REVIEW

Secondary transport of the critically ill and injured adult

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There is significant interest in the secondary transport of the critically ill and injured. High profile cases entailing the long distance transfer of patients have highlighted the lack of availability of critical care beds and appropriate systems for transferring this patient group. These and other issues have culminated in the release of *Comprehensive Critical Care* by the Department of Health in 2000. It has been shown that a large number of critical care transfers originate in the emergency department. The transportation of patients has not traditionally been part of the core curriculum of emergency medicine specialists in the UK. It is imperative that clinicians have an understanding of the issues surrounding transportation of the critically ill and injured. This should include appreciation of the local and regional organisational frameworks implemented for this patient group. This review describes the core issues relevant to emergency medicine relating to the transportation of the critically ill and injured.

In 2000, the Department of Health released *Comprehensive Critical Care* partly as a result of high profile cases involving the long distance of critically ill and injured patients.[1] It has been shown that a large number of critical care transfers originate in the emergency department.[2] Previous publications have estimated that 11 000 critically ill and injured adult patients are transferred between hospitals in the United Kingdom each year.[3] These figures are likely to be an underestimate as they reflect transfers between or into an intensive care unit (ICU) rather than the transfer of all critically ill or injured. Nationally, the numbers of critically ill and injured transferred from or into an emergency department (ED) is unknown although data from a regional study in Yorkshire[2] suggest that it is a significant proportion of the total number of critically ill adults requiring secondary transport.

The transportation of patients can be divided into a number of specific categories: Primary transport (prehospital care) is the transfer of patients from site of illness or injury to first hospital contact. This is largely undertaken by paramedics in the UK. Primary transport is beyond the scope of this review and is well described in the emergency medicine literature.[4–6] Secondary transport is the transfer of the patient from one hospital to another for continuing clinical care (interhospital transfer). This type of transfer may occur for a variety of clinical and non-clinical reasons. Intrahospital transport is the transfer of patients between departments within the same hospital, for example, from the ED to radiology suite or ICU. The hazards and care required during intrahospital transfer are identical to that required for secondary transport[7–10] and will not be covered separately in this review.

The standards of care provided during transfer have been widely reported as frequently being suboptimal with a lack of monitoring and appropriately trained staff[3 11–14] leading to a significant number of adverse events in both adults and children.[14–19] These findings resulted in professional organisations publishing guidelines on how the transfer of the critically ill should be conducted.[20–26]

Emergency medicine has a key part to play in the organisation of secondary transportation. The specialty has historically had strong links with prehospital care and emergency medical services (EMS). Recent data also suggest that the ED is the second most common department within the hospital to refer and to receive critically ill and injured adults (unpublished data, Alasdair Gray).

This review details the processes of care of the critically ill and injured adult during secondary transport emphasising current clinical and political issues specifically pertinent to the specialty of emergency medicine.

INDICATIONS FOR TRANSFER

Secondary transport should only occur if it is likely to improve the patient's clinical outcome.[26 27] It should be undertaken in a manner that does not jeopardise the level and quality of care being given.[28 29]

Table 1 lists the indications for the secondary transport of the critically ill adult. The foremost reason for transfer from the ED is a requirement for specialist care. This is often for neurosurgical care[2 30 31] but includes patients with ruptured abdominal aortic aneurysm and other injured patients requiring specialist management (cardiothoracic, maxillofacial, orthopaedic, and burns). Another reason for transfer is for further investigations that are unavailable at the referring site such as angiography. Non-clinical transfers occur when a patient is transferred because of the lack of a critical care bed or insufficient staff capacity at the referring hospital. The decision to transfer a patient for a non-clinical reason can be extremely difficult as the risk of transfer to another hospital may exceed the anticipated benefits.[26] Ideally, no patient should be transferred for non-clinical reasons. However, if necessary, the patient transferred should be normally the most ''stable''

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critically ill patient in the hospital. Another factor, which may influence the decision, is the next of kin being required to travel long distances to be with the patient and the length of time that the person is likely to require critical care support. A final reason for transfer is for repatriation because the patient has become ill or injured in a different geographical area to their residence or because they were originally transferred away from their local hospital.

MODE OF TRANSPORT

The mode of transport[26] used is dependent on the characteristics outlined in the box. Standard road ambulances undertake most of the transfers in the UK. Increasingly, local EMS services have specific vehicles designed for the secondary transport of the critically ill. These need to be accessible and have equipment familiar to the transferring staff. Air transport by helicopter is becoming more available but is not necessarily ideal if landing sites are not adjacent to the ED necessitating additional short distance ambulance transfers. Nevertheless, air transport should be considered if transfer distances greater than 80 kilometres or transfer times greater than 90 minutes are anticipated.[26 29] Irrespective of the mode of transport, but particularly with aeromedical transport, access to the patient is limited and therefore if the patient does deteriorate en route intervention may be difficult.[26] The physiological response to air transportation and environmental factors such as noise and vibration also needs to be considered.[31 32] Accompanying staff should be aware of the potential dangers of air transportation and have participated in specific aeromedical training.

