# 27 Early assessment and management of severe trauma

# A Airway with cervical spine control

A: Airway with cervical spine control

All trauma patients should have their cervical spine immobil ised and protected throughout. An immediate assessment of the patient’s airway is made. A compromised airway requires a stepwise progression, first clearing the airway by suctioning secretions or b lood, followed by simple airway manoeuvres such as a jaw thrust, chin lift and insertion of an oropharyn geal or nasopharyngeal airway . Advanced airway manoeuvres necessitate the insertion of a cu ff ed endotracheal tube. This may require an anaesthetic with rapid sequence induction or a surgical airway . Emergency intubation of the severely injur trauma patient is a di ffi cult and demanding skill – standardised and rehearsed procedures should be in place for failure to intubate ( Figure 27.1 ). Equipment and expertise for achieving a surgical airway must be readily available.

# B Breathing and ventilation

B: Breathing and ventilation

All patients should receive high-flow oxygen. Life-threatening chest pathology such as tension pneumothorax, massive haemothorax and flail segment should be diagnosed and managed immediately . Equipment and expertise for rapid insertion of intercostal chest drains should be available.

# C Circulation and haemorrhage control

C: Circulation and haemorrhage control

All patients require adequate intravenous (IV) access with at least two large-bore IV cannulae. Equipment and expertise for insertion of central or intraosseous venous access should be - - - available where peripheral access is not easily obtainable. Blood should be taken for cross-match and laboratory assessment, - including haemoglobin and venous lactate. An assessment of the haemodynamic status should be made to identify shocked patients: the skin may be cool and sweaty , the pulse rate raised to over 100 per minute and the blood pressure low . A pelvic ed binder should be applied to all haemodynamically unstable patients following blunt trauma and not removed until after a pelvic fracture has been excluded. Hypotensive trauma patients are treated as hypovolaemic until proven otherwise. The priority is simultaneous fluid resuscitation and identifica - tion of the source of the haemorrhage. Permissive hypotension, massive transfusion protocols and tranexamic acid The initial aim of resuscitation is to maintain the blood supply to the vital organs: the brain, heart and kidneys. For a short time, this can be achieved with a target systolic blood pressure of 70–90 /uni00A0 mmHg, although a higher pressure of >90 /uni00A0 mmHg should be the target if a head injury is suspected. Small boluses of IV fluids (e.g. 250 /uni00A0 mL of O negative blood, or normal saline if blood is not immediately available) should be administered to achieve this target, which should result in a palpable radial pulse. Excessive IV crystalloid or colloid solutions should be

# Figure 27.1 Unrestrained driver with severe craniofacial injury (cour

tesy of Johannesburg Hospital Trauma Unit).

