemorrhage. Four patients survived the initial shock, but died later: 1) The patient in Case 2 died on the second day from a posterior fossa subdural haematoma and cerebral contusions; 2) The patient in Case 4 died on the fourth day from pulmonary and cerebral fat embolism; 3) The third patient died on the sixth day from chest infection, in spite of tracheostomy on the third day. He was in coma throughout; 4) The fourth patient died on the 142nd day from broncho-pneumonia. She was in coma throughout.

The results in the group of patients with mild head injuries have not been detailed, as they did not differ materially from those in patients with uncomplicated femoral fractures. In the group with severe head injuries the results were as follows.

**Results of the fractured femur**—The femur united without open reduction or internal fixation in seventeen of the eighteen survivors; six of these had compound fractures, and in one of them a mid-thigh amputation was performed because of associated vascular damage. Union was considered to have occurred when the patient walked without crutches or sticks (except
in the patient who remained in coma throughout; her femur was united clinically and radiographically.

Union was complete within twelve weeks in three of the children; in the fourth child union was present at sixteen weeks, after remanipulation at six weeks. In the adults seven fractures united within twenty weeks, five united between the twenty-first and thirty-sixth week, and one patient was untraced.

Function was good in thirteen patients, with good alignment and 90 degrees or more of knee movement; three had shortening of \( \frac{3}{4} \) to \( 1\frac{1}{2} \) inches, but none was seriously impaired functionally. Of the remaining four patients function was moderate in two (they had persistent knee stiffness), and not known in two.

**Results of treatment of the head injury**—In all the survivors except one the major effects of the head injury had resolved before in-patient treatment of the other injuries was completed. On discharge some had minor disabilities, which resolved later. On final assessment eleven had no disability, six had minor disability and one had serious disability.

**DISCUSSION**

In the management of the patient with a fractured femur, a head injury, and other injuries the aim has been to treat all the injuries and to avoid neglect of one injury in favour of another. To make this possible accurate assessment of the relative urgency of the various injuries requiring treatment is essential, and in some cases a compromise must be accepted.

In deciding for or against the use of general anaesthesia the state of the head injury, potentially the more lethal injury, has taken precedence over the femur in most cases. But this does not imply neglect of the femur, for the results suggest that manipulation of a simple fracture of the femur can be deferred for several days without affecting the final result. Furthermore, without disregarding the precedence of the head injury, it has been possible to treat nearly all the compound wounds by excision and primary suture under general anaesthesia within eight hours of the accident as a result of careful treatment and observation of the head injury in the early stages. However, there are no set rules of precedence in the treatment, and each patient must be assessed individually.

In the management of the patient we have used the Thomas's splint in all adults except one. It is not ideal, but possesses fewer disadvantages than other methods. It is safe, it can be used throughout the treatment first as a temporary splint and later with modifications as the definitive treatment, and only a short general anaesthetic is needed for manipulation; on the other hand it requires frequent attention, and is best used where the nurses are familiar with it. Intramedullary fixation appears attractive for the immobilisation of the fractured femur in comatose or restless uncooperative patients: it simplifies nursing and may shorten the stay in hospital, but it is a major operation not free from complications, and in patients with severe multiple injuries any major operation that is not essential for survival or prevention of gross morbidity is unjustifiable. There may be a place for it in patients with a suitable type of fracture, who have made a complete recovery from a mild head injury, though even then it may increase the risk of fat embolism. Plaster spicas have not been used in the early stages because they entail a general anaesthetic; otherwise they would be useful for suspending and turning the unconscious patient. However, there is a place for the use of a plaster spica in the recovery phase for a very restless and destructive patient.

The unconscious patient requires frequent turning for the care of the skin and chest. This is difficult but can be managed in a Thomas's splint. In the care of the patient's chest frequent aspiration with a rubber catheter is essential. The advantages of tracheostomy in the nursing of patients with prolonged coma are well known; it has added advantages for the patient in whom turning is difficult because of a fractured femur, and it is most beneficial when done early.
In the day-to-day management of these patients with head injuries and multiple other injuries several specialists are involved, but it is important that one person should be in charge of the patient under the supervision of the neurosurgeon and the orthopaedic surgeon. This type of patient is best cared for in an Accident Service working within a general hospital.

The combination of a head injury and fractured femur is associated with a high incidence of other injuries, and the mortality rate (20 per cent) is high. With effective treatment there is a low incidence of serious morbidity; most of the survivors make a good recovery.

SUMMARY
1. Some of the problems of treatment of a patient with a head injury and a fractured femur are mentioned.
2. The methods of treatment and results obtained in fifty-nine such patients from the Oxford Accident Service are described.

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REFERENCES