Fifteen-minute consultation: A guide to the paediatric primary survey

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ABSTRACT

It's 21:00 and you receive a stand-by call from the local ambulance service. Peter, a 9-year-old boy, was riding an electric scooter and has collided with a car. He has reduced consciousness, signs of shock and is hypoxic. How will you prepare your team? What are the possible injuries? Who will perform the primary survey? Injury is the leading cause of morbidity and mortality in the paediatric population accounting for approximately half of all attendances to paediatric emergency departments in the UK and Ireland. Major trauma can be distressing for patients, parents and physicians. Managing major trauma is challenging and it is vital to have a clear and organised approach. In this 15-minute guide we describe a structured approach to the primary survey that includes how to prepare before the child's arrival, the suggested roles of team members and the key components of the primary survey. We discuss life-threatening injuries, the life-saving bundle and the principles of resuscitation, and the role of imaging in the initial assessment of the injured child.

INTRODUCTION

Injury is the leading cause of morbidity and mortality in the paediatric population accounting for approximately half of all attendances to paediatric emergency departments (PEDs) in the UK and Ireland.[1] Major trauma can be distressing for patients, parents and physicians. Managing major trauma is challenging and it is vital to have a clear and organised approach. In this 15-minute guide we will discuss the role of the primary survey as a structured approach for identifying and treating paediatric major trauma.

THE CASE

You are the paediatric ST6 covering a busy PED and receive a prealert at 21:00 hours. The paramedic relays the following information:

The handover information is crucial, allowing the trauma team to allocate resources accordingly. ATMIST and ASHICE handover tools are commonly used (table 1).

PREARRIVAL

This is the opportunity to prepare the team for the incoming patient. Instead of repeating the prealert message *ad verbatim*, synthesise the information and present a clear picture of expectations to the trauma team (as below).

> 9-year-old male, electric scooter vs car, possible high-velocity. The crew reports the GCS 13. He is tachycardic and hypoxic on oxygen. Given the mechanism, he may have sustained blunt chest trauma and we need to assess for a haemo/pneumothorax. Prepare chest drains and if he suddenly deteriorates, we should perform bilateral thoracostomies. His GCS would imply we need to consider neuroprotective measures, a CT brain and prepare for possible intubation. Let's reassess HR on arrival as this may be pain related. Haemorrhagic shock is a differential so ensure two units of O negative blood are available. Let's prepare for the identification and management of life threats and complete the primary survey. I am now going to allocate roles for each member.

This format provides a *shared mental model* to allow the team members time to adjust their mindsets for potential invasive procedures. The use of a whiteboard or communication board is recommended.

For 'Role Allocation', it is encouraged to forgo descriptive roles (ie, surgeon, anaesthetist) in favour of procedural roles. Available roles are largely dependent on the number and capabilities of staff present (table 2). It is important to ascertain the expertise of those allocated to the roles, that is, can they insert a chest drain.

Having a predefined trauma team improves patient outcomes and can reduce

Table 1 ASHICE handover versus ATMIST handover

ASHICE		ATMIST	
Age	9 years	Age	9 years
Sex	Male	Time of injury	20:40 hours
History	Patient riding e-scooter, hit by car	Mechanism	Patient riding e-scooter, hit by car
Injuries	Head injury. No LOC. Initially drowsy but now agitated. Complaining of abdominal pain	Injuries found or suspected	1. Airway intact 2. Decreased air entry on left, complaining of pain over left chest wall 3. Abdominal pain with guarding of right upper quadrant 4. Obvious head injury, possible skull fracture/ intracranial bleed
Condition	GCS 13/15. HR 132 bpm, RR 25, SpO_2 92% on 15 L, Temp 36.7°C, BP 115/60 mm Hg. Spinal precautions in place.	Signs and symptoms	1. Talking 2. RR 25, SpO_2 92% on 15 L, 3. HR 132 bpm, BP 115/60 mm Hg 4. GCS 13/15, Temp 36.7°C Spinal precautions in place.
ETA	15 min	Treatment given	1. Manual in-line stabilisation 2. 15 L O_2 3. N/A 4. Wound pad applied to head injury

AVPU, alert voice pain unresponsive; BP, blood pressure; CXR, chest X-ray; ETA, estimated time of arrival; GCS, Glasgow Coma Scale; HR, heart rate; LOC, loss of consciousness; RR, respiratiry rate.

duration of stay, complications and costs.[2] Depending on the prealert, you may contact radiology and blood transfusion laboratory as part of your trauma team activation.

