PAPERS AND ORIGINALS

Moorgate Tube Train Disaster

BY MEMBERS OF THE MEDICAL STAFF OF THREE LONDON HOSPITALS*

Part I—Response of Medical Services

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Summary

Experience of the medical staff at a major subterranean accident scene showed that there appeared to be a substantial advantage in using site medical teams that could offer anaesthetic facilities. The need for adequate communication from the accident site to the hospital is emphasized.

Introduction

At about 8.50 a.m. on Friday 28 February 1975 a six-car underground train crashed at Moorgate station in a "blind" tunnel. At 9 a.m. St. Bartholomew's Hospital was asked by the London Ambulance Service to send one doctor to the site. A casualty officer left almost immediately in an ambulance with a medical student and a small first-aid bag. On arrival he assessed the situation and called for a resuscitation team, which left at about 9.20 a.m.

Scene on Arrival

It was not appreciated in the initial confusion that two and a third carriages were compressed in the tunnel out of sight of the platform (fig. 1). Rescue workers mingled with injured passengers either lying or standing on the platform. No estimate could be made of the likely number injured, trapped, or dead. Faced with so many casualties, none of whose condition appeared critical, it was decided to remove them to hospital as quickly as possible. As soon as it was realized that a further, possibly large group of people remained trapped on the train a request was made for more medical assistance. Shortly afterwards the first site medical team arrived and moved into the train to help the injured.

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Access to the two carriages in the tunnel was difficult because they had been compressed in both the horizontal and vertical planes. A medical post was, however, established in the middle third of the second carriage, where the patients' vital signs were checked and their placement on Neil-Robertson stretchers was supervised. It was not possible to resuscitate patients there and they were passed back along the tunnel to the platform by a chain of firemen (fig. 2). Pethidine and morphine were drawn into syringes and passed forward for administration where necessary. Later Entonox became available and proved to be invaluable despite the equipment being rather unwieldy in the cramped conditions.

Shortly before 10.30 a.m. a second mobile medical team arrived and decided to establish an emergency resuscitation area on the adjacent platform. The hospital was immediately asked to send extra medical and nursing staff and equipment. Ultimately 16 doctors (mainly anaesthetists) and 10 nurses were at the site.

Assessment and Treatment

A regular pattern of assessment and treatment was adopted. The anaesthetist cleared the airway, aspirating the pharynx and inserting an endotracheal tube when necessary. Oxygen was administered via a Mary Catterall mask. When ventilation was inadequate the lungs were ventilated manually with a Waters bag and oxygen. Other members of the team cut the clothing off the limbs and exposed the chest and abdomen of the patients. A brief assessment of the injuries was made and details were written on cards attached to the patients' wrists. Particular points included the level of consciousness, any obvious injuries, the condition of the chest and abdomen, and details of analgesics given. Patients were also classified according to the severity of their injuries using the system of crosses marked on the forehead (see fig. 3). In many cases the face was covered in soot and marks had to be made on the chest. Obvious fractures were arrowed with a felt-tip pen. For those who were shocked or had severe injuries an intravenous infusion was set up and plasma protein fraction administered. Whenever practicable a seriously injured patient was escorted back to hospital by a nurse or medical member of the team. One patient had her foot amputated under ketamine anaesthesia.

Death was difficult to diagnose. Though many patients were pulseless and cyanosed, their pupils were small and their extremities warm. Heart sounds were inaudible because of the noise of pneumatic drills close by. When there was doubt full resuscitative measures were taken until it was clearly established that these were fruitless.

A total of 74 live patients were evacuated by 10 p.m. the same day.

