Middle Articles

CONTEMPORARY THEMES

Accidents, Emergencies, and Ambulances: a Survey in Portsmouth

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The object of this pilot study was to measure factors occurring at the sites of accidents or emergencies, factors influencing treatment at the site of the accident, and the treatment and handling of the patients during transport to hospital. These factors were then considered in conjunction with the subsequent progress of the patient.

This study has been undertaken under the auspices of the Wessex Regional Hospital Board in conjunction with, and with the co-operation of, the Public Health Departments of the Hampshire County Council and the City of Portsmouth. It has been centred on the Royal Portsmouth Hospital, which takes all 999 'phone calls from the City of Portsmouth and the surrounding part of south-east Hampshire. The total population at risk is about 450,000. Details of the area were given in the Portsmouth Casualty Survey (Parry *et al.*, 1962).

To interpret some of the results of the survey it is necessary to enumerate the items of ambulance equipment. All ambulances concerned had oxygen cylinders with mask, a Brook airway, a foot-operated sucker, and inflatable splints. Some ambulances were equipped so that head-down tilt could be obtained with the stretchers. All the county ambulances had an AMBU resuscitator apparatus; two city accident ambulances were equipped with Stevenson Minute-man apparatus. Accidents in the city were dealt with by accident ambulances, whereas in the county any vehicle was likely to be diverted when necessary by radio to an accident.

The timing of vehicles concerned was as follows: from the ambulance station to the site of the accident was between 1 and 18 minutes; from the accident to the hospital from 2 to 45 minutes, with an average of about 20 minutes.

To enable the review to be carried out, in conjunction with the consultant staff of the orthopaedic and accident unit of the Royal Portsmouth Hospital, a questionnaire was devised using a hundred-hole punch card. The ambulance personnel needed to write on this in only a minimal number of cases. In most instances it was necessary merely to tick the appropriate box and line.

This card was designed to extract detailed information about

various factors thought to be important, including mileage and timings, delay in extrication of the patient, assessment of injuries, vomiting, etc. The other side of the card was used for other comments and for follow-up notes on the patients and post-mortem investigations. Particular study was also made of the circumstances in which any person died as a result of a road traffic accident.

Cards were completed by ambulance personnel in respect of all emergency cases as soon as the patient was admitted to the accident and emergency department. In all, 1,612 cards were completed during a period of 20 weeks from 24 March to 14 August 1967.

Results

For the purposes of this report unconsciousness was defined as a state in which the patient did not respond to questions or commands, but might have responded to other physical stimuli—for example, pain caused by movement of injured parts.

The Table shows that of 127 unconscious patients brought into the accident and emergency department during this period 36.4% were carried in an unsatisfactory position. Five of these patients were carried in such a way that would embarrass the airway (by tongue falling back, etc.) and aggravate any airway obstruction already present.

Out of a total of 597 road traffic accident cases 172 were admitted to hospital because of the degree of injury sustained. Most of these cases were found lying at the site of the accident on their backs or sides. In 121 of these a head injury was sustained with or without associated injuries. It is also interesting to note that in most (80%) of these head-injury cases there was an associated injury of varying degree to the facio-maxillary area. These injuries, though in many cases slight, were so situated—for example, the nose, oral cavity, etc.—that if the patient were on his back at the site of the accident blood could trickle down in the direction of the pharynx.

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Position of Patients

Position of Patient during Transport in 127 Unconscious Patients			Position of Patient in 172 Road Traffic Accident Cases Admitted to Hospital						
Position	No. of Cases	% (Approx.)	At Site of Accident		During Transport				
			Position	No.	Type	Level of consciousness	Total No.	Satisfactory position	Unsatisfactory Position
Semi-prone (the unconscious position) ..	57	44.8	Standing	13	I	Unconscious	28	16	12
Side	19	14.8	Sitting	26	II	Semiconscious	43	25	18 (3 had been definitely unconscious)
Side + head-down tilt ..	5	4.0	Side	42	III	Conscious	101 (49 head injuries)	Many of these cases were in sitting or lying position in the ambulance according to associated injuries.	
Back	41	32.4	Back	76					
Back + head-down tilt ..	5	4.0	Semi-prone/Prone	15					
			Total	172					

Of the unconscious patients 12 out of 28 were considered to be carried in an unsatisfactory position. Of semiconscious patients 18 out of 43 were considered to be carried in an unsatisfactory position, and some conscious patients were either lying on their back or sitting because of associated injuries. The position in these last two categories would probably not matter so much so long as no complications were present, such as extradural haemorrhage.