pathy and increase the risk of adult respiratory distress syndrome. However, the key to this approach of permissive hypotension is that it is time limited. The primary sour haemorrhage must be identified and controlled as soon as possible. Severely injured hypovolaemic patients should be resusci tated with blood and blood products, not crystalloid/colloid fluids. These must be warmed. All hospitals managing severe trauma should have a massive transfusion protocol that aims to provide blood and blood products in a ratio of 1 packed red cells /uni00A0 : /uni00A0 1 fresh-frozen plasma /uni00A0 : /uni00A0 1 platelets. Tranexamic acid Tranexamic acid is an antifibrinolytic drug that reduces the risk of mortality from bleeding in both blunt and penetrating trauma. One gram is given intravenously over 10 minutes, followed by a further 1-g dose over 8 hours. Tranexamic acid should be given to all trauma patients suspected to have significant haemorrhage, including those with a systolic blood pressure of <110 /uni00A0 mmHg or a pulse of over 110 per minute. It needs to be administered as early as possible and ideally within the first hour from injury; the first dose should not be administered more than 3 hours from injury . In the UK it is normally given by paramedics in the prehospital environment. Summary box 27.2 Severe hypovolaemia /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF Identification and management of haemorrhage The sites of major haemorrhage in trauma patients are the chest, abdomen, pelvis and long bones, and external haem orrhage ( Figure 27.2 ). Blunt trauma patients frequently have multiple sources of haemorrhage. Clinical examination and investigations should aim to rapidly confirm or exclude signifi cant bleeding from eac h of these sites. Computed tomography (CT) from the head to pelvis with IV contrast, the so-called 'whole-body CT' (WBCT), is the gold standard investigation in patients with signs or symptoms of multiple injury or deranged physiology , but note that WBCT should not be perf ormed on the basis of the mechanism of injury alone (see Further reading ). There is no role for scanning selective body systems in the severely injured trauma patient. Wherever possible, WBCT should be performed as soon as possible during the patient's resuscitation. A provisional 'hot report' can be issued to the trauma team. A more detailed definitive report should be available within 30–60 minutes. Traditionally , chest and pelvis radiographs have been ce of obtained early in the assessment of patients with polytrauma but these investigations are increasing ly omitted in favour of obtaining a rapid CT scan, as described above. Most trauma - centres now have rapid access to CT scanners located within, or immediately adjacent to, the resuscitation area. This has allowed haemodynamically unstable patients to have a WBCT with resuscitation by the trauma team continuing simultane - ously during CT . Identifying which patients are too haemo - dynamically unstable to scan safely is a di ffi cult decision for the trauma team leader and will be influenced by local factors and facilities. Some patients will be so haemodynamically unstable on arrival that they need immediate surgical control of their haemorrhage before a CT scan. T he most likely sources are abdominal or pelvic bleeding . An immediate chest radio - graph will exclude catastrophic intrathoracic haemorrhage. An immediate pelvic radiograph is essential but should not delay transfer to the operating theatre. A focused abdominal sonography for trauma (FAST) scan (if immediately available) may also be useful in this scenario to locate the major source of haemorrhage. All patients undergoing immediate laparotomy in the operating theatre should have a pelvic binder applied and not removed. A correctly positioned pelvic binder at the level of the greater trochanters does not obstruct trauma lap - arotomy . These patients will invariably require a WBCT scan after surgical control of haemorrhage has been achieved. Summary box 27.3 Whole-body CT (WBCT) /uni25CF /uni25CF /uni25CF /uni25CF - -

Tranexamic acid reduces mortality after trauma All traumatised patients suspected of bleeding should receive tranexamic acid as soon as possible after injury All trauma centres should have an established massive transfusion protocol Severely hypovolaemic trauma patients should be resuscitated using blood and blood products The only role for crystalloids in the initial management of severely hypovolaemic patients is for the administration of small quantities to maintain blood pressure while waiting for blood products to become available WBCT from the head to pelvis with

IV contrast is the gold standard investigation of the severely injured adult blunt trauma patient There is no role for selective scanning of body systems in these patients WBCT scan is a time-critical investigation and should be obtained as early as possible in resuscitation of the severely injured patient Any patient undergoing immediate trauma laparotomy after blunt trauma without a WBCT scan should have a pelvic binder applied and not removed until a pelvic fracture is excluded. Such patients should have an immediate pelvic radiograph either in the emergency department or as they arrive in the operating theatre

# D Disability and E Exposure

D: Disability and E: Exposure

On admission, the GCS score should be calculated ( Table 27.1 ), the pupils assessed for size and reaction to light and the patient observed to determine whether they are moving all four limbs. The core temperature must be recorded. Patients are managed with cervical spine protection (cervical collar and blocks) and protection of the thoracolumbar spine using standard log roll techniques until a spinal injury has been excluded. Early WBCT scan will rapidly identify the majority of intracranial and spinal pathology . The patient must be adequately exposed to allow a thor ough and systematic clinical examination during the second ary survey but they must be kept warm. Trauma patients are frequently hypothermic and this will further increase coagulo pathy . Every e ff ort should be made to maintain normal tem perature by minimising unnecessary exposure of the patient and by using warmed blankets and trolleys and warmed fluids during resuscitation. Log-rolling patients with severe pelvic fractures may harm the patient b y disturbing established blood clots. Log-rolling should not occur until a pelvic fracture has been - radiographically excluded. If patients need to be moved - during their primary survey , such as when moving onto the CT scanning gantry , a 20° roll with inline spinal stabilisation - should be used. Modern ‘scoop stretchers’ mean that there is - no requirement to roll any patient more than 20° until a pelvic fracture has been excluded. Formal log-rolling of the blunt trauma patient to exam - ine the back during the primary survey adds minimal useful clinical information, delays the WBCT scan and may cause harm to a patient with a pelvic fracture. It should be deferred until after the primary survey , with the exce ption of patients

