Trauma: Who cares?

A report of the National Confidential Enquiry into Patient Outcome and Death (2007)

NCEPOD

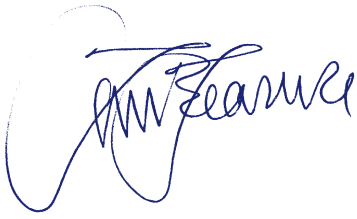
Foreword

Severe injury – a car crash, a fall from a height – accidents such as these are the commonest causes of loss of life in the young. The chance of survival and the completeness of recovery are highly dependent on the care that follows. Some are killed outright but those who survive the initial impact may still die in the hours, days or weeks that follow. The speed with which lethal processes are identified and halted makes the difference between life and death. The injury sets in train life threatening effects of injury on the circulation, tissue oxygenation and the brain. The sooner we can halt and reverse these processes, the more likely and complete will be return to health.

As a junior in the emergency and neurosurgical departments in Cambridge in the early 1970s we were trained in these rather obvious principles. To use a current catch phrase – it's not rocket science or another, nearer the point – it doesn't take a brain surgeon to work that out! And yet somehow the apparently obvious – or we might see it as "common sense" – was not so commonplace. Then in 1976 an orthopaedic surgeon James Styner crashed his plane in Nebraska. His wife was dead and there he was in a field with three of his four children critically injured. He flagged down a car to get to the nearest hospital – which was closed. Once opened it became clear to him that the care available was inadequate and inappropriate.

The minutes and first hours after an accident are not the time to be working out care from first principles. We miss the obvious under pressure; we cannot hope to make consistently inspired diagnoses. It is not the time to be negotiating a hierarchy, debating priorities and searching shelves and drawers for equipment. We need a well worked out process based on getting most things right and very few things wrong. Realising this, Styner started to work out a system of care. From his initial efforts came Acute Trauma Life Support (ATLS) and with it a new philosophy of care of the severely injured patient based around well thought through processes and teams trained in them – all adhering to the same workshop manual.

To be effective all processes, including ATLS and other components of care of severely injured patients must be embedded in practice at every stage: the scene of the accident; alerts to the hospital; the journey from scene to the emergency department; preparations made there; expertise accessible on arrival and at all subsequent stages, including transfer to specialist services. This NCEPOD report has studied how well we do – and where we sometimes fail. It is by sympathetically but analytically studying where things go wrong that we can learn most.



Professor T. Treasure
Chairman

Introduction

Trauma remains the fourth leading cause of death in western countries and the leading cause of death in the first four decades of life. As the incidence of trauma is particularly high in the younger population; an average of 36 life years are lost per trauma death[1]. Furthermore, trauma is also a major cause of debilitating long-term injuries. For each trauma fatality, there are two survivors with serious or permanent disability[2]. Trauma is, therefore, not only a leading cause of death but also a large socio-economic burden. In 1998, the estimated cost to the NHS of treating all injuries was £1.2 billion per annum[3]. Reducing injuries is, therefore, a key government objective. By 2010, the Department of Health aims to have reduced the incidence of accidents by at least 20% from the baseline that was set in 1996[3].

Road trauma accounts for over a third of all deaths due to injury[4]. In 2001-2003, there were (on average) 3,460 traffic related fatalities per annum in Great Britain[5]. The incidence of severe trauma, defined as an Injury Severity Score (ISS) of 16 or greater, is estimated to be four per million per week[6]. Given that the UK population in mid-2003 was in the region of 59.5 million[7], there are approximately 240 severely injured patients in the UK each week.

In 1988, the working party report by the Royal College of Surgeons highlighted 'serious deficiencies in the management of severely injured patients'[8]. Following this report, there was increased focus on the care of trauma patients in the UK and consequently the fatality rate of trauma patients reduced. However, most of the improvement in the outcome of these patients occurred prior to 1995, with no further significant change occurring between 1994 and 2000[9].

In 2000, a joint report from the Royal College of Surgeons of England and the British Orthopaedic Association recommended that standards of care for the severely injured patient should be nationally coordinated and

systematically audited[6]. It was also recommended that standards and outcome measures be developed, against which institutions can audit the outcome of treatment. The standards of care recommended in the report include the use of advance warning systems by the ambulance service, the establishment of trauma teams, the involvement of a senior anaesthetist from the outset and criteria for the activation of the trauma team. The overall purpose of these recommendations was to improve the care of severely injured patients in terms of reduced mortality and unnecessary morbidity.

A number of UK-based single and multi-centre studies have addressed specific issues relating to the care of trauma patients[10-15]. The use of ambulance crews to alert hospitals of severely injured patients, the effect of inter-hospital transfers and the determinants affecting outcome have all been studied. One of the largest UK-based studies looked at the treatment of neurosurgical trauma patients in non-neurosurgical units[16]. There has not, however, been a national study to examine the overall care of trauma patients in the UK to date.

