Trauma systems and emergency medicine

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Abstract

The impact of trauma is a major public health challenge which is likely to escalate in the early 21st century. A systematic approach to this problem is required. This review explains the conceptual framework that defines a trauma system, gives a brief historical perspective and describes some of the essential elements of the system which should make a difference to patient outcome. Emergency physicians are well placed to play a leading role in the development and implementation of trauma systems.

Key words: emergency medicine, trauma systems.

Introduction

Trauma presents a huge, multifaceted, global, socio-economic and organizational challenge which acutely affects emergency physicians. In 1990, trauma accounted for 5.1 million deaths, or 10% of global mortality.1 According to the Global Burden of Disease Study, projected health trends predict that by 2020 injuries from road traffic crashes alone will be the sixth leading cause of death, and that self-inflicted injuries, violence and war will occupy 10th, 14th and 15th place.2 Injury has been estimated to account for an annual loss of 500 years of productivity per 100 000 in the USA3 and by 2020 will be the single leading cause of global morbidity accounting for 20.1 million disability-adjusted life years.2 Injury is also the leading cause of hospital bed day usage and of years of life lost, yet in one of the most developed countries of the world (USA) no more than 4% of National Institute of Health research funds is channelled into trauma research.4

Such statistics present a formidable challenge to health care providers in terms of health service research and development, political importance, capital investment and cost-effectiveness, training and evaluation. Regional trauma centres and systems have been proposed as one way forward in the USA,5 the UK,6,7 other European countries8,9 and Australia10 but such systems have not been universally implemented because of questions of need, efficacy, cost and possibly political enthusiasm. Emergency physicians with their systems-based approach to assessing and managing complex, acute, clinical problems may be in a position to drive trauma care forward especially in areas where the quantity and quality of trauma may not justify the development of highly specialized trauma services.

This review highlights some general principles in the development of trauma systems and important elements of these systems, and serves as a starting point for further discussion.
The perfect system

The perfect trauma system does not exist. In most cases any system is likely to be better than no system. Some systems are likely to be better than others. The question is not so much whether a system is needed but which one is best for individual circumstances. Unfortunately, the evidence is extremely difficult to collect, let alone implement. Therefore many systems have developed on an ad hoc basis, largely as a result of subjective personal experience and political will and influence rather than objective evidence that is built on trauma epidemiology, evidence-based clinical studies, cost-effectiveness analyses and available resources.

Definition

The concept of an inclusive trauma system has been difficult to define. Recently, the Australian state of Victoria has begun to develop a state trauma system. The background paper described a trauma system as ‘being able to provide a coordinated and systematic means of delivering trauma patients rapidly to definitive care’. Some of the key principles that were highlighted were coordination, systematic processes and clear end points (definitive care). The American College of Emergency Physicians similarly states that a trauma care system represents a continuum of integrated care that is a coordinated effort between out-of-hospital and hospital providers with close cooperation of medical specialists in each phase of care. An example of the various components of a system of trauma care can be seen in Figure 1.

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Historical perspective

In 1922 the American College of Surgeons took a leading role in developing the medical response to trauma. The first steps in the modern age began with military rather than civilian experience. One of the early drives towards a systematic approach to trauma care was based on preventable deaths studies and the belief that many preventable trauma deaths fell into distinct prioritized categories. Patients were more likely initially to die of airway (A) problems, a little later because of respiratory (B) problems, and later still as a result of circulatory (C) and neurological (D) problems. It was believed that some of these deaths could have been avoided if a (better) system for assessment and management had been in place.

Much of the early ‘evidence’ for these conclusions emerged in the 1960s to 1980s, and was subjective and descriptive. Some based their conclusions on retrospective assessment of quality of care. Others noted that in many cases the time from injury to death exceeded 1 h and that any surgical intervention was either absent or considerably and unnecessarily delayed. Decisions needed to be made and people were not making them. These preventable deaths studies have been recently criticized and more rigorous evaluation and research is beginning to emerge for developing trauma care.