# (c) TABLE 27.1 Glasgow Coma Scale. Best eye response (E) Best verbal response (V) 4 Eyes opening spontaneously 5 Oriented 3 Eye opening to speech 4 Confused 2 Eye opening in

# response to pain 3 Inappropriate words 1 No eye opening 2 Incomprehensible sounds 1 None (d) Figure 27.2 (a–d) Severe degloving injuries to the upper and lower limbs following a high-speed road traf /f_i c accident. The initial appear

ance and severity of the injury should not detract from following the important Advanced Trauma Life Support (ATLS) sequence in evaluating and treating immediate life-threatening injuries. Bleeding and severe injuries within the chest, abdomen and pelvis must be actively excluded. Best motor response (M) 6 Obeys commands 5 Localises to pain 4 Withdraws from pain 3 Flexion in response to pain 2 Extension to pain 1 No motor response

presence of a posterior torso wound. Mechanical testing of the pelvis in the emergency room (‘springing the pelvis’) adds no useful clinical examination and will disrupt any blood clot that has formed around vic fracture. It should never be performed – a pelvic fracture should always be diagnosed radiographically . Summary box 27.4 The cABCDE of trauma care /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF /uni25CF

c – Control of massive external haemorrhage A – Airway with cervical spine protection B – Breathing and ventilation C – Circulation and haemorrhage control: apply a pelvic binder and do not remove until a pelvic fracture is excluded D – Disability (neurological status) E – Exposure (assess for other injuries)

# DAMAGE CONTROL SURGERY VERSUS EARL Y TOTAL CARE

DAMAGE CONTROL SURGERY VERSUS EARL Y TOTAL CARE

As discussed in Chapter 26 , the concept of damage control surgery (DCS) was developed because severely traumatised patients with impaired physiology have poor outcomes after lengthy and complex surgical reconstructive procedures performed shortly after their trauma. Prolonged procedures result in additional trauma and further immune and physio logical derangement; the 'triad of death' – a cycle of acidosis, coagulopathy and hypothermia – may develop and result in multiorgan failure and death. Consequently , surgical interventions in the trauma patient with physiological abnormality are limited to rapid life- and limb-saving procedures: control of haemorrhage, decompres sion of ca vities (e.g. craniotomy , fasciotomy), revascularisation of ischaemic organs and limbs and removal of contamination. This damage control approach aims to rapidly achieve these objectives and then mo ve the patient to a critical care environ ment and continue with resuscitation. Subsequent definitive reconstructive procedures are deferred until the patient is adequately resuscitated and physio logically optimised. DCS in the abdomen is limited to packing and control of haemorrhage, debridement and resection of ies or faeces. Damage control orthopaedic sur gery is limited to debridement of severe open fractures, rapid temporary splin - tage or stabilisation of long bone fractures and decompression of limb compartment syndrome where requir ed. a pel - Revascularisation of a limb following arterial injury may be appropriate f or isolated injuries but in the patient with severe multiple system trauma it may increase the threat to life and therefore amputa tion may be the better option. Such patients are then transferred to critical care for further resuscitation and physiological stabilisation before definitive surgical procedures can be planned. The majority of trauma patients respond well to resusci - tation, are not physiologically compromised after appropriate resuscitation and are therefore suitable for early total care (ETC). A number of physiological indices are used to evalua te the response to resuscitation, including a pulse rate less than 100 per minute, normal blood pressure and respiratory rate, as well as urine output >30 /uni00A0 mL/h. The patient should not have hypothermia (temperature <35°C) nor evidence of acidosis on arterial blood gases and should have a normal coagulation screen. Lactate levels are also a good indicator of tissue perfusion - and should rapidly return to normal. In this situation, it is usu - ally safe for the surgeon to proceed with definitive repair or reconstruction of injured organs. For musculoskeletal injuries, ETC allows definitive fixation of all unstable long bone, spinal and pelvic fractures within - 36 hour s of injury . This facilitates nursing care, allows early mobilisation of the patient and reduces pulmonary complica - tions and length of stay on intensive care. If a sequence of fracture fixations is required, at the con - clusion of each procedure the surgeon and anaesthetist should determine whether the patient’s physiological status has been maintained su ffi ciently to allow the next procedure, or whether the pa tient should return to critical care for a further period of resuscitation. Summary box 27.5 ETC versus DCS /uni25CF - /uni25CF /uni25CF -