Much of the research on trauma care in the UK has been carried out using data from the Trauma Audit and Research Network (TARN), which was established in response to the Royal College of Surgeons working party report. Approximately 50% of trauma receiving hospitals submit data to TARN[17]. The Trauma Network Database is now an important source of epidemiological data and, in 2000, it contained information on over 120,000 cases[18]. The Healthcare Commission is working with TARN to increase participation in TARN from 50% to 100% of hospitals and to expand the number of quantitative trauma audits. At a local level, the feedback provided by TARN to individual hospitals highlights, amongst others, those cases in which patient outcome was 'unexpected'. This markedly aids internal audit and the review of trauma cases by those multi-specialty clinicians who were involved in the care of particular patients. Together with national evaluations of trauma care, in particular head injury, processes of trauma care are also analysed and provide a factual basis for system review.

A lack of continued improvement in outcome is coupled with concern that the quality of care in hospital is not of a consistently high standard across the UK, despite the availability of guidelines that indicate referral pathways for optimum triage, management and access to specialist care[6,19,20]. Furthermore, owing to the incidence of severe trauma, hospitals are unlikely to treat more than one severely injured patient weekly. It has been suggested, therefore, that as sufficient trauma experience cannot be achieved at all hospitals, optimal outcomes may be compromised. One of the overall recommendations of the 2000 report was the establishment of a National Trauma Service trauma hub and spoke network between hospitals in each geographic area[6].

The organisation of trauma services in the UK remains highly topical. The recent report from The Royal College of Surgeons of England (2006) confirms that high quality trauma care is not consistently available within the NHS. Recent public debate and government statements reflect the continuing controversies regarding the optimum system of delivering trauma services within the present resource constraints[21]. This study is therefore timely as it explores the organisation in trauma services from the perspective of the patient journey. NCEPOD have identified remediable factors and made recommendations for improvement in the management of the severely injured patient.

The Royal College of Surgeons Trauma Committee submitted the Severely Injured Patient Study proposal as part of NCEPOD's topic selection process in February 2004. The NCEPOD Steering Group selected the topic, which falls under NCEPOD's extended remit.

Principal recommendations

Organisational data

There is a need for designated Level 1 trauma centres and a verification process needs to be developed to quality assure the delivery of trauma care (as has been developed in USA by American College of Surgeons). *(Royal College of Surgeons, College of Emergency Medicine)*

Prehospital care

All agencies involved in trauma management, including emergency medical services, should be integrated into the clinical governance programmes of a regional trauma service. *(All healthcare providers)*

Airway management in trauma patients is often challenging. The prehospital response for these patients should include someone with the skill to secure the airway, (including the use of rapid sequence intubation), and maintain adequate ventilation. *(Ambulance and hospital trusts)*

Hospital reception

Trusts should ensure that a trauma team is available 24 hours a day, seven days a week. This is an essential part of an organised trauma response system. *(Hospital trusts)*

A consultant must be the team leader for the management of the severely injured patient. There should be no reason for this not to happen during the normal working week. Trusts and consultants should work together to provide job plans that will lead to better consultant presence in the emergency department at all times to provide more uniform consultant leadership for all severely injured patients. *(Hospital trusts and clinical directors)*

Airway and breathing

The current structure of prehospital management is insufficient to meet the needs of the severely injured patient. There is a high incidence of failed intubation and a high incidence of patients arriving at hospital with a partially or completely obstructed airway. Change is urgently required to provide a system that reliably provides a clear airway with good oxygenation and control of ventilation. This may be through the provision of personnel with the ability to provide anaesthesia and intubation in the prehospital phase or the use of alternative airway devices. *(Ambulance trusts)*

Management of circulation

Trauma laparotomy is potentially extremely challenging and requires consultant presence within the operating theatre. *(Clinical directors)*

If CT scanning is to be performed, all necessary images should be obtained at the same time. Routine use of 'top to toe' scanning is recommended in the adult trauma patient if no indication for immediate intervention exists. *(Royal College of Radiology and radiology department heads)*

Head injury management

Patients with severe head injury should have a CT head scan of the head performed as soon as possible after admission and within one hour of arrival at hospital. *(Trauma team leader and radiology heads)*

All patients with severe head injury should be transferred to a neurosurgical/critical care centre irrespective of the requirement for surgical intervention. *(Strategic health authorities, hospital trusts, trauma team leaders)*

Paediatric care

Each receiving unit should have up to date guidelines for children which recognise the paediatric skills available on site and their limitations and include agreed guidelines for communication and transfer with specialised paediatric services within the local clinical network. *(Strategic health authorities and hospital trusts)*

Transfers

There should be standardised transfer documentation of the patients' details, injuries, results of investigations and management with records kept at the dispatching and receiving hospitals. *(Trauma team leader, Department of Health)*

Published guidelines must be adhered to and audits performed of the transfers and protocols. *(Hospital trusts)*

Incidence of trauma and organisation of trauma services

Given the relatively low incidence of severe trauma in the UK, it is unlikely that each individual hospital can deliver optimum care to this challenging group of patients. Regional planning for the effective delivery of trauma services is therefore essential. *(Strategic health authorities, hospital trusts)*

Summary of findings

This study shows a rounded picture of current trauma care provision in England, Wales, Northern Ireland and the Offshore Islands. It draws on data provided by the clinicians involved in the care of these patients (from questionnaires) and data extracted from the casenotes. However, these data are accompanied by peer review, by practising clinicians involved in the day-to-day care of trauma patients, to give a much richer picture than a purely quantitative assessment would allow.