ACCOMPANYING STAFF

About 90% of all secondary transports are undertaken by personnel from the referring hospital using their equipment and a standard ambulance.[29] These medical and nursing staff are often not appropriately trained or experienced.[3 12–14]

There is some evidence from the UK[34 38] and other countries[39] that the quality of care is improved if a specialist retrieval or transfer team is used. It is however unproven as to whether this is attributable to availability of equipment, increased seniority or training of transport personnel, or better stabilisation that the team may perform before transfer. Retrieval teams are advocated by the Department of Health[1] and some professional organisations.[26] No clinical or cost effectiveness data are available for teams transporting adults when compared with standard care. More robust data are available for paediatric retrieval teams, which have been shown to be safer and more effective than standard care.[40 41] The Paediatric Intensive Care Society[42] now recommends the use of paediatric retrieval teams. Emergency departments receiving children should be aware of local availability of a paediatric retrieval team and methods of team activation. Potential difficulties that need consideration include contingencies when the team is needed in two places simultaneously and how rapidly the transfer is required. The role of the team when they are not involved in patient transfer also needs to be defined. The optimal make up of these teams has not be delineated. In general, a senior middle grade doctor from anaesthesia or intensive care and at least one senior intensive care nurse in addition to the ambulance staff would constitute the team.

Influencing factors on choice of transport

1. The nature of the illness
2. Urgency of transfer
3. Availability of transport
4. Mobilisation times
5. Geographical factors
6. Traffic and weather conditions
7. Cost

TRAINING

Comprehensive Critical Care[1] discusses the need to improve training in all aspects of critical care. There is, however, little structured training available either for medical or nursing staff on the process of transferring the critically ill and injured. Training courses such as the Safe Transfer and Retrieval (STaR) course[43] are run by the ALSG group have been developed recently. Increasingly, ED medical and nursing staff are involved in the transfer of critically ill patients. It is, therefore, imperative that they have the appropriate training.

PRETRANSFER CARE

All transfers require physiological stability for optimum patient outcome.[26 43–45] Physiological stability during the transfer mandates careful pretransfer assessment and optimisation of the patient. Missed or undertreated injuries,[16 17 46–48] neglected pretransfer respiratory or cardiovascular instability,[16–18 46 47] and lack of anticipation of potential events[19 43] during the transfer can adversely affect outcome.

Patients who require resuscitation on arrival at the receiving hospital are likely to have a worse outcome and often should not have left the referring hospital without further treatment. Equally, delay in transfer may be detrimental to certain groups of patients, for example, intracranial

Table 1 Reasons for the secondary transport of the critically ill adult

Reason for transfer	Definition
No critical care facilities	No critical care facilities on hospital site at any time, for example, cottage or private hospital
Investigation	Need for specialist investigational facilities, for example, angiography or referral centre (imaging?) diagnostic facilities unavailable
Absence of normal clinical expertise	Normal medical expertise not available at referral site, usually because of medical staff absence, for example, vascular surgeon on holiday
Specialist facilities	Medical expertise or therapeutic intervention
Repatriation	This can be local, regional, or international. Either because the patient was originally transferred from their local hospital or because they became ill at a remote site
Non-clinical transfer	Current unavailability of an appropriately staffed critical care bed at referring site

haematomas[49 50] or ruptured abdominal aortic aneurysms. There is little evidence that other groups of patients are adversely affected by longer pretransfer times.[51 52] It is clear that time constraints should not affect the essential provision of physiological stability to the patient before transfer.

It is recommended that pretransfer assessment and stabilisation is approached using the ABCDE method (visit the journal web site to see details of the ABCDE method http://www.emjonline.com/supplemental).

PREPARATION FOR TRANSPORT

The ED must ensure appropriate preparation and packaging of the patient before transfer. Appropriate equipment, monitoring, and trained staff should be readily available. Patient assessment and packing should follow a system as already described. The return journey should be organised before leaving the hospital and transferring staff should have appropriate clothing, mobile telephone and money in case of emergencies. The accompanying staff, if from the referring hospital, should have ideally been involved in the patient's care since presentation. If this is not the case there should have been adequate hand over between staff before departure. The route to the hospital and access to the receiving department should be clearly defined. Relatives should be informed and provision made for their travel arrangements to the receiving hospital.