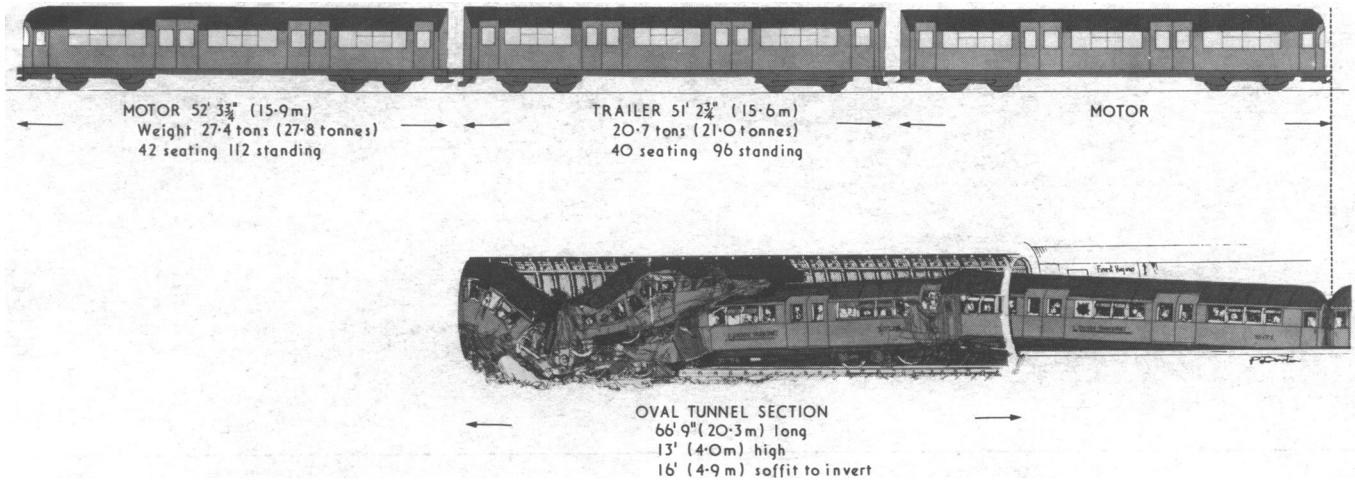

FIG. 1—Scene of Moorgate tube disaster and details of train.

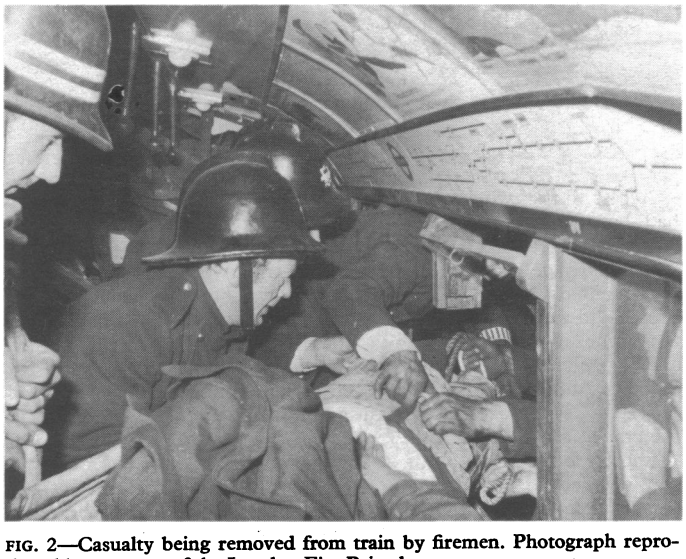

FIG. 2—Casualty being removed from train by firemen. Photograph reproduced by courtesy of the London Fire Brigade.

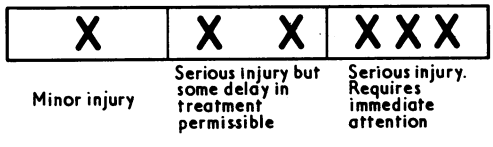

FIG. 3—System used for marking foreheads according to severity of injury

Hospital Administration

The hospitals initiated their major accident plans, which are based on well-established principles.[1 2]

There was no shortage of medical, nursing, or technical staff. Key personnel were issued with action cards outlining their duties.[3] Extra equipment was mobilized and delivered to various treatment areas according to the prearranged plan. Beds in two adjacent wards close to theatres and intensive care facilities were prepared.

Discussion

SITE MEDICAL TEAM

Many people were trapped in the wreckage; many were severely injured and in pain. They required analgesia and sedation while waiting to be released. Some tried to escape the terror of their situation by breathing Entonox until they became semiconscious. Others were severely disturbed and fought off attempts to help them.

It was an advantage to examine patients as they were released from the train, so that those whose condition was likely to deteriorate during transfer could receive emergency treatment. Clearing the airway, administering oxygen, and setting up an infusion did not seriously delay the move to hospital and ensured that essential treatment was begun early. These tasks, however, are never simple under such conditions. Fortunately enough anaesthetists with suitable experience were available.

Several factors made the task of the site medical teams easier. Firstly, they were never overwhelmed by large numbers of patients needing treatment at the same time. Secondly, the adjacent platform provided a warm, dry, and protected medical centre, though the lighting was inadequate and the noise of pneumatic drills made examination difficult. Thirdly, the accident occurred in a confined space, so that personnel and equipment did not have to be dispersed over a wide area. Finally, the accident occurred in daytime, so that additional staff and equipment were readily available. Effective resuscitation would have been more difficult if the site of the medical centre had been worse lit or exposed to the weather or had no suitable dry floor.

It is important for the site medical controller to co-ordinate the medical services and establish liaison with other emergency departments. He can do this only if he is relieved of the duties of individual patient care as soon as possible.

COMMUNICATIONS

There was difficulty in establishing adequate communications with the accident site. No accurate estimate of the number of casualties, the severity of their injuries, or the time when they were likely to arrive at the hospital was obtained. Effective communication probably requires direct radio contact between the site medical controller and the hospital medical controller. This was not possible because the accident occurred underground, and much of the information from the site was confused and exaggerated.

EQUIPMENT

When searching for equipment there was a tendency to "stir" the various boxes, so that everything became muddled. Many items had been packed together in bags that were not clearly labelled. Extra intravenous cannulae, giving sets, and endotracheal tubes were required and subsequently provided by the hospitals. In future it is planned to have a box of reserve equip-

ment. Thirty bottles of plasma protein fraction are stored at one of the hospitals for use in major accidents, and these were valuable.