Almost 60% of the patients in this study received a standard of care that was less than good practice. Deficiencies in both organisational and clinical aspects of care occurred frequently.

There were difficulties in identifying those patients with an ISS >16. With large costs involved in both the provision of care and resources for the management of these patients, it us surprising that that there is no current method of identifying the demand for the management of these patients.

The organisation of prehospital care, the trauma team response, seniority of staff involvement and immediate in-hospital care was found to be deficient in many cases.

Lack of appreciation of severity of illness, of urgency of clinical scenario and incorrect clinical decision making were apparent. Many of these clinical issues were related to the lack of seniority and experience of the staff involved in the immediate management of these patients.

It was clear that the provision of suitably experienced staff during evenings and nights was much lower than at other times. In the management of trauma, which very often presents at night, this is a major concern. NHS Trusts should be open about the differences in care by day and night and look to address this as a matter of urgency. Public awareness of these differences may be useful in any debate about the future configuration of trauma services.

Severe trauma is not common and many hospitals see less than one severely injured patient per week. This has a direct bearing on experience and ability to manage these challenging patients. Not only does this relate to clinical skills but also to the feasibility of providing the entire infrastructure required to manage the trauma patient definitively in all centres.

Method

Study aim

The aim of this study was to examine the process of care for severely injured patients and identify variations that affect the achievement of agreed endpoints.

The expert group identified six main thematic areas that would address the overall aim of the study:

1. Timeliness of events making up the clinical management process.
2. Issues associated with prehospital care at the site of injury and transfer to hospital.
3. Issues associated with the care team that performs the initial resuscitation.
4. Processes and procedures associated with secondary transfers.
5. Issues associated with pathways, handovers and communication.
6. Membership of the Trauma Audit Research Network (TARN).

Case identification

Patients were identified prospectively. A nominated contact in the emergency department identified patients as "severely injured" based primarily on their own, and their colleagues', clinical judgment.

Data collection ran for three months from February 1st 2006 to April 30th 2006. Patients of all ages were eligible for inclusion.

Questionnaires and casenotes

Three questionnaires were used to collect data for this study, two clinical questionnaires per patient and one organisational questionnaire per site.

1. A&E clinician questionnaire
This questionnaire was sent to the A&E clinician in charge of the patient's initial resuscitation.

2. Admitting consultant questionnaire
This questionnaire concerned information on the location and consultant specialty to which the patient was admitted.

3. Organisational questionnaire
This questionnaire concerned data on the staff, departments, facilities and protocols for each participating hospital.

To complement the data available from the above questionnaires, copies of all the casenotes, including the patient report form for patients' first 72 hours in hospital were requested. If the patient was transferred within 72 hours, the casenotes from the receiving hospital were also requested.

The casenotes were used by NCEPOD staff to calculate an injury severity score (ISS) for each patient. Patients with an ISS of 16 or more were included in the study.

Advisor group

A multidisciplinary group of advisors was recruited to review the casenotes and associated questionnaires. The group of advisors comprised clinicians from the following specialties: emergency medicine, anaesthetics, general surgery, intensive care medicine, maxillofacial surgery, neurosurgery, nursing, paediatrics, plastics, orthopaedics and vascular surgery.

After being anonymised each case was reviewed by one advisor within a multidisciplinary group. At regular intervals throughout the meeting, the chair allowed a period of discussion for each advisor to summarise their cases and ask for opinions from other specialties or raise aspects of a case for discussion.

The grading system below was used by the advisors to grade the overall care each patient received.

Good practice:
A standard that you would accept from yourself, your trainees and your institution.

Room for improvement:
Aspects of **clinical** care that could have been better.

Room for improvement:
Aspects of **organisational** care that could have been better.

Room for improvement:
Aspects of **both clinical** and **organisational** care that could have been better.

Less than satisfactory:
Several aspects of **clinical** and/or **organisational** care that were well below that you would accept from yourself, your trainees and your institution.

Insufficient information submitted to assess the quality of care.