Early reports therefore focused extensively on mortality data collection but a more rigorous, objective, systematic assessment of care was lacking. Factors such as morbidity, process of care, time in hospital and intensive care stay and relative cost were not considered. Since then, however, there have been substantial developments of systematic, regionalized trauma care in the USA and other countries including the UK, Germany and Australia have since begun to address the issue.

Figure 1. Basic structure of a trauma system.
Elements that make a difference

A target population

Many countries have now developed a national registry which defines and clarifies the scale of the problem and provides baseline data against which future changes can be assessed. Increases in resources towards trauma care should not be undertaken until good quality data are provided that show that such an allocation is justified. However, this is not to say that no system should be constructed using existing resources. Often a reorganization of what is already available is sufficient to make a considerable difference. So a geographical community (region, city, town) needs to be identified and data collected on a well-defined major trauma group.

Uniformity in definition, data collection and comparison

As major trauma may implicate a variety of different organ systems, affected with varying degrees of severity and with varying probabilities of complications and death, it is important to standardize terms and methods for uniform reporting, analysis and for fair and meaningful comparison. Adjustments need to be made for many factors including mechanisms of injury, age and anatomical and physiological derangement. A number of tools have been developed including methods for scoring injuries and assessing physiological derangement, analysing individual and population injuries and uniform reporting.

Prevention is better than cure

In general, prevention is better than cure, and also nearly always cheaper.

If an accident or event never occurs, the vast resources that may be required to treat injuries and their complications are completely averted. The emergency department (ED) has a large catchment population of ill and injured patients and their relatives who may spend time waiting for medical attention and for discharge or admission. The ED is therefore a prime site for education of patients on the risk of injury and of effective preventive strategies.

Organizations with political influence

Major structural and systematic changes depend upon lobbying politicians and raising public awareness of the problem of and solutions for managing trauma. In order to do this effectively a credible body needs to be created which may wield some political power. A number of surgical bodies have taken up this role (for example, the American College of Surgeons and The Royal College of Surgeons of England), whilst others have arisen with the specific purpose of addressing issues of trauma (for example, the Trauma Association of Canada, the Australian Trauma Society and the Ministerial Taskforce on Trauma and Emergency Services of Victoria, Australia). Well-presented, highly focused data are usually the stimulus for political will.

Trauma teams and senior team leadership

Apart from preventable death studies, there have been many other published reports of deficiencies in the management of trauma. The Royal College of Surgeons of England concluded that some trauma deaths were associated with the delivery of emergency care by inexperienced doctors, and others have shown that survival after major injury is positively related to increased experience and greatest when consultants are present early in the resuscitation.

Therefore, it is essential in the development of any trauma system that a single individual is identified who leads each resuscitation and that this individual is of the highest possible level of seniority.

Trauma resuscitation is multidisciplinary and it is essential that the leader has seniority over other members in the team in order to command the authority and respect required for clear decision making. Leadership falls down when systems are reluctant to identify a single individual but want every discipline to contribute to leadership. Trainees need clinical mentors rather than administrators who dictate from a distance. This principle not only applies in the ED but also in the prehospital and in-hospital arenas. Whilst consultant medical staff cannot staff every ambulance responding to trauma, the presence of senior medical staff at least for some of the time is likely to enhance the quality of prehospital care in general and trauma in particular.

Consultants may be reluctant to take on these responsibilities for a number of reasons. First, they often have large administrative, clinical, research, political and educational burdens. Second, a significant proportion of trauma is out of hours and breaking normal sleep patterns may adversely affect judgement and other duties. Third, health authorities may be unwilling to adequately fund such initiatives.
Nevertheless, senior input is essential if a system is to be effective.