General Assessment and Special Injuries

The general standard of assessment by the ambulance crew was good. Of the total road traffic accidents it was found that in 60% of cases the assessment of injuries both to content and to severity was reasonable; 25% of the assessments were regarded as fair and 15% as poor.

Only one out of the five patients with severe faciomaxillary injury was not treated as adequately as might have been hoped. Treatment of minor chest injuries was satisfactory, but with the four patients who had severe chest injuries and unconsciousness it was a matter of chance on which side the patient was lying when he was brought in—that is, whether it was the side that was injured or uninjured. This was caused by the extreme difficulty of assessing chest injuries in the unconscious patient who was fully clothed. In this type of injury speed of transport to hospital, saving unnecessary delay, is important, and previous warning of the patient's arrival by radio link would be most advantageous.

Splintage

The use of splints was analysed. It was apparent that they should have been used in 165 cases, yet in 20 of these splints had not been applied. A particular study was made of the inflatable splint, the conclusion being reached that undoubtedly this splint is far superior to other methods of splintage. It was found easy to apply and there was little variation in the efficiency of application that might occur. No cases of circulatory embarrassment during transport were noted. Some of the newer types of inflatable splint are cheaper and even easier to apply than the earlier types. All cases were followed up and compared in various respects with those that had had other types of splint applied. Pain at the fracture site was practically abolished in those who had the inflatable splint, but in patients treated with other kinds of splint there was a great variation in the degree of pain felt during transport to hospital. Study of the healing of wounds and fractures in these cases showed that there was no difference between the cases treated with the inflatable splint and those treated with other methods of splintage.

Haemorrhage, Vomiting, and Airway Difficulties

Haemorrhage was treated very well except in 11 cases out of 365. These cases involved extensive scalp lacerations or compound fractures of the legs.

Vomiting occurred in 83 patients (5.1% of the total), of whom 21 sustained road traffic injury. Of the latter, seven vomited before arrival of the ambulance, three while they were being moved, and 11 on the journey. This was a distinct reversal of the pattern of the whole number of cases, vomiting occurring in these mainly before arrival of the ambulance. Nine out of 21 patients were unconscious; four of these were unconscious from the time of the accident to arrival in hospital, while the other five had been unconscious for varying periods of time. Of these nine cases three were placed on their sides in the ambulance, three were semi-prone, and three were carried on their backs. In six cases there were airway difficulties, but the sucker was used in only three. In one case oxygen was given.

Of 18 patients who had taken overdoses two were carried on their backs to facilitate mouth-to-mouth ventilation with a Brook airway. In these two cases spontaneous respiration stopped two or three times and the patient was revived by the mouth-to-mouth method. In a further five overdose cases there were airway difficulties associated with vomiting, but the sucker was not used at all.

Vomiting is therefore not a frequent occurrence, and, to put it in perspective, it occurs in potentially dangerous situations in about 0.25% of the total work load of the ambulance personnel. Nevertheless, when it does occur, correct treatment may be a vital factor in determining the outcome. However, some of the patients placed in the semi-prone position continued to have airway difficulties. These might have been overcome by further extension of the patient's neck, and also, in the case of the road traffic accidents, possibly by clearing out some associated blood clot in the pharynx. Skilled use of intraoral airways may be indicated in such cases.

Mortality from Road Traffic Accidents

Particular study was also made of the patients who were brought in dead and of those involved in road traffic accidents who subsequently died in hospital.