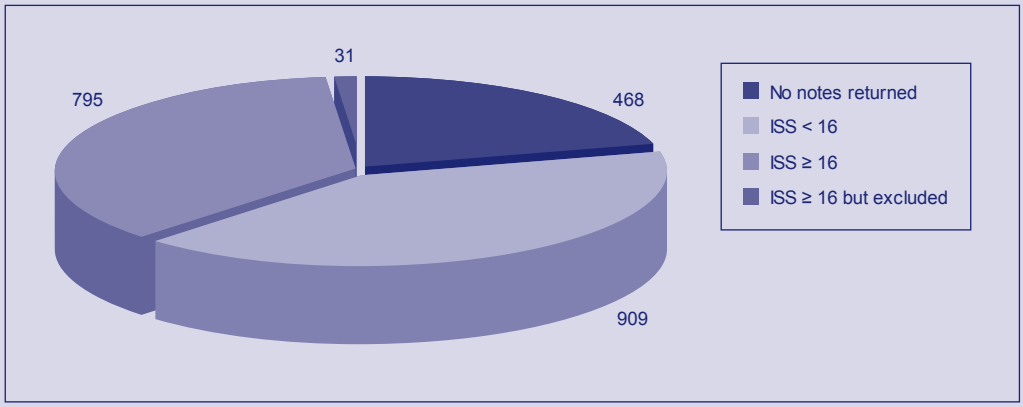
Overview of data collected

Hospital participation

An organisational questionnaire was completed for 183/218 (84%) hospitals, that were expected to participate.

Case identification

Patient sample



A patient identifier spreadsheet was returned for 180/218 (82.6%) hospitals that were expected to participate. In total this equated to 2203 patients, for which NCEPOD received 1735 (78.8%) sets of casenotes to calculate an injury severity score (ISS). Of these 909 cases had an ISS less than 16, 826 patients (47.6%) had an ISS ≥ 16, 31 of which were excluded as they were either dead on arrival, had complications of a previous injury or there was insufficient information for the advisors to assess any aspect of the patient's care. The remaining 795 patients were included in the study sample.

Clinician questionnaires

The study was designed such that the overwhelming majority of the quantitative and qualitative data could be obtained directly from the casenotes and the focussed opinions of the advisors (i.e. from the advisor assessment form).

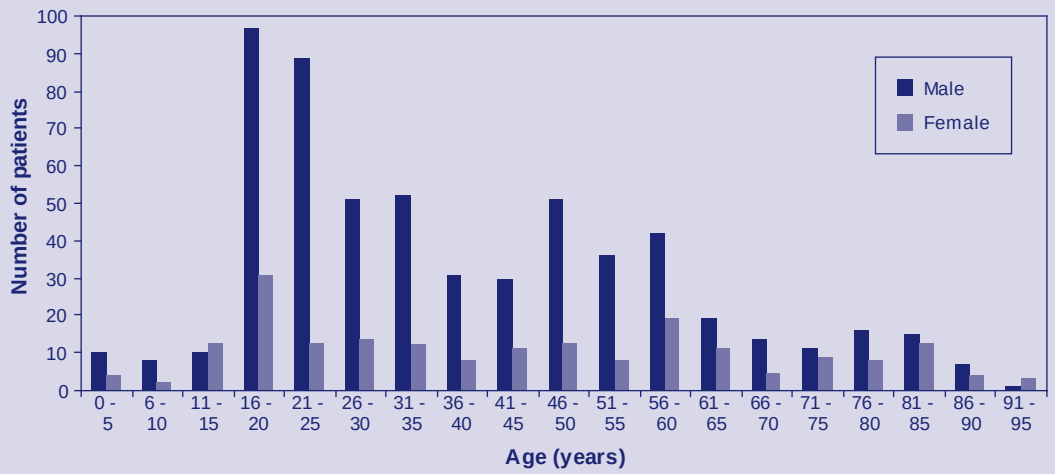
To supplement this, the clinician responsible for the initial resuscitation of the patient and the admitting consultant (if applicable) were asked to complete a patient care questionnaire. In total 513 A&E clinician questionnaires and 432 admitting consultant questionnaires were returned.

Age and gender

Seventy five percent (594/795) of the patients were males, and the mean age of the whole sample was 39.6 years. The mode age of the study sample was 18; one in six (128/795) patients being 16-20 years old.

The average age for males was 38 and average age for females 44. There was a peak in frequency for males aged 16-25.

Age range of patient sample by gender



Of the patients in the study 56.3% (442/785) were involved in a road traffic collision (RTC).

Mechanism of injury

	Number of patients	%
RTC (driver/passenger)	319	40.6
RTC (pedestrian)	123	15.7
Fall from height	136	17.3
Assault	72	9.2
Industrial/agricultural	21	2.7
Sport/leisure	18	2.3
Self harm	15	1.9
Other	81	10.3
Subtotal	**785**	
Not recorded	10	
Total	**795**	

The majority of patients 652/783 (83.3%) were transported to hospital by road ambulance. A further 92/783 (11.7%) patients arrived by helicopter. Only 25 patients arrived by means other than an emergency service vehicle.

Mode of arrival to hospital

	Number of patients	%
Ambulance	652	83.3
Helicopter	92	11.7
Other emergency service	5	<1
Hospital transfer	9	1.1
Member of public	13	1.7
Self referral	8	1.0
Other	4	<1
Subtotal	**783**	
Not recorded	12	
Total	**795**	

Organisational data

Key findings

Many severely injured patients are taken to hospitals that do not have the staff or facilities to provide definitive care.

