

Jason Smith

9.1 Introduction

The Emergency Department management of patients with ballistic trauma should include rapid assessment and life-saving intervention, followed by appropriate investigation and referral for definitive management depending on the haemodynamic status of the patient.

9.2 Preparation

Prior notification of the imminent arrival of a trauma patient is vital if an adequate and prepared response is to be initiated. Equipment should be prepared, personnel amassed and briefed, and theater and blood bank notified of the imminent arrival of the patient. Ballistic trauma should prompt the activation of a multi-disciplinary trauma team, the typical composition of which is described in Fig. 9.1. If the pre-hospital notification suggests a patient with life-threatening haemorrhage, additional personnel specifically tasked with the delivery of massive transfusion of blood and blood products through a rapid infusion device should be assembled. The team in attendance should be dressed in the appropriate protective equipment (including lead aprons). Equipment preparation should include the means to perform rapid sequence induction of anesthesia and intubation, chest decompression, and vascular access. Radiography should be present and prepared to perform a chest X-ray during the first few minutes of assessment (pre-loading X-ray plates if necessary).

J. Smith

Academic Department of Military Emergency Medicine, Royal Centre for Defence Medicine, Birmingham Research Park, Vincent Drive, Birmingham B15 2SQ, UK
e-mail: jasonsmith@nhs.net



Fig. 9.1 A trauma team—layout of seven personnel around a resus bay (team leader, airway plus one, procedures plus one, survey, scribe) (Reprinted with permission from Hodgetts and Mahoney 2008)

9.3 Arrival

As the patient arrives in the resuscitation room, the trauma team leader should be easily identifiable. The whole trauma team needs to listen in to a brief handover from the pre-hospital team, prior to transfer from the ambulance stretcher to the resuscitation trolley. This occurs most easily if there is silence other than the person giving the handover. The handover should give a brief summary of events in an easily digestible format, such as the ATMIST handover (Table 9.1).

The only exception to this is if there is immediate life threatening instability such as ongoing cardio-pulmonary resuscitation or the requirement for definitive airway management. In this instance the patient is immediately transferred, the handover is then given whilst clinical treatment to address the immediate problems is commenced.

The patient then needs to be transferred from stretcher to trolley. This is followed by a primary survey including assessment and treatment of catastrophic hemorrhage, airway, breathing, circulation, and disability (Table 9.2).

In ballistic trauma the back of the patient must be examined early as part of the primary survey. It may be appropriate to examine the patients back during initial transfer to the ED trolley if a roll is performed as part of the transfer. If the patient is already on a scoop or vacuum mattress as part of their pre-hospital management examination of the back must not be forgotten.

Table 9.1 ATMIST handover

A	Age
T	Time of injury
M	Mechanism of injury
I	Injuries sustained
S	Signs—vital signs including pulse, respiratory rate, blood pressure and Glasgow coma score
T	Treatment—pre-hospital treatment administered

Table 9.2 Primary survey

<C>	Catastrophic hemorrhage (control of exsanguinating hemorrhage)
A	Airway (low probability of cervical spine injury with GSW)
B	Breathing (give high flow oxygen)
C	Circulation (with control of hemorrhage and circulatory access)
D	Disability
E	Exposure and control of environment

9.4 The Primary Survey: <C> ABCDE

Traditional trauma courses teach a vertical and sequential approach to assessing the trauma patient, starting with catastrophic haemorrhage, moving on to airway, breathing and then circulation. In reality, in the presence of a trauma team, this primary survey should happen horizontally or simultaneously, with the airway clinician at the head end assessing and managing the airway and administering oxygen, while the primary survey clinician assesses breathing, an assistant attaches monitoring, and intravenous access is gained by the individual nominated to undertake procedures. The radiographer should be moving in to perform a chest X-ray, and the team leader and surgeon making an initial assessment of whether or not immediate surgery is indicated. The operating theater staff need an update at this stage as to whether they need to prepare for the imminent arrival of a trauma patient.

Key questions during the primary survey are:

- Is there uncontrolled external hemorrhage?
- Does the patient require a definitive airway?
- Does the chest need to be decompressed?
- Does the patient have cardiovascular instability?