Appropriate documentation is essential and a standardised approach is adopted such as a trauma flowsheet.[3 4] It can serve as an *aide memoire* ensuring no elements are omitted. It also incorporates a list of those in attendance along with the time stamps of their arrival.

Ensure a team member is allocated as a scribe, a role that can be often overlooked. The scribe role works best if performed by a team member with appropriate training for the role.

ARRIVAL

Peter is crying and calling for his mother. You introduce yourself as the team leader (TL) and the paramedics handover. The nurse assigned to family support introduces themself to the parents.

Handover

An appropriate formal handover conveys the salient details of the case. The '5 s Round' is a brief initial assessment by the TL prior to handover. Its purpose is to rule out the following imminent life-threatening injuries:

1. Traumatic cardiac arrest
2. Tension pneumothorax
3. Massive external haemorrhage
4. Complete airway obstruction.

Should any one of these be evident, it must be managed prehandover. For example, should the patient exhibit respiratory distress with unequal chest rise in the setting of haemodynamic instability, the suspected tension pneumothorax must be decompressed prior to any other discussion or intervention. In a similar theme, a cardiac arrest secondary to trauma necessitates bilateral thoracostomies and consideration of cardiac tamponade. In the absence of a life threat, all team members should pause to listen for a 'hands-off' handover.

Primary survey

Instead of the traditional assessment pattern of history-taking followed by examination and then investigations,

Table 2 Roles and responsibilities

Role	Responsibility
Team leader (TL)	A hands-off role that supervises the entire process. The TL amalgamates all the findings, directs management and pays particular attention to the identification and management of life threats.
Airway doctor	Performs airway and anterior neck assessment, controls 20° tilt, assesses requirement for oxygen supplementation or need for advanced/definitive airway. In the conscious patient, this role is aptly placed to talk to the patient and try to calm them.
Assessment doctor	Depends on local practice. This role can operate as either: ► One person examines the patient from B to E in primary survey, relays all findings to the TL Or ► Individual role allocations for assessment of each aspect of airway, breathing and circulation
Procedure doctor	Performs relevant procedures as part of the trauma reception and resuscitation, including but not limited to: chest drain insertion, finger thoracostomy, application of a pelvic binder, intraosseous access
Airway nurse	Assists the airway doctor in airway management
Transfusion nurse	Preparation of the rapid transfuser One team member to solely focus on transfusions
Medication nurse	Responsible for medication preparation and administration
Family support	A liaison for the family that can ensure they are updated and comforted throughout the process
Scribe	Documents all information from prehospital services, progress through resuscitation and any interventions performed

Figure 1 Primary survey parallel resuscitation.

Figure 3 Airway assessment.

the trauma patient should be approached in a different manner. The primary survey was developed to systematically identify and manage the immediate life-threatening issues. For the purposes of explanation, we address each aspect in order, however in practice these components occur simultaneously, termed *parallel resuscitation* (figure 1). The format of the primary survey is cABDCE (figure 2). The process is the same in adults and paediatrics, with some deviation which we cover below.

Catastrophic haemorrhage

Examine for external haemorrhage and if present, apply direct pressure until the bleeding stops and consider haemostatic dressings. In the case of persistent bleeding from a limb despite direct pressure, apply a combat tourniquet.