In this study only 17 hospitals had the range of specialities available to be considered for a Level 1 Trauma Centre (under the verification system of the American College of Surgeons).

39.3% (72/183) of hospitals did not have a resident anaesthetist at SpR level or above.

65% (118/183) of hospitals stated that a consultant was not involved in the initial care of a severely injured patient who presented at 0200 on Sunday 5th February 2006.

Recommendations

There is a need for designated Level 1 trauma centres and a verification process needs to be developed to quality assure the delivery of trauma care (as has been developed in USA by the American College of Surgeons). *(Royal College of Surgeons of England, College of Emergency Medicine)*

All hospitals receiving trauma cases should have at least four resuscitation bays. *(Hospital trusts)*

All hospitals receiving trauma patients should have a resident SpR or above with the skills to immediately secure the airway in trauma patients. *(Hospital trusts)*

There should be a CT scanner within or adjacent to the resuscitation room. *(Hospital trusts)*

Each trust involved in trauma care should develop a core group of clinicians with a special interest in trauma management. This trauma care delivery group should include a member of the trust executive staff. *(Hospital trusts)*

Overall assessment

Key findings

Less than half (47.7%) of the patients in this study received good care.

Patients were more likely to receive good care in centres that reported a high volume of cases (>20) compared to a low volume of cases (<20) – 57% v 39%.

13.4% of cases had an inappropriate initial hospital response. It was much more likely to be an inappropriate response if the team leader/first reviewer was an SHO (23.5%) than a consultant (3.1%).

If the initial hospital response was inappropriate, it was more likely that the patient's overall care would be compromised.

Prehospital care

Key findings

In a third of cases (245/749), the ambulance patient report form was not available.

652/783 patients (83.3%) were transported to hospital by road ambulance and 92/783 patients (11.7%) by helicopter.

23/56 (41.1%) patients treated by a helicopter-based system were intubated on scene compared to 32/440 (7.3%) patients treated by a road ambulance system.

None of the patients treated by a helicopter based system were taken to an inappropriate hospital compared to 31/440 (7%) patients treated by a road ambulance system who were initially taken to an inappropriate hospital.

Blood pressure was recorded in 398/504 (80%) cases despite recommendations that this should not be measured in the prehospital phase.

Only 46/170 (27.1%) patients who suffered a severe head injury (GCS less than 9) were intubated prehospital.

Only 110/504 (21.8%) patients were given analgesia in the prehospital phase.

Recommendations

All agencies involved in trauma management, including emergency medical services, should be integrated into the clinical governance programmes of a regional trauma service. *(All healthcare providers)*

Ambulance trusts should work together to standardise the content and layout of the Patient Report Form (PRF), and ensure that it is fit for purpose and facilitates comparative audit. Clinicians must ensure that a PRF is received for every patient and secured in the medical record. *(Emergency medicine physicians and ambulance crews)*

It is important that where guidelines exist, they are widely disseminated to appropriate groups, and there is a robust system in place to monitor compliance with those guidelines. *(Ambulance and hospital trusts)*

It is vital that all patients who have sustained serious trauma should have a primary survey conducted at the earliest opportunity, and that critical resuscitation involving airway, breathing and circulation (with cervical spine control) should be undertaken and reviewed throughout the prehospital phase of care. This must be documented. *(Emergency medicine physicians)*

Airway management in trauma patients is often challenging. The prehospital response for these patients should include someone with the skill to secure the airway, (including the use of rapid sequence intubation), and maintain adequate ventilation. *(Ambulance and hospital trusts)*

Severely injured patients are likely to be in pain and the provision of adequate analgesia is required. If analgesia is not given there should be a clear record in the Patient Report Form of the reasons for this. *(Ambulance trusts)*

Hospital reception

Key findings

A pre-alert from the ambulance crew to the receiving emergency department was documented for only 50.1% of patients in this study.

One in five hospitals admitting severely injured patients did not have a formal trauma team.

When a pre-alert was made to the receiving emergency department, there was no trauma response in one in four cases.

A trauma team response was documented for only 59.7% of patients in this study.

A consultant was the team leader/ first reviewer in only 169/419 (40.3%) of cases.

Advisors felt that the patient's initial management was inappropriate in 23.5% of cases where an SHO was the team leader/ first reviewer compared to 3.1% of cases where a consultant was the team leader/ first reviewer.

If no trauma response was activated, then it was more likely that an SHO was the first reviewer or team leader for the severely injured patient.

176/419 (42%) patients were not seen by a consultant in the emergency department.

89/795 (11.2%) patients did not have a primary survey documented in their casenotes.

The initial management of the patient was thought to be inappropriate in 94/699 cases (13.4%).