**Prioritization and decision making**

Some means of categorization and system activation (such as trauma team call) is necessary in order not to waste doctors’ time on the one hand and not to disadvantage seriously injured patients on the other. Guidelines need to be determined on the basis of local expertise and available resources. In some areas senior staff may prefer to train staff to use their judgement in determining when to call the team. However, more commonly, trauma systems are turning to a protocol-based approach. One example is the modified CRAM scale, a 10-point scoring system initially used in the field but more recently applied for triage within trauma centres. It uses an assessment of the circulation, respiration, abdomen (and chest), motor and speech components to guide team activation.

**Prehospital emergency medical systems**

Prehospital care is a hostile area for staff whose training and experience is solely within the hospital. Managing patients in this field is often left to ambulance personnel — paramedics and non-paramedics — who have limited training and supervision compared with physicians. However, optimal knowledge and skills are likely to be achieved when well-trained individuals venture into this area and supervise, model and impart knowledge, skills and attitudes to paramedical prehospital staff. It is essential that hospital personnel gain experience in prehospital care and serve in this area. Of all hospital staff, emergency physicians are best trained and able to cross this frontier.

**Training**

The introduction of Advanced Trauma Life Support (ATLS) courses has coincided with the development of trauma systems in many areas and is likely to be an essential component for success. Although ATLS is a dogmatic program with a limited evidence base, it provides a sensible and logical process for assessing and managing patients which all trauma health personnel can use as a guideline. All modern emergency physicians who are involved in trauma leadership should have some experience with ATLS. This program should not be seen as an end point but rather the beginning of trauma resuscitation training.

**Prioritization and decision making**

Major trauma involves multiple system derangements and therefore requires prioritization and rapid, accurate decision making. Emergency physicians are ideally placed to take on this role as they have to process multiple patients, identify and exclude major illness and injury, and make appropriate decisions regarding initial management and disposal on a daily basis. Indecision is the bane of trauma but the specialty of emergency medicine attracts and trains decision makers.

**Interest and motivation**

Major trauma provides a highly stressful environment and multiple competing interests often at unsocial hours. Without recruiting staff and leaders with a genuine interest in trauma it is unlikely that any trauma system will have much success. It is essential that individuals have a genuine interest in and commitment to the service.

**Trauma audit**

Audit may take place at a national, regional or local level. Regular audit and evaluation serves to highlight strengths and weaknesses in the system, and provided it is conducted with a spirit of mutual trust and respect, guides surgeons, intensivists and emergency physicians who strive for excellence in service. However, where political agendas take over it may become destructive.

**Accreditation and verification**

The introduction of hospital trauma system evaluation and verification has recently been assessed in the USA and in Canada and there is some evidence that such methods of accreditation may improve hospital performance and patient outcome. Verification confirms the value of some centres in excellence of trauma care and affirms the worth of investing health care funds in specific hospitals. Such accreditation implies that the resources, caseload, training and morbidity and mortality outcomes of a given institution reach certain high standards and set apart such a centre for recognition.
It is not clear whether this accreditation process should be incorporated into the normal accreditation of a hospital or whether it should involve the expense of a separate trauma verification process as advocated in the USA.

**Models**

**The American model**

Many studies of the American model of regional trauma centres have reported that such centres reduce mortality after trauma especially in those with multiple injuries.\(^5,36,52\) These early studies either were uncontrolled or used historical controls. Recently more rigorous studies have shown less impressive benefits of the American model of a trauma centre compared with areas without a trauma centre.\(^29,30\) Nevertheless, the key elements in the model are 24 h reception in the ED by senior staff, all key specialties necessary for treating trauma on the same site, a high volume of seriously injured patients (about 10–20 per week), and a system to ensure that seriously injured patients are delivered to and treated in a trauma centre.

The interaction between emergency physicians and trauma surgeons varies vastly between different centres. Some surgeons no doubt still believe that emergency physicians have no role in the management of trauma and some emergency physicians believe that surgeons have no role outside of the operating theatre. Such views are not universal and some level one trauma centres in the USA have developed systems with mutual respect between emergency physicians and trauma surgeons.