ETC describes the de /f_i nitive management of a patient’s injuries within 36 hours of injury after a period of initial resuscitation DCS describes simultaneous resuscitation with early rapid life- and limb-saving surgery. Time-consuming de /f_i nitive surgery is deferred until the patient’s physiological status allows An ETC approach can be changed to a damage control approach if the patient’s physiology deteriorates during de /f_i nitive surgery

# FURTHER READING

FURTHER READING

Sierink HJC, Treskes K, Edwards MJR et al ., for the REACT-2 Study Group. Immediate total-body CT scanning versus conventional imaging and selective CT scanning in patients with severe trauma (REACT-2): a randomised controlled trial. Lancet 2016; 388 : 673–83.

# IDENTIFICATION OF SEVERE TRAUMA

IDENTIFICATION OF SEVERE TRAUMA

The severely injured patient, with multiple injuries to di ff er ent body systems, poses unique diagnostic and treatment challenges. The early assessment and management of severe trauma begins in the prehospital environment. Many of these patients will be easily identified at the scene of injury Forewarning the receiving hospital allows the activation of the trauma team to prepare for the patient's arrival. Key informa tion in the pre-alert includes basic demographic information (age and gender), mechanism of injury , injuries identified and vital signs, including respiratory rate, pulse, blood pressure and Glasgow Coma Scale (GCS). Pa tients who are identified before reaching hospital as having sustained, or are at high risk of sustaining, severe multisystem trauma should generate trauma team activ in the receiving hospital. It should be noted that not all patients with severe multisystem trauma are immediately obvious. An older adult patient falling down a few steps can easily sustain a hip fracture, multiple rib fractures and a small subdural haemorrhage. At first glance the patient can appear well, but their injury severity score (ISS) and potential mortality could easily exceed those of a younger patient with multiple open long bone fractures. Both patients are critically injured and should be managed with the same principles in mind.

# Introduction

## Introduction

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# Learning objectives

Learning objectives

How to identify and assess the severely injured patient • Early treatment goals for multiply injured patients • Understand the role of permissive hypotension, • tranexamic acid and massive transfusion protocols

# ROLE OF THE TRAUMA TEAM

ROLE OF THE TRAUMA TEAM

All hospitals managing severe trauma should have a dedicated trauma team that is available immediately to attend and manage patients presenting with severe trauma. The composition of the team will depend on local policies but it will invariably involve doctors from the emergency department, anaesthetics and/ or critical care, trauma and orthopaedics and general surgery . Increasingly , radiology and haematology doctors are contrib uting to the trauma team, as part of the patient's initial assess ment and management. Hospitals managing large volumes of cases of severe multisystem trauma are recognising the need for an enhanced trauma team activation for the most severely injured patients – the so-called 'code red trauma call'. Patients identified before reaching hospital as being haemodynamically - unstable or having acute airway compromise may initiate 'code red', triggering the automatic attendance of the most senior clinicians from each discipline prior to the patient's arrival and prehospital activation of massive transfusion protocols. . The role of the trauma team is to apply the principles of Advanced Trauma Life Support (ATLS) to rapidly identify and - treat life-threatening injuries during the primary survey . The principal advantage of a trauma team is that this activity can occur concur rently instead of sequentially; while the anaes - thetist is assessing and managing the patient's airway , another team member can be assessing and managing the patient's breathing, etc. The importance of the trauma team leader cannot be overemphasised: they brief and prepare the team, ation coordina te these sequential activities, manage time, interpret findings and plan the next move. Increasing recognition of the importance of this role has led to the development of post - graduate training courses designed to teach both the technical and non-technical skills required. Generally , the trauma team leader and most senior clinicians should be standing back from the patient, looking at the big ger picture, in order to anticipate the next key decisions. Summary box 27.1 The role of the trauma team /uni25CF /uni25CF /uni25CF /uni25CF - -

Understand the principles of damage control surgery • (DCS) versus early total care (ETC) Allows the simultaneous and ef /f_i cient application of ATLS principles to rapidly identify and treat life-threatening pathologies Should be led by the most senior clinician The most senior clinicians from each specialty should attend 'code red trauma calls' The team leader should be constantly trying to anticipate the next move

The primary survey aims to identify and manage the most immediately life-threatening pathologies first and follows cABCDE.