Recommendations

Ambulance trusts and emergency departments should have clear guidelines for the use of pre-alerts in the severely injured patient population. The ambulance crew should be able to speak directly to clinical staff in the receiving emergency department to ensure an appropriate clinical response is available immediately. *(Ambulance trusts and emergency departments)*

Trusts should ensure that a trauma team is available 24 hours a day, seven days a week. This is an essential part of an organised trauma response system. *(Hospital trusts)*

Hospital and ambulance trusts should ensure there are agreed explicit criteria for issuing a pre-alert activation of the trauma team. *(Hospital and ambulance trusts)*

A consultant must be the team leader for the management of the severely injured patient. There should be no reason for this not to happen during the normal working week. Trusts and consultants should work together to provide job plans that will lead to better consultant presence in the emergency department at all times to provide more uniform consultant leadership for all severely injured patients. *(Hospital trusts and clinical directors)*

All patients should have a primary survey performed and clearly documented on admission to the emergency department. *(Emergency medicine physicians)*

Standardised documentation for the trauma patient should be developed. This will improve patient care and multidisciplinary communication. In addition, comparative audit will be facilitated. *(RCS and College of Emergency Medicine)*

As previously recommended, a consultant must be the team leader for the management of the severely injured patient. However, it is appreciated that this will not be achievable immediately. In the absence of this standard all severely injured patients should be reviewed by a consultant as soon as possible; ideally this should be within four hours of arrival at hospital, but must be within 12 hours of arrival. *(Hospital trusts)*

Airway and breathing

Key findings

One in eight patients arrived at hospital with either a partially or completely obstructed airway.

Prehospital intubation failed on 11/85 attempts (12.9%).

131 patients were intubated either on admission or within the first 30 minutes after admission to hospital.

Data on grade of medical staff performing tracheal intubation was poorly documented and not available in 223/362 cases (61.6%).

Management of the airway was considered unsatisfactory in 52/741 cases (7%).

The management of the potentially unstable spine was considered unsatisfactory in 55/660 cases (8.3%).

Recommendations

The current structure of prehospital management is insufficient to meet the needs of the severely injured patient. There is a high incidence of failed intubation and a high incidence of patients arriving at hospital with a partially or completely obstructed airway. Change is urgently required to provide a system that reliably provides a clear airway with good oxygenation and control of ventilation. This may be through the provision of personnel with the ability to provide anaesthesia and intubation in the prehospital phase or the use of alternative airway devices. *(Ambulance trusts)*

CT scanning of the cervical spine should be performed in adult patients who have any of the following features:

- GCS below 13 on initial assessment
- has been intubated
- is being scanned for multi-region trauma

(Radiology heads)

Case study 1

A young patient was admitted following a motor vehicle crash. Initial Glasgow Coma Score was 5 and the right pupil was fixed and dilated. The patient was transferred for a CT head scan which showed some cerebral contusions and swelling but no lesion requiring neurosurgical intervention. Given the mechanism of injury there was concern that the cervical spine may also have been damaged. No CT of the cervical spine was performed; instead the patient was transferred back to the emergency department to have plain x-rays of the cervical spine. Despite several attempts, plain x-rays provided inadequate views of the whole cervical spine and the patient was then transferred back to the CT scanner for CT imaging of the cervical spine.

Management of circulation

Key findings

51.3% (254/495) of the patients had a CT scan of the chest, abdomen and pelvis for assessment of blood loss.

In 55/254 (21.7%) cases there was a delay to CT scanning.

In 61/671 cases (9.1%) it was felt that the possibility of haemorrhage was not investigated satisfactorily.

110/795 patients (13.8%) underwent surgery or further procedures for the control of haemorrhage.

57/73 (78.1%) operations were performed by consultants.

In 37/110 (33.6%) poor documentation prevented the grade of the surgeon being determined.

The interventions performed were considered untimely in 27.6% (24/87) of patients.

Where operative intervention for haemorrhage was considered timely the 72 hour mortality was 23.8% (15/63) compared to 33.3% (8/24) where the intervention was considered delayed.

19/98 (19.4%) patients from whom data were available and who required surgery for management of haemorrhage had unsatisfactory overall management.

Recommendations

Rapid identification of patients who require immediate surgery for control of haemorrhage is essential. Ongoing fluid requirements and instability identify a group of patients who require immediate intervention rather than further investigation. Local protocols should clearly identify the patient population for whom it is inappropriate to delay the surgery/intervention for reasons of 'stabilisation' or further investigation. *(Hospital trusts, clinical directors and emergency physicians)*

Trauma laparotomy is potentially extremely challenging and requires consultant presence within the operating theatre. *(Clinical directors)*

CT scanning will have an increasing role in the investigation and management of trauma patients. In major centres, CT facilities should be co-located with the emergency department to provide a combined investigation/resuscitation area. *(Hospital trusts)*

If CT scanning is to be performed, all necessary images should be obtained at the same time. Routine use of 'top to toe' scanning is recommended in the adult trauma patient if no indication for immediate intervention exists. *(Royal College of Radiology and radiology department heads)*

Timely access to CT scanning is essential. CT radiographers should be available within 30 minutes of the patient arriving in hospital. In larger trauma centres, with a higher workload, CT radiographers should be immediately available at all times.