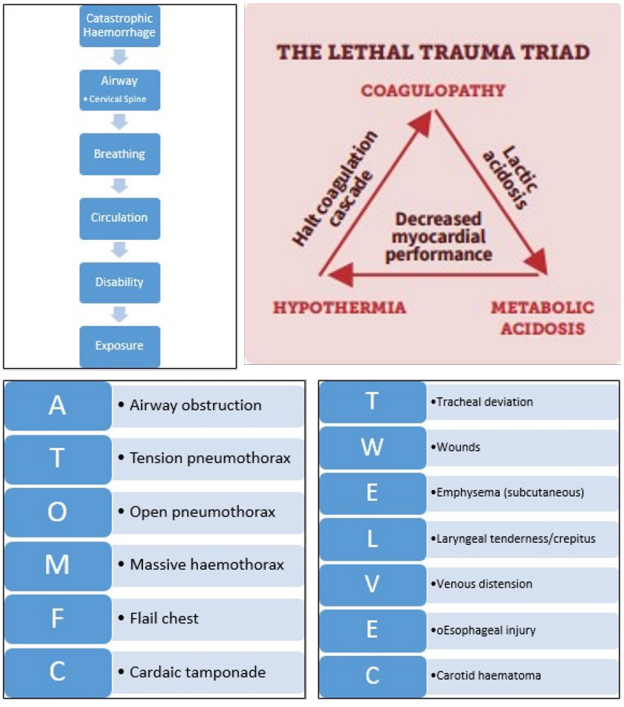

Figure 2 Aide memoire including 'primary survey approach, advanced paediatric life support', 'life-threatening anterior neck injuries', 'life-threatening chest injuries' and 'the lethal trauma triad'.

Case findings

There is a boggy mass in the occipital area with minimal bleeding. It is not a catastrophic haemorrhage and the bleeding is stopped with the application of direct pressure. Formal closure is not yet required.

Airway

Loose teeth can easily occur in trauma and the airway doctor must be conscious of this during their assessment when looking for debris in the oropharynx. Examination of the neck can be performed with the aid of the TWELVE-C mnemonic (as explained in figure 2) and should be performed by the airway doctor (figure 3).

Spinal immobilisation and imaging must be considered too at this junction. This is covered in a recent publication '*How to interpret spinal imaging in paediatric trauma*' based on guidelines from the Royal College of Radiology.[5] If imaging is required, the modality (plain film vs CT vs MRI) is based on the synthesis of all available information and discussion with your radiology department.

Case findings

No loose teeth or debris are identified in the oropharynx. The patient is crying and calling out, displaying no evidence of obstruction. Examination of his neck shows no significant injuries. He is tolerating the head blocks and in-line immobilisation well.

Breathing

Case findings

Peter is tachypnoeic at 40 bpm and with oxygen saturations of 95% in 5 litres of oxygen. There is decreased air entry on the left side and hyper-resonance on percussion. You suspect a pneumothorax. This is confirmed by bedside point-of-care ultrasound (POCUS). A colleague asks if they should perform a needle decompression or thoracostomy. You direct the procedures doctor to perform a thoracostomy and insert a chest drain once the patient has been adequately sedated.

The most common life-threatening chest injuries can be found in figure 2. The traditional management of traumatic pneumothorax by needle decompression is now discouraged in favour of a thoracostomy,[6–9] the purpose

Figure 4 Chest drain in situ.

of which is to perform a finger sweep. The finger (or if intercostal space is too narrow, artery forceps or mosquito forceps) is carefully inserted to develop the tract and sweep the pleura clear of the entry point. This frees any obstructing pleura impinged by a nearby rib fracture, and ensures a clear path for both air/blood evacuation and chest drain insertion. You may observe a further gush of air and blood at this point.[9]

However, it is important that team members operate within their comfort zone and do not attempt procedures which they feel unqualified to perform. Thoracostomy is followed by insertion of a chest drain but can be left open without a drain if the patient is intubated. POCUS is useful in the diagnosis of pneumothorax where a team member is proficient in its use. In the absence of a team member who is experienced in POCUS, the decision to insert a chest drain remains a clinical one. In a stable patient a CXR may be obtained for confirmation. However, in an unstable patient, management must not be delayed in lieu of imaging (figure 4).

Circulation

In the presence of circulatory compromise, administer 15 mg/kg of tranexamic acid and consider a further infusion of TXA if there is ongoing haemodynamic instability or evidence of bleeding. The patient's volume status must then be assessed. The first sign of hypovolaemia in children is tachycardia. Unlike adults, children maintain a normal blood pressure despite significant blood loss and hypotension is a late sign. A child in haemorrhagic shock needs blood products and the use of crystalloid should be avoided where possible.[9] To ensure the availability of appropriate blood products many hospitals make use of a major haemorrhage protocol and you should familiarise yourself with your hospital's local policy. Administration of saline in a bleeding patient worsens the acute trauma coagulopathy.[10] Acute trauma coagulopathy (resulting from the trauma sustained), if left untreated, progresses into trauma-induced coagulopathy (the culmination of coagulopathy from both the trauma and other factors). This pathology forms part of the *Lethal Trauma Triad* that is addressed below.