9.4.1 Is There Uncontrolled External Hemorrhage?

In the presence of continuing external haemorrhage, attention needs to be directed at controlling this by pressure and elevation, use of a tourniquet, sutures, or novel haemostatic agents. If control is not possible early surgical intervention is likely to be required the speed of which will be dictated by the patients physiological stability.

9.4.2 Does the Patient Require a Definitive Airway?

In the presence of airway obstruction, it may be necessary to secure a definitive airway. Indications for this are listed in Table 9.3. This is usually performed by rapid sequence induction (RSI) of anesthesia and intubation. In the presence of complicating factors such as an airway burn, or expanding neck haematoma, the use

Table 9.3 Common indications for tracheal intubation in ballistic trauma

Airway obstruction (absolute or impending)
Facial trauma
Expanding neck haematoma
Airway burn injury
Reduced conscious level including agitation
Requirement for anesthesia
Requirement for ventilation

of fiberoptic instruments, videolaryngoscopy or a surgical airway may be necessary. In the case of ballistic neck injury with bleeding into the oropharynx the use of videolaryngoscopy or fiberoptic scopes cannot be relied upon as the view may be obscured by blood.

Significant care needs to be taken when anaesthetising cardiovascularly unstable patients. The delivery of anaesthetic drugs combined with the increase in thoracic pressure from positive pressure ventilation can result in precipitous falls in blood pressure and cardiac arrest in hypovolemic patients. Fluid resuscitation should be commenced prior to RSI unless the airway is threatened by direct neck injury or airway obstruction. In this instance fluid resuscitation should occur simultaneously.

9.4.3 Does the Chest Need to Be Decompressed?

When assessing breathing, attention should be paid to symmetry, expansion, air entry, and external evidence of injury. Half of the chest is obscured in the supine trauma patient, as described earlier a log roll is essential to detect injury on the back in penetrating trauma. Physiological parameters including respiratory rate, pulse, blood pressure and oxygen saturation should be measured. In the presence of asymmetrical chest movement, reduced air entry and abnormal physiology, the patient may require urgent chest decompression for treatment of a tension pneumothorax. The classical signs of a tension pneumothorax (deviation of the trachea, engorged neck veins, hyper-resonance) are often not present in the spontaneously ventilating patient.

Decompression can be performed with a needle or cannula, placed into the second intercostal space in the mid-clavicular line, although this method is unreliable and often fails to resolve the problem. Definitive chest decompression by thoracostomy (making the hole through which an intercostal drain is inserted) is often necessary to relieve pressure. In a ventilated patient open thoracostomies can rapidly be performed if chest drains are not immediately available. This allows rapid reduction of the intrathoracic pressure particularly if the patient is haemodynamically compromised. Both are safe procedures if performed in the fourth or fifth intercostal space, just anterior to the mid-axillary line.

9.4.4 Is the Patient Shocked?

The next question is whether the patient is displaying signs of hemorrhagic shock. In the presence of shock from ballistic injury, the cause is almost always hemorrhage, and control of hemorrhage is therefore the immediate priority. In the meantime, vital organ perfusion should be maintained, although the absolute level of blood pressure (or other physiological target) that should be maintained is still the matter of some debate. A practical solution is to maintain consciousness, although some would advocate titrating intravenous fluid to the presence of a radial pulse or a systolic blood pressure of 80 mm Hg.

With regard to which fluid to use, there has been a move to the early use of blood and blood products in severely injured ballistic casualties. This should be given initially in a ratio of 1:1:1 (plasma, platelets and packed red blood cells) but can be tailored to individual requirements if near patient coagulopathy testing such as rotational thromboelastometry is available and bleeding is controlled, However, hemorrhage control must be the absolute priority.

9.5 Initial Investigations

In time-critical patients, only those investigations that will immediately alter management should be performed. Typically, for penetrating torso trauma, this will include a chest X-ray, collection of blood for cross-matching, and little else.

At the same time as blood is drawn, however, an initial venous blood gas will give useful information regarding blood pH, serum lactate, and base deficit, and blood should also be sent for a baseline full blood count, clotting profile, and electrolyte screen.