# SECONDARY SURVEY

SECONDARY SURVEY

All severely injured patients require a detailed top-to-toe exam ination after life-threatening injuries have been identified and managed during the primary survey . Patients may be intubated and unresponsiv e at this point, limiting the accuracy of clinical examination. Such patients should have a ‘tertiary survey’ when extubated and alert to identify any missed ‘minor’ inju ries, such as a scaphoid fracture in the wrist or a rotator cu ff tear in the shoulder. These injuries have the potential to cause significant long-term disability . It is essential that the findings of the primary , secondary and tertiary surveys are clearly recor ded in the patient’s case notes.

# Venous lactate

Venous lactate

V enous lactate is a useful marker of resuscitation and phys - - iological state. A normal lactate (<2 /uni00A0 mmol/L) is a sign that the patient is probably resuscitated and suitable for ETC. An elevated lactate (>3 /uni00A0 mmol/L) suggests the patient is - under-resuscita ted and should either have a period of further resuscitation or DCS if surgery is urgent. If a patient’s lactate be noted and the other physiological markers considered to determine whether the patient is suitable for definitive surgical procedures. The identification of patients suitable for ETC versus DCS should be made by senior surgeons and anaesthetists/critical care doctors. This may be an easy decision, for example the haemodynamically unstable patient with intra-abdominal bleeding will always undergo rapid damage control lapar omy . In other cases a careful review of the patient’s physiology and coagulation state will be required. Summary box 27.6 Venous lactate is an essential marker of resuscitation /uni25CF /uni25CF /uni25CF /uni25CF The early assessment and management of trauma patients should follow established ATLS principles. A WBCT scan, from the head to the pelvis, with IV contrast is the gold standard investigation for major trauma patients and should be performed early and whenever possible. Warmed b lood and blood products in a 1:1:1 ratio of blood /uni00A0 : /uni00A0 plasma /uni00A0 : /uni00A0 platelets should be used with tranexamic ot - acid in the early resuscitation of haemodynamically unstable trauma patients. Trauma patients r equiring surgery should have an early decision made whether a damage control or ETC approach is required. Surgical procedures in physiologically compromised patients should be limited to those required to save the life and/or limb of the patient, while simultaneous resuscitation is continued.

<2 /uni00A0 mmol/L – ETC 2–3 /uni00A0 mmol/L – look at the trend (increasing or decreasing)

> 3 /uni00A0 mmol/L – may be under-resuscitated; should either have further resuscitation or DCS if surgery is urgent 5 /uni00A0 mmol/L – DCS (see Chapters 26 and 29 )

# c Exsanguinating external haemorrhage

c: Exsanguinating external haemorrhage

Experience from war zones over the past 20 years has shown that exsanguinating external haemorrhage from massive arte rial bleeding needs to be controlled even before the airway is managed (see Chapter 34 ). Most of these injuries are due to gunshot wounds or blasts and are mainly seen in military prac tice. However, they are also encounter ed in civilian practice. Bleeding must be controlled immediately by the application of packs and pressure directly onto the bleeding w ound and proximal artery . Haemostatic dressings that contain agents that augment local coagulation are now available. Failure to control bleeding in the limb by direct pressure with surgical dressings should be followed by the application of a tourniquet proximal to the wound. In the field, simple tourniquets can be improvised if pneumatic tourniquets are not available. It is vital to appreciate that once a tourniquet is applied the limb becomes ischaemic; therefore, the length of time for which the tourniquet is applied must be recorded on the patient and the patient requires urgent surgical control of the bleeding in order to reperfuse the limb.