Accompanying medical and nursing staff should have appropriate levels of insurance cover.[26]

CONSIDERATIONS DURING TRANSPORT

If appropriate measures have been taken before transfer, there should be little requirement for active intervention during transport. Continued reassessment of the patient's clinical status during transfer is mandatory. Vascular access sites should remain accessible during transfer. Ideally, the level of monitoring and the frequency of measurement of physiological parameters should be the same as it would be in theatre or the resuscitation room. Vibration and vehicle movement may interfere with the monitoring. All equipment and monitoring should be adequately secured and staff seated and wearing seatbelts. Battery life of equipment should be long enough to cover the transfer time comfortably. If not spares should be carried or the compatibility with the ambulance power supply needs to be ensured. Additionally the difficulty with communication during transport between staff and patient especially during air transport needs to be considered. Adverse events should be recorded and action taken to resolve the problem as quickly as possible.

The use of ''blue lights'' and police escort should be restricted to situations that are completely necessary and not used routinely.

The ambulance should conform to the current CEN regulations (UK–BS EN 1789; 2000). This standard is currently voluntary and indicates the design, performance, and specification of the ambulance.

POST-TRANSFER CARE

The patient is the responsibility of the transferring team until formal nursing and medical handover has occurred in the receiving department. The patient should be received in a safe environment with the receiving team already assembled. If the patient has potential for instability or the management plan is unclear the patient should be received by the team in the ED resuscitation room.[61] The patient should then be reassessed using the ABC method, monitoring and ventilators changed, and blood gas pressures rechecked. The patency and security of all lines, tubes, and drains should be re-evaluated. All relevant documentation should be handed over including blood results and radiographs. The receiving staff must be informed of issues relating to the patient's relatives. All equipment must be collected and return with the transferring staff.

COMMUNICATION AND DOCUMENTATION

Good communication between referring and receiving medical and nursing staff is imperative. Specific faxed transfer letters and teleradiology[62] have been shown to be effective. A number of authorities have published pretransfer checklists, en route documentation, and transfer forms. These should include all pertinent clinical details including physiological status.

The ambulance service needs to be informed and an ambulance booked according to local policy.

The receiving hospital should be informed if there is any change in anticipated time of transfers or clinical status. The receiving hospital should be alerted when the patient leaves the referring hospital and 10 minutes before arrival.

Directions to the hospital and the department within the hospital need to be clear. The patient and relatives should be kept informed at all times. Relatives should not routinely travel with the patient.

LOCAL AND REGIONAL ORGANISATION OF SECONDARY TRANSPORTATION

The Department of Health report, *Comprehensive Critical Care*,[1] outlines ways in which critical care should be delivered locally and regionally in England and Wales. This has implications for all EDs, as they are an integral part of each hospital's critical care facility. A regional system for the care of the critically ill and injured coordinated through the development of critical care networks is being implemented. These Critical Care Networks are responsible for developing guidelines and quality assurance programmes for the secondary transport of the critically ill and injured adult. They are also tasked with improving the training of staff involved in the transfer process. The principal objective of these developments is to improve and standardise clinical care across a defined geographical area by setting standards and developing quality assurance programmes.

The ED must be aware of contact numbers for their regional intensive care bed bureau and other members of the local transfer group. Local referral policies and guidelines and contacts for specialist services, for example, neurosurgery and burns and paediatric retrieval team would be useful.

Other initiatives that may have an impact on the number of secondary transports of critically injured patients from the ED include the recent publication by the Royal College of Surgeons of England and the British Orthopaedic Association[63] on the management of major trauma and head injuries. These documents advise that patients should be taken from the site of the accident to the most appropriate hospital not the nearest as has traditionally happened within the United Kingdom. This would result in a reduction in the number of secondary transfers, in particular, patients with significant head injuries.

Traditionally, critically ill patients have been transported from the referring to receiving hospital in an ad hoc manner. This has resulted in varied clinical practice and standards during the transport process (see pretransfer care). *Comprehensive Critical Care*[1] explicitly supports local as well as regional coordination of the process. The level of care given to an individual patient will be consistent within a hospital and not dependent on their source department or the individual clinician involved. This will once again require the ED to be responsible with the rest of the hospital in developing a safe robust system for transferring patients from the ED to other hospitals and departments. There should be

clear guidance as to who accompanies patients during transfer, in particular, the non-intubated but critically ill patient who have been shown to have a high critical incident rate.

IMPLICATIONS FOR EMERGENCY MEDICINE

This review highlights the central position of the ED in the process and organisation of the secondary transfer of the critically ill and injured and the delivery of critical care in the hospital. Recent proposals from the Department of Health and professional bodies suggest that our specialty will be increasingly involved in the development of transport systems and the Critical Care Networks associated with them. The specialty requires medical and nursing representation at local and network levels to address the issues that surround the transfer of the critically ill from the ED. Quality assurance systems are required to monitor processes and quality of care within the system. Adequate training is mandatory for ED medical and nursing staff accompanying critically ill patient during transfer. Consideration needs to be given to standardisation and the improvement in availability of transport equipment and monitoring in individual hospitals and across networks.