Brought in Dead.—A total of 47 patients were brought in dead to the accident and emergency department. In all cases it was established that the patient was dead on arrival of the ambulance at the scene of the accident or emergency. Of these deaths, six were due to road traffic accidents, and in every case there was no doubt that the patient had died at the scene of the accident. Necropsies on these patients confirmed that such injuries received were not compatible with life for very long.

Death Subsequently in Hospital.—During the period of this study no patients involved in road traffic accidents died in the ambulance on the way to hospital. Mortality from road traffic accidents occurred at the site of the accident within a very short period or subsequently in hospital. Altogether seven patients died in hospital during this study. In three cases the treatment at the site of the accident and transport to hospital were carried out adequately; in one case no form of treatment could have helped as the patient was suffering from severe abdominal injuries.

Two of the remaining three case histories illustrate various important points. Neither patient's airway was completely unobstructed on the way to hospital. Both suffered from intermittent hypoxia. At the same time severe bleeding—one from a scalp laceration and the other from compound fractures of the legs—produced hypotension on admission to the accident and emergency department. In the case of a boy aged 6 the blood pressure was 80/60, and in a woman of 70 it was 60/30. Though these patients were initially resuscitated, difficulty with the airway plus hypotension was no doubt a large factor in their death 36 hours later.

Another important point emerged in one instance in that a second badly injured patient from the same accident was placed in the same ambulance. This meant that sufficient attention could not be paid to either patient's airway, since there was only one ambulance attendant.

Occurrence of Hypoxia

These accounts show that persistent or intermittent hypoxia occurs in some patients, some of whom eventually die. Hypoxia can be the sole cause of gross cerebral oedema (Potter, 1964; Lewin, 1966), and it can certainly increase the degree of cerebral oedema that is likely to occur anyway from cerebral contusion, especially in children, in whom cerebral oedema can be particularly severe (Lewin, 1966) as the result of injury. In this way

cerebral oedema due solely to injury may be worsened to the extent that fatal cerebral compression may occur.

With more efficient positioning of the patients, use of the sucker, and the use of oral airways, much of the prolonged intermittent hypoxia could be avoided; hence some of the deaths of patients purely from gross cerebral oedema with compression might be prevented. Nevertheless, it must be remembered that irreversible events may have occurred before the ambulance personnel arrive.

Discussion

In any discussion of ambulance training and the equipment provided the following points must continually be borne in mind. Firstly, the facilities at present for training ambulance personnel are minimal. A first-aid certificate is necessary to qualify for full pay, etc. Otherwise, training, especially paramedical training, is gradually acquired by experience—that is, use of equipment, care of airway, etc. The training in the Portsmouth area has been backed up locally by a series of lectures given by consultant staff of the Portsmouth group of hospitals, particularly the orthopaedic surgeons and anaesthetists. However, the Hampshire training school with full-time courses has now been established since October 1967.

Secondly, the knowledge of first aid and the experience acquired and also paramedical training are put into practice in only a small proportion of cases. Of the work load of ambulance personnel, only 4.5% is concerned with accidents and sudden emergencies (Working Party Report on Ambulance Training, 1966).

Thirdly, it must be remembered that the environment in which first aid and the use of equipment occurs is a bumpy, swaying ambulance in which there is only a limited space to manoeuvre. There is often a second patient in the ambulance at the same time, and this greatly limits efficiency.

Ambulance Training

From this survey and analysis of results certain points of emphasis appear to be necessary in ambulance training.

(1) There should be particular emphasis on the treatment of the unconscious patient, especially the one with head injuries. There should be highly dogmatic teaching on the clearing out of the mouth of debris, clot, and vomit, the turning over of the patient on his side into the semi-prone or unconscious position, with the avoidance of the tongue falling back by extending the neck and closing the mouth in the extended position. These should be done at the site of the accident, taking time, before the patient is placed in the ambulance. If mouth-to-mouth resuscitation is indicated this should be done, and, if successful, then the patient turned on his side. These various factors are often emphasized quite strongly from time to time in lectures, but they should be so taught that each member of the ambulance service should carry them out every time in every appropriate circumstance.