In the setting of remote radiology facilities and/or lack of timely access to CT scanning, unstable patients should not be taken to the CT scanner. These unstable patients should have immediate surgery. *(Trauma team leader)*

Case study 2

A young back seat passenger was involved in a high-speed road traffic collision. Glasgow Coma Score was 14 on admission. A CT head scan excluded significant head injury. Haemoglobin level fell from 12 to 6 over three hours. The eventual injuries identified were: pelvic fracture; splenic and renal lacerations; and mediastinal haematoma. There was only one measurement of blood pressure in the first hour of admission and no IV access. When the blood loss was recognised, the patient was over transfused with six litres of crystalloid and three units of blood.

Case study 3

An elderly patient was involved in a road traffic collision. The patient arrived at hospital speaking, pulse 120 but blood pressure was unrecordable. The patient became agitated and was intubated. A chest x-ray, pelvic x-ray and abdominal ultrasound were performed. The ultrasound of the abdomen revealed a splenic injury and free fluid in the peritoneal space. The patient was then transferred to CT for chest, abdomen, head and spine. During this time the patient was unstable and received seven litres of fluid and five units of blood. Following CT scanning, the patient was transferred to critical care to be stabilised prior to laparotomy and thoracotomy. At surgery splenic and liver injuries were packed and a diaphragmatic tear repaired. The patient returned from theatre unstable despite inotropic support and subsequently arrested and died. The casenotes did not document any consultant involvement in the management of this patient and the advisors believed that this was an avoidable death.

Head injury management

Key findings

Head trauma is very common in the severely injured patient and has a negative impact on outcome.

Secondary insults (hypoxia, hypercapnia and hypotension) are common and these are known to worsen eventual outcome (higher mortality and more severe disability).

The prehospital management of the airway and ventilation was inadequate in 14.3% and 10.6% of cases respectively.

In a small number of cases steroids are being used in the routine management of the head injured patient, despite evidence that this therapy may cause harm.

One in five patients who required a head CT scan did not have this performed in a timely fashion.

Delays in CT scanning were primarily due to organisational factors rather than patient factors.

More than half of the patients who required neurosurgical advice or input were taken to hospitals where there was no onsite neurosurgical service.

Only 6/43 (14.0%) patients who required a secondary transfer to access neurosurgical services had an operation within four hours of injury.

There were delays to neurosurgery in 13/81 (16.0%) cases. Most of these cases were evacuation of traumatic space occupying lesions.

Only 9/48 (18.8%) patients who had major neurosurgical procedures as a result of trauma were operated on by consultant surgeons.

Less than half of the severely injured patients who suffered head trauma received a standard of care that was judged to be good practice.

Recommendations

Prehospital assessment of neurological status should be performed in all cases where head injury is apparent or suspected. This should be performed using the Glasgow Coma Scale. Pupil size and reactivity should also be recorded. *(Ambulance trusts)*

A pre-alert should be made for all trauma patients with a GCS less than or equal to 8, to ensure appropriately experienced professionals are available for their treatment and to prepare for imaging. *(Ambulance trusts)*

Patients with severe head injury require early definitive airway control and rapid delivery to a centre with onsite neurosurgical service. This implies regional planning of trauma services, including prehospital physician involvement, and reconfiguration of services. *(Ambulance and hospital trusts)*

Patients with severe head injury should have a CT head scan performed as soon as possible after admission and within one hour of arrival at hospital. *(Trauma team leader and radiology heads)*

All patients with moderate or severe head injury should have case and CT findings discussed with a neurosurgical service. *(Trauma team lead)*

All patients with severe head injury should be transferred to a neurosurgical/critical care centre irrespective of the requirement for surgical intervention. *(Strategic health authorities, hospital trusts, trauma team leaders)*

Consultant presence should be increased at operations requiring major neurosurgery. *(Hospital trusts)*

Case study 4

A middle-aged patient was admitted to the emergency department at 22:15 hours following a fall onto the back of the head. Admission GCS was documented as 6. It appeared that the patient was admitted to the minor injuries section of the emergency department. Despite the low GCS and the history of head trauma there was no ambulance pre-alert and no trauma team response. The patient was placed in a cubical, commenced on neuro observations, given 15l/min oxygen and placed in the recovery position. No medical review happened until 23:40 when the patient was seen by an SHO. This medical review was prompted by the occurrence of a tonic-clonic seizure. The patient's GCS was recorded as 3 after this seizure. No investigation or intervention occurred at this time. The patient had a subsequent seizure at 00:05 and was given Lorazepam at that time. Finally at 01:00 the patient was taken for a CT scan. The GCS was still recorded as 3. The patient was not intubated and was escorted to radiology by the surgical SHO. The CT scan revealed a large intracerebral haemorrhage with significant midline shift. The patient was transferred back to the emergency department and at 01:30 the patient was referred to the anaesthetic SHO. The anaesthetic SHO contacted the SpR on call for anaesthesia and following their attendance the patient was intubated at 03:00. The patient subsequently died from severe brain injury.