Medical staff were not familiar with the ambulance oxygen apparatus and were not certain that the cylinders were delivering adequate gas flows. Therefore, they asked for extra cylinders with visual flow meters.

HOSPITAL ORGANISATION

In the receiving hospitals the major accident plan worked satisfactorily. The arrival of casualties was well spaced. This was fortunate because the resuscitation area in one hospital is small and limits the number of patients that can be treated at the same time.

A queue of patients tended to develop in the *x*-ray department. This was minimized by delaying non-urgent cases until the next day and by using a portable machine for emergency cases. A senior radiologist gave immediate reports on the *x*-ray pictures.

Crowd control in the front lobby of one hospital proved difficult and required closure of corridors by porters aided by large notices. Police were also stationed at hospital entrances.

There is a danger that a patient will be lost or forgotten when being moved from one department to another. This would be eliminated if patients were to be escorted when they are sent outside the casualty area. Alternatively, a top copy of the notes should be retained at a central desk.

BLOOD TRANSFUSION

Extra supplies of blood had to be sent from the Regional Blood Transfusion Centre at Brentwood. Because of the inevitable transport delay it was essential to notify the hospital blood transfusion laboratories as early as possible so that blood stocks could be mobilized. Regular communication with the accident control centre is also necessary so that the blood supply can be adjusted to meet expected requirements.

The hospitals were besieged by offers to donate blood in response to calls on the radio. Hospitals are not organized to take advantage of these donors, and any local shortage of blood is more readily made good by movement of stocks from other regions than by bleeding volunteer donors. In future major accidents we recommend that no appeal for blood donors should be made by the police or by radio without a request from the Regional Blood Transfusion Service. Nevertheless, some arrangements are necessary to deal with the unsolicited donors who inevitably arrive at the hospital whenever there is a major accident.

Conclusion

It is not possible to plan for every eventuality. Each incident will have its special circumstances and range of injuries, so a certain flexibility in the organization is necessary. A command structure must be rapidly set up and effective communications need to be established. Clearly a hospital can handle only a few seriously ill patients at a time. Adequate medical and nursing services are apt to be restricted by a shortage of staff, especially at night, and the services of several hospitals may be required, both for providing site medical teams and accepting casualties. A co-ordinated plan incorporating all the hospitals in one area is probably necessary.

We thank Mr. Paul Danton, of the department of medical illustration at St. Bartholomew's Hospital, for fig. 1.

The address from which reprints may be obtained is given at the end of part II of this paper.

References

1 Caro, D., and Irving, M., *Lancet*, 1973, 1, 1433.
2 Rutherford, W. H., *British Medical Journal*, 1975, 1, 443.
3 Savage, P. E. A., *British Medical Journal*, 1972, 3, 42.

Part II—Clinicopathological Review

Summary

A review of the injuries sustained by the 113 casualties of the Moorgate tube train disaster has shown the need for rapid evacuation of casualties. Recognition of the "crush syndrome" and its early consequence, hyperkalaemia, is important and a radical surgical approach is suggested. Chest injuries were common and contributed to many of the deaths.

Introduction

Altogether 43 people died as a result of the Moorgate tube train disaster and 72 were treated in hospital. We review here the injuries sustained and their management.

Initial Survivors

Out of 74 patients taken to hospital, 31 were discharged the same day and 41 were admitted. Two arrived dead.

Patients Discharged.—Of the 31 patients discharged from hospital the same day, seven had no physical injury. Fourteen needed minor wound toilet or suturing, one of whom also had a fractured clavicle. The remainder sustained minor bruising only.

Admissions.—Of the 41 patients admitted, four went to an intensive care unit. Sixteen required a general anaesthetic on the day of admission, two underwent laparotomy, eight had wound toilet or suturing, and five had manipulation followed by plastering or traction. There was one on-site amputation. Two patients subsequently died.

INJURIES

Chest.—There were seven chest injuries. These included two cases of severe flail chest needing ventilation, two of fractured ribs with unilateral pneumothorax, one of fractured ribs in the left lower chest associated with a ruptured spleen, one of uncomplicated fractured ribs, and one of uncomplicated dislocation of the fifth and sixth left chondrosternal joints. In one case of severe flail chest recognition of bilateral tension pneumothorax in the accident department was life-saving. Ventilation in both cases of severe chest injury was continued for about three weeks, tracheostomy being performed on the day of admission. Both patients made a good recovery. Of the two cases of unilateral pneumothorax one needed an intercostal drain; the other was small and resolved spontaneously. Both these patients were discharged within seven days of admission.

Head and Facial.—Sixteen patients had a head injury. All had been unconscious but 14 were alert and orientated on arrival at hospital. The other two were unconscious; one recovered over 48 hours, while the second remained in coma for three days and gradually regained normal cerebral function over one week. A transient right hemiplegia in this patient resolved spontaneously. Facial fractures included one of the right malar complex, which was reduced under anaesthesia, and a broken nose, which did not need reduction.

Abdominal.—Abdominal trauma was suspected in 13 cases. In