(2) Training in insertion of oral airways is a practical proposition, and this practice will improve the condition of many patients who, at present, are suffering from varying degrees of hypoxia on admission to hospital.

(3) Ambulance men should be taught that the occurrence of an unstable spinal injury in a patient who is also unconscious from head injuries is extremely rare. The priority in all cases should be maintenance of the airway.

(4) *Splintage*.—A definite policy should be adopted towards the use of splints. It would seem that it would be best for inflatable splints to be used in all the below-elbow and the below-knee fractures, and that fractures above the knee and above the elbow should be treated by splintage to the other leg or splintage of the arm to the chest, respectively. Though these inflatable splints are available, some ambulance personnel do not feel confident that they can apply them satisfactorily. They are somewhat worried about the possibility of circulatory embarrassment, etc. Those who use them regularly find little fault. It would be necessary for the

hospitals at the same time to buy a number of these splints for exchange when the patient is brought in to the accident and emergency departments.

(5) *Haemorrhage*.—On the whole this is well dealt with by ambulance personnel. More could be done, in that firm manual pressure should be used in severe lacerations and in those cases in which bandages alone are not controlling bleeding sufficiently. Elevation of limbs is also important.

(6) *Assessment of Injury*.—This could probably improve with the better training that is envisaged. Much of this is a matter of experience. In particular more deliberation is indicated at the site of the accident and the calling of other ambulances if necessary.

(7) The use of mouth-to-mouth respiration with the Brook airway appears to be well understood, as is also the use of oxygen, though in several cases where the latter was used it was probably not necessary.

(8) There is some obvious difficulty at times in selecting the appropriate equipment with which to treat the patient. The AMBU resuscitator and the Stevenson Minute-man have not been used in many cases. Probably simple methods are most satisfactory, and these should be emphasized so that these resuscitators are used only in the appropriate circumstances.

(9) *Cardiac Massage*.—This is best not attempted, unless by someone who has passed the proposed advanced proficiency certificate.

Radio Link

At the moment there is a proposed radio link between the hospitals in Portsmouth and the City Ambulance Service, so that communication can be established between the ambulance at the site of accident or emergency and the appropriate department of the hospital. There is no doubt that such a radio link is of enormous benefit both to the ambulance service and to the hospitals concerned (Hall and Garden, 1967). The early prior warning of arrival of patients is particularly helpful—for example, where resuscitative procedures are necessary in order to save life. At the same time ambulance personnel can receive advice from the hospital while they are at the site of the accident, and also during the journey to hospital. In this way practical application of training procedures is improved and the natural anxiety of the ambulance personnel in certain circumstances can be allayed. It will also gradually increase the confidence of ambulance personnel in dealing with different situations that may arise. This has been proved in a number of areas—for example, in Derby (Collins, 1966), Preston (Hall and Garden, 1967), and Oxford (Scott, 1967)—where several different radio frequencies have been converted into one frequency in order to provide a radio link. The proposed radio link in Portsmouth could easily extend into the area surrounding the Portsmouth group of hospitals, and there is no practical reason why the link could not be extended in this way, and indeed over the whole of the Wessex Region. It would be particularly appropriate for the County Ambulance Service, as their patients are carried for much longer periods of time than by City Ambulance Services.

It cannot be emphasized enough that a radio link is of inestimable value in overcoming the lack of practice caused by the relatively low proportion of the work load occupied by accident and emergency cases.

The Ambulance

As is generally realized, it is difficult to carry out procedures such as resuscitation in the present-day ambulance. It should not be impossible to produce a very much better ambulance from this point of view, and it would be most advantageous if there was a device to ensure that the stretchers remained level.

Ideally, accident ambulances should contain only one stretcher, so that the attendant has only one severely injured patient to look after. If this ideal is not attainable, any second patient carried in any ambulance should be one with minimal

injuries that need little attention during the journey to hospital. It was evident during this survey that one ambulance attendant could not adequately look after two severely injured patients in the back of an ambulance, and was certainly not able to apply life-saving measures.