**One size will not fit all**

The vast qualitative and quantitative differences in the nature of trauma, its relative importance to other disease groups, and the resources available between different countries in the developed world, let alone developing regions to meet these demands suggest that modifications are necessary in local regions. It is now well recognized that considerable differences exist between military and civilian trauma (age, fitness, preinjury illness, nature of insult), between rural and urban communities,\(^22\) between children and adults,\(^23,24\) and between prehospital and hospital perspectives,\(^25\) such that extrapolating findings from one area is not appropriate for others.

**A British comparison**

A recent before and after study on mortality in the North-west Midlands of England showed little improvement on mortality between one hospital developed and resourced as a trauma centre and two other hospitals with competent and reasonably well-resourced ED and hospital specialties.\(^6\) Failure to show an impressive reduction in mortality in the trauma centre was put down to several factors. First, application of the American model was not rigorous. Second, many patients who should have been referred to the trauma centre were routed elsewhere so the performance of the system may have been suboptimal. Third, the epidemiology of trauma differs greatly between the UK and the USA.

It is important to note that in this comparison, emergency physicians took their share of leadership responsibility in both the trauma centre and control centres.

**Designated trauma centres**

It seems sensible in principle to develop ‘centres of excellence’ to which patients may be delivered and where resources and experienced staff are concentrated. However, it is less easy to define what factors genuinely make a difference. Level one trauma centres are supposed to have better resources, a greater concentration of major trauma and more experienced, highly trained staff. Apart from the British experience, some USA data have also shown that patients with major injuries may be as well cared for in a level two centre as in a level one centre.\(^28\) Therefore whether the cost of developing a level one centre over a level two centre is justified remains debatable.

**Trauma is not exclusively a surgical disease**

The American College of Surgeons unequivocally states that ‘trauma is a surgical disease’ and has led the way in improvement in trauma care both in the USA and the world by defining the problem epidemiologically, societally and financially and by lobbying governments for support.\(^17\) It has led the development of graded regional trauma centres and the Advanced Trauma Life Support Course for Physicians. But is trauma exclusively a surgical disease requiring general surgical leadership alone.
to the exclusion of other specialties? No doubt many patients require surgical assessment, admission and operative management, but many do not, perhaps the majority, and leadership by other specialties at various steps may be appropriate. Many argue that continuity in care is important and as these patients require surgery for definitive care then a surgeon should take charge at the earliest opportunity.

A number of issues require clarification. First, in the prehospital arena trauma is managed by either physician or non-physician ambulance personnel. A surgeon-led prehospital team is almost unheard of. Second, on arrival at many ED, surgeons are not available to receive the patient at the door. Third, most trauma surgeons have training that is limited to certain bodily regions (for example, abdomen and chest) and patients with other injuries are referred to other surgeons who do not play a part in the trauma team, like neurosurgeons, orthopaedic surgeons and cardiac surgeons. Fourth, surgeons’ primary interest is in operating so when patients do not have a surgical problem in their area of expertise, the surgeon may lose interest.

Most trauma patients do not require immediate surgery and emergency laparotomy is much less common than craniotomy and orthopaedic procedures. However, the well-trained emergency physician is well placed to look after the whole patient both in the prehospital, emergency and investigative phase prior to admission to theatre. He or she is trained in priority-based, systems assessment and management and is used to having a broad view of the whole patient.

Gaps in our knowledge

Large gaps remain in our knowledge of optimizing trauma systems. We have little data on the economic value of trauma systems or on which elements provide cost-effective differences to patient morbidity, hospital ward and ICU stay. Little data exist to show that well-trained ambulance personnel provide a cost-effective alternative to paramedics or physician-led prehospital responses. How much regular exposure to and training in trauma do physicians need in order to optimize their decision making and practical skills?

Conclusions

Trauma systems require a coordinated, integrated, multispecialty team approach. Emergency physicians with their broad, multisystem, priority-based training and rapid decision making are well placed to take a leading role both at a political level and in the early management of trauma patients before they require definitive surgical care.

References