The role of focused assessment with sonography for trauma (FAST) in penetrating torso trauma is less convincing than in blunt trauma. The same principles apply, in that if there is free intra-peritoneal blood, and the patient is shocked, they will require surgery. FAST can be used to triage the body cavities for surgery.

9.6 Secondary Survey

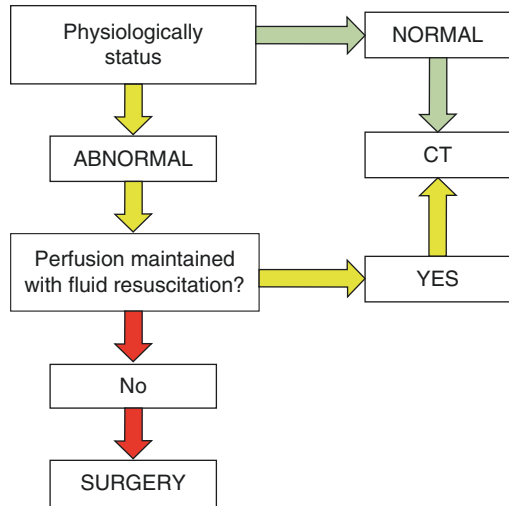
It is particularly important in penetrating trauma that a full and thorough secondary survey is performed to identify wounds that may be entry or exit wounds. This includes a log roll to examine the back, and careful examination of the scalp, axillae, and perineum. Small wounds may be hidden among hair so dried blood needs to be cleaned off and the underlying structures examined.

9.7 Decision Making

Patients with ballistic trauma fall into two groups. They are either physiologically normal or abnormal. The abnormal group can be further subdivided into those in whom critical organ perfusion can be maintained, and those in whom it cannot. This final group need urgent surgery to control hemorrhage or they will die. This should not be delayed further and such patients should be transferred to the operating theater within a few minutes of arrival in hospital (Fig. 9.2).

At the other end of the spectrum is the patient with anatomical evidence of injury but no physiological disturbance. This patient can undergo further investigation in the form of X-rays, contrast-enhanced computed tomography (CT), or angiography as necessary. Somewhere between these lies the group of patients who respond to initial resuscitation, but have had at some time evidence of physiological disturbance.

Fig. 9.2 Destination decision making in ballistic trauma



These patients will often require surgery, but there may be time to perform limited investigations such as CT or angiography to better inform the surgeon.

The decision as to the disposal of the patient and the time-critical nature of their condition needs to be made at a senior level, with appropriate senior surgical expertise to support it.

9.8 Handover

Adequate verbal and written handover of the key points are vital for seamless care of the trauma patient. In UK hospitals, the team leader in the resuscitation room will normally be an emergency physician, who will hand over responsibility to in-hospital clinicians as the patient leaves the emergency department. A clear delineation of responsibilities should be in place so there is no confusion. In an ideal world, trauma patients would be admitted under a named trauma surgeon who will oversee care and recruit the expertise of other specialties as necessary. Documentation should be clear and standardized to minimize confusion.

9.9 Considerations with Multiple Patients

As with a single patient preparation is the first key step. It is vital that every trauma hospital has a major incident plan that can be enacted in the event of a major incident (MI). The important factors that need to be addressed early are those of staff and resource availability. The main differences of a ballistic over other MIs will be the higher number of high priority casualties requiring volume resuscitation and early surgery. Access to both are likely to be limited especially in the early phases of an incident.

To overcome this triage of casualties entering the ED and early identification of those requiring urgent surgery is essential. It is unlikely that capacity will exist to take all those requiring surgery to theatre immediately. Prioritization by senior clinicians is essential.

O negative blood stocks are limited, the early use of O positive blood will be necessary in suitable recipients and an early switch to type specific blood. Both will help to minimize depletion of O negative stock. Early group and saves should ideally be one for all patients. Without a robust planned approach to patient labeling there will be an increased risk of ABO incompatibility reaction due to administrative error.

9.10 Summary

The management of the ballistic trauma patient requires a systematic approach to patient treatment and assessment. Pre-established systems need to be in place to allow urgent access to resuscitation and surgery to improve outcome in this severely injured group.

Further Reading

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