In future, in the Portsmouth group a type of stretcher will be used through which x-ray films can be taken. Thus patients on these stretchers can be placed directly on to a combined resuscitation and x-ray trolley. The patient stays on the same stretcher from admission to the accident and emergency department until he goes to the ward or theatre. In order to do this a supply of similar stretchers has to be available in the accident and emergency department for exchange purposes.

Ambulance Equipment

The following points must be mentioned in connexion with the sucker. Firstly, some, but by no means all, ambulance personnel who are taught how to use a sucker are not completely happy about using it. Secondly, it is very difficult to use a foot sucker properly, or at all, in the present-day ambulance, especially if two severely injured patients are in the same vehicle. Thirdly, in some types of apparatus the sucker has a fairly wide tube, but the end is of hard bakelite material in which the tube diameter is narrowed down considerably, being about a third of the width of the preceding piece of tube. It is not efficient for all circumstances. Lastly, it may be difficult to use the sucker because of clenching of the teeth by the patient, particularly in hypoxic cases. Thus all ambulances should carry at least a triangular wooden gag, and not merely small dental gags. All ambulances would be better supplied with Ferguson ratchet mouth gags with eccentric rubber-covered (Ackland type) jaws. These are easier to insert and easy to keep inserted to sufficient width to allow the sucker to be efficiently used, and to help with the insertion of oral airways if provided.

All ambulances should be fitted with a sucker that runs from the engine, preferably from the battery. The sucker needs firm stiff tubing at least as wide as an oesophageal or stomach tube. The foot sucker should be retained as well, however, because this will be of some use if taken to the patient, either in the home or at the scene of an accident.

AMBU Resuscitator

This is a very good apparatus, but even with an oral airway inserted it needs two hands for use, and there must be a fair degree of skill to maintain a good airway while using it, especially if no intraoral airway has been inserted. If only one size of mask is provided there will not always be the airtight fit obtained which is essential. Hence if these resuscitators are to be used a number of airways should be provided, and the ambulance personnel should be trained to insert them. At the same time the ambulances should be provided with at least three different sizes of mask. It is suggested, therefore, that each ambulance be provided with these and also with three Guedel type airways and one Philips airway (Guedel No. 1 for small children; Guedel No. 2 for women; Guedel No. 3 for men; and a large Philips airway for the large obese patient).

Stevenson Minute-man Apparatus

This apparatus is expensive but easier to use than the AMBU resuscitator. Philips airways tend to produce more vomiting than a Guedel airway on the whole, especially in patients who are not deeply unconscious. It would seem that the Stevenson

Minute-man could be used with the variety of airways as proposed above for the AMBU resuscitator. On balance it would appear that the Stevenson minute-man apparatus would be the better one to use in the ambulance services, though it is the more expensive.

All airways should be inspected regularly and if they become worn and soft should be immediately replaced, as any slight clenching of the teeth can obstruct defective airways.

Originally it seemed that it would be difficult for ambulance personnel to insert these airways, but it does appear that certain ambulance personnel, if properly trained, can insert them without any danger of actually pushing the tongue back. The resuscitators (AMBU and Minute-man) are valuable if properly used, but should be used only when the other simpler methods have failed to produce any improvement. In particular the AMBU resuscitator needs a high degree of skill, and also two hands to operate it.

Ability to Achieve Head-down Tilt

The ambulances in the City Ambulance Service have ratchets in which the head-down tilt can be achieved to 15° or slightly more. It would seem desirable that all ambulance stretchers should be so constructed that this can be done.

Conclusion

It should be made clear that this report refers to an area in which the standard of ambulance services is as high as any in Great Britain. Nevertheless, I think that the efficiency of the Ambulance Service could be improved by better training and equipment, and by improved communications between the Ambulance Service and the hospitals. Mortality and morbidity after accidents and emergencies could be appreciably reduced with these measures.

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