These changes need to be led and directed by the specialty in conjunction with, rather than be invoked by outside agencies and other specialties.

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Contributors

AG conceived the idea and formulated the review outline with SW and SB. AG, SW, and SB all contributed to the writing of the review. AG edited the manuscript and will act as guarantor.

Details of the ABCDE method are available on the journal web site (http://www.emjonline.com/supplemental).

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Airway

Intubation should be performed if there is any need for assistance in maintenance of the airway (positioning or adjuncts).[53] Other indications include failure of protection of the airway (low GCS, inability to swallow), expected clinical course (burns, deteriorating GCS) or if assistance with ventilation is needed to maintain oxygenation or for controlled ventilation in head injury.[53] If intubated, the tracheal tube must be firmly secured and its position confirmed clinically, by capnography[53, 54] and chest x-ray. Reassessment of the airway and position of the tracheal tube should occur after any significant movement of the patient such as moving from resuscitation room to ambulance.

Breathing

A transport ventilator must be used for all ventilated patients.[55] Patients should be stabilised on the ventilator before transfer to allow assessment of the adequacy of ventilatory settings. An arterial blood gas sample should be analysed just prior to transfer to assess adequacy of ventilation and to ensure appropriate blood gas targets are achieved prior to transportation e.g. pCO_2 4–4.5kpa in the head injured.[43, 53] Any change to ventilator settings or inspired oxygen concentration mandate re-assessment after sufficient time to allow stabilisation of the respiratory parameters. O_2 saturation monitoring should be used throughout the transfer process. All ventilated patients should have end tidal CO_2 monitoring during transfer. Airway pressures must be monitored.[26]

Any suspicion of pneumothorax necessitates intercostal drainage. Drain tubes should not be clamped and Heimlich flutter valves may be preferred to underwater seals unless the patient has a haemothorax. If these devices are changed for the transfer, this

should not occur immediately prior to transfer but with sufficient time before to allow assessment of any malfunction.

Orogastric or nasogastric tubes should be inserted, not spigoted, and allowed to drain freely. This is especially important during air transport.[26] NG tube position, if possible, should be confirmed by x-ray before transport.

Circulation

A minimum of 3 lead ECG monitoring is needed. The rhythm should be stable, or if not, appropriate management e.g. pacing instituted before transfer.

Hypovolaemic patients tolerate movement poorly.[56–58] Hypovolaemic patients should, therefore, not be transferred unless absolutely necessary e.g. ruptured aortic abdominal aneurysm. Adequate resuscitation to maintain a normal and stable pulse and blood pressure is mandatory. Whenever possible bleeding should be controlled. Laparotomy, fracture stabilisation and other interventions to control haemorrhage should be performed prior to transfer.[54] Inotrope requirements should also ideally be stable and not escalating.

At least two functioning secured intravenous lines should be present before transfer. If central access is required, this should be provided before transfer and the position of the lines should be checked on X-ray films. Invasive arterial monitoring is recommended for most critically ill and injured patients to allow accurate blood pressure assessment during transport.[57] This should be secure and functioning before transfer. CVP lines should be well secured and accessible. Pulmonary artery catheters should be withdrawn 5–10♣cm to prevent inadvertent “wedging” during transport (unless waveform is displayed).

Recent haematology and electrolytes results should be reviewed and when significant abnormalities are detected corrective therapy is instituted before transfer.

A urinary catheter must be placed and draining adequately.

Disability

A significant number of critically ill patients will not require to be intubated before transfer. However, all intubated patients must be adequately sedated and paralysed. If the patient is having seizures, these should be controlled prior to transfer. Regular pupil checks should be performed and specialist advice sought should evidence of raised intracranial pressure be detected before transfer.

Exposure

It is essential that the primary survey and log roll be completed to avoid non-detection of injuries in patients with major injury. A secondary survey should be undertaken preferably before transfer.

The patient must be well secured on the transfer trolley. In-line immobilisation of the entire spine is usually required for all unconscious trauma patients. The patient should not, however, be transferred on a spinal board unless there are no alternatives. Ideally, patients with spinal cord injury should be transferred using a full-length vacuum mattress[59] providing it can be adequately secured.

Critical illness or injury disrupts the patient's normal temperature control mechanisms. This is particularly important in children. The core temperature must be normal or rising to normal before transfer as active warming is difficult during transfer. Movement may also precipitate malignant arrhythmias in severe hypothermia.[60] Consideration needs to be given to continuous core temperature monitoring during transfer if there are specific concerns regarding temperature control. The StaR course[43] advocates "mummy wrapping" in blanket or sleeping bag to prevent heat loss and to secure the patient and tubes and lines.

Some patients may need specific positioning such as in raised intracranial pressure.

Specialist advice may be needed and the position attained well before transfer.

Patients should have their eyes covered to prevent corneal injuries.