Paediatric care

Key findings

68/795 (8.6%) cases were aged 16 or less.

Only 54% of cases had consultant staff involved in the immediate management.

The pattern of assessment of overall care was similar to adults with less than half the cases judged as receiving care classified as good practice.

Advanced Paediatric Life Support (APLS) trained staff were not resident or available 24 hours in 20.2% of hospitals.

Only 22 out of 146 hospitals had Registered Sick Children's Nurse cover 24 hours a day, 7 days a week.

Recommendations

All recommendations in this report apply equally to severely injured children.

All sites accepting children for definitive trauma management should have protocols for their management in place. These protocols should be regularly reviewed and updated. *(Hospital trusts)*

All hospitals should have up to date guidelines on the management and referral of suspected non-accidental injury in children. *(Hospital trusts)*

Hospitals should use standard, universal definitions for neonates, infants and children. *(Royal College of Paediatrics and Child Health)*

Each receiving unit should have up to date guidelines for children which recognise the paediatric skills available on site and their limitations and include agreed guidelines for communication and transfer with specialised paediatric services within the local clinical network. *(Strategic health authorities and hospital trusts)*

An Advanced Paediatric Life Support (APLS) (or equivalent) trained consultant and a Registered Sick Children's Nurse (RSCN) or an APLS trained nurse should be involved in the immediate management of all severely injured children. *(Hospital trusts)*

If a hospital does not admit children for definitive care then a bypass protocol should be in place. *(Hospital and ambulance trusts)*

Transfers

Key findings

There was a lack of adherence to the numerous recommendations and guidelines that exist regarding the transfer of critically ill and severely injured patients.

The arrangements for the secondary transfer of severely injured patients were haphazard.

One in four severely injured patients required a secondary transfer to receive definitive care.

The use of a helicopter system reduced the need for secondary transfers compared to a road ambulance system.

The documentation of transfers was almost uniformly poor.

Despite the limited information available from the poor documentation, there was an apparent lack of consultant input into the arrangement and conduct of secondary transfers.

This study of a three month period suggests that there are approximately 800 transfers annually for severe trauma and that the situation of 'many critically ill patients are transferred between hospitals in an ad hoc manner by inexperienced trainees with little formal supervision and potentially serious complications can occur' is correct. There does not appear to have been any significant change in the last five years.

Recommendations

A clear record of the grade and specialty of all accompanying staff involved in the transfer or retrieval of severely injured patients should be made and this documentation should accompany the patient on transfer. *(Trauma team leader)*

There should be standardised transfer documentation of the patients' details, injuries, results of investigations and management with records kept at the dispatching and receiving hospitals. *(Trauma team leader, Department of Health)*

Published guidelines must be adhered to and audits performed of the transfers and protocols. *(Hospital trusts)*

Local networks should develop protocols for the transfer of severely injured patients suitable for regional requirements. *(Hospital trusts)*

The number of transfers may be decreased if appropriate arrangements are made for cross cover in specialties, e.g. interventional radiology, between trusts. *(Hospital trusts)*

Case study 6

A young patient had a severe brain injury following a fall. The patient had a GCS of 3 at presentation with unresponsive pupils and a compound skull fracture with brain matter exuding from the ear. The patient was transferred to a neurosurgical unit but certified brain dead shortly after arrival.

Case study 7

An elderly patient tripped while intoxicated. A Glasgow Coma Score of 3 was recorded in the ambulance. At the receiving hospital it was recoded as 8. The hospital was unable to perform a CT head scan therefore the patient was transferred to the local neurosurgical hospital. The transfer was performed without securing the airway. At the neurosurgical hospital the patient was transferred to CT still with an unprotected airway. Intubation was subsequently performed after CT scanning.

Incidence of trauma and organisation of trauma services

Key findings

129/141 (91.5%) hospitals in this study dealt with a severely injured patient less often than once per week.

High volume hospitals (>20 severely injured patients in this study) deliver a higher percentage of care assessed as good practice.

Only 77/183 (42.1%) hospitals participate in TARN.

Recommendations

A system should be initiated for identifying these patients so that the demand on the health service can be properly quantified and resources appropriate to that demand be made available. *(Department of Health)*

Given the relatively low incidence of severe trauma in the UK, it is unlikely that each individual hospital can deliver optimum care to this challenging group of patients. Regional planning for the effective delivery of trauma services is therefore essential. *(Strategic health authorities, hospital trusts)*

Given the importance of evaluation of processes and outcomes in the trauma patient, all units providing treatment for severely injured patients should contribute to the Trauma Audit Research Network. *(Hospital trusts)*

There should be a system of designation and verification of each hospital with regards to their function as a trauma centre, in a similar fashion to the system instituted by the American College of Surgeons. *(Strategic health authorities, Royal College of Surgeons)*

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