There is now an abundance of evidence, including National Institute of for Health and Care Excellence recommendations, favouring transfusion with blood products. The recommended ratio of blood products is 1:1:1 of plasma, platelets and red blood cells.[11]

For suspected intra-abdominal bleeding, CT is the recommended modality, FAST (Focused Assessment with Sonography for Trauma) scanning is not currently recommended in the paediatric population given concerns with its specificity and sensitivity.

Case findings

Peter remains tachycardic at 140 bpm with a BP 110/60 mm Hg and CRT 4 s. He has a tender right upper quadrant with bruising, leading you to be suspicious of a liver injury. Wide bore intravenous access is obtained, and you administer warmed blood products (5 mL/kg O-negative) and a TXA bolus 15 mg/kg (max 1 gm) over 10 min followed by infusion 2 mg/kg/hour for at least 8 hours.

Disability

Evaluation of disability involves a brief neurological assessment. The AVPU grading system is practical for rapid categorisation as it is applicable across all ages. It is an expeditious evaluation which grades the patient's level of consciousness. It ranges from Alert, responding to Voice, responding to Pain, or Unresponsive. A formal GCS is required once feasible, however there are different age-dependent scores for the individual categories, especially relating to the verbal component.

Pupil size and reactivity should be documented.

Case findings

Peter's pupils are 3+ and he remains confused but is now less agitated. His GCS is 13/15 (E4, V4, M5). You ask for analgesia to be administered.

Exposure

Temperature assessment is an often forgotten but critical component of trauma care. Turn the heat up in the room, have the Bair Hugger ready for immediate application and ensure your blood warmer is working. It is essential that trauma patients do not get cold. Exposure should be graduated as a child has a greater body surface area to body mass ratio. Hypothermia is a contributor to the cycle known as the *Lethal Trauma Triad* in trauma (figure 2). This is the combination of hypothermia,

metabolic acidosis and coagulopathy[12–15] that poses significant mortality to the trauma patient.

It is vitally important to ensure you have examined the patient fully during the graduated exposure to rule out occult injuries, including the posterior aspect. The traditional log roll has been discouraged owing to the risk of dislodging a 'first clot'. The new method recommends a 20° tilt that allows adequate exposure and is the minimum space required to transfer onto a scoop if required.

Case findings

A boggy mass is noted on the right occipital region, and you consider the possibility of a skull fracture and intracranial bleed. Peter has a deformity of the left wrist with a good pulse and you suspect a closed fracture.

Temperature is 35°C and a Bair Hugger is applied

Secondary survey

The secondary survey is an absolute requirement.[16] The timing of the secondary survey is variable, however, it can occur in parallel or in sequence with the primary survey. For patients that remain unstable and are transferred for definitive management, that is, operative intervention/intensive care, a thorough secondary survey may not be possible. This should be clearly documented and handed over.

Case conclusion

On completion of the primary survey and management of the acute injuries identified, Peter's vitals improved. Both his tachypnoea and tachycardia resolve indicating stabilisation of his condition. Peter underwent a CT brain/c-spine/thorax/abdomen/pelvis. This revealed:

1. No acute intracranial bleed. No skull fracture. Subgaleal haematoma noted occipitally.
2. Resolving left-sided haemopneumothorax with chest drain in situ, positioned appropriately.
3. Grade II subcapsular hepatic haematoma, non-expanding in nature.
4. No other visceral injury identified.
5. No spinal fracture identified.

A secondary survey was performed which identified no other injuries. At this point Peter's confusion was improving. An X-ray was arranged for the deformity of the left wrist and confirmed a fracture with dorsal angulation. This was reduced with the assistance of the orthopaedic team. General surgery admitted Peter with input from orthopaedics. The liver injury was managed conservatively. Peter continued to improve and was discharged 7 days later.

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