6 Initial Trauma Assessment and Resuscitation

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Introduction

In the United States, accidental injury is the leading cause of death for people between the ages of 1 and 44. Traumatic injury of all causes is responsible for more than 170,000 deaths annually. More than 42 million people will seek medical care due to intentional or accidental trauma this year, at an annual national cost of greater than $406 billion dollars.

The injured patient must be assessed quickly and treatment of life-threatening injuries begun immediately. A systematic approach to this evaluation assures that the most critical injuries are identified early and that potentially lethal injuries are not missed. The American College of Surgeons Advanced Trauma Life Support (ATLS) course promotes the "ABCDE" primary survey sequence, and this is the most widely accepted approach to the initial evaluation of the trauma patient (Fig. 6.1). This strategy also provides a framework for reevaluation if the patient's condition deteriorates, redirecting the physician back to the start of the algorithm in search of a missed or worsening injury.

Once the primary survey is complete and the patient's vital signs are normalizing, the secondary survey is begun.

Preparations

Prior to the patient's arrival, the hospital trauma team should be mobilized, including notification of radiology, blood bank, respiratory therapy, and the operating room. Intravenous (IV) fluids should be warmed, and the trauma bay should be warmed if possible. The team should follow standard precautions (cap, gown, gloves, mask, shoe covers, face shield).

Airway

Evaluation of the patient's airway is the first priority. Spontaneous speech in an awake patient indicates a patent airway. Depressed level of consciousness may cause airway obstruction due to collapse of the soft pharyngeal tissue or blockage by the posterior movement of the tongue, a situation that can be improved with a jaw thrust or chin lift maneuver, or placement of an oral airway. Similarly, severe facial trauma may lead to obstruction, mandating immediate intervention. Indications for intubation include inability to protect the airway, profound shock, or a Glasgow Coma Scale (GCS) less than or equal to 8. Nasotracheal intubation requires a spontaneously breathing patient and is contraindicated in patients with severe facial trauma or suspected basilar skull fractures. The orotracheal route is generally the preferred method for airway control. A contingency plan should exist for the difficult airway and includes adjuncts such as bougies, Combitubes, and intubating laryngeal mask airways (LMAs). Video laryngoscopes are generally of limited use in the acute trauma setting as the equipment is often not immediately available, and the presence of blood or gastric contents in the oropharynx limits visibility. Inability to intubate mandates a surgical airway, with cricothyroidotomy the preferred procedure in adults. Needle cricothyroidotomy is favored in children younger than 12 years old due to their narrow cricoid ring, but it is important to note that this temporizing measure only provides oxygenation, not ventilation. A definitive airway will need to be secured either by more experienced personnel or surgically in the operating room. All patients with blunt head trauma or altered mental status should be presumed to have a cervical spine injury until proven otherwise. Inline cervical spine stabilization should be maintained at all times when securing a definitive airway.

Breathing

Once the airway is assessed and secured, all trauma patients should be started on supplemental oxygen. Breathing first should be evaluated by inspection, looking for external signs of injury, asymmetry of chest rise, paradoxical motion, and the use of accessory respiratory muscles. Tracheal deviation or the presence of distended neck veins should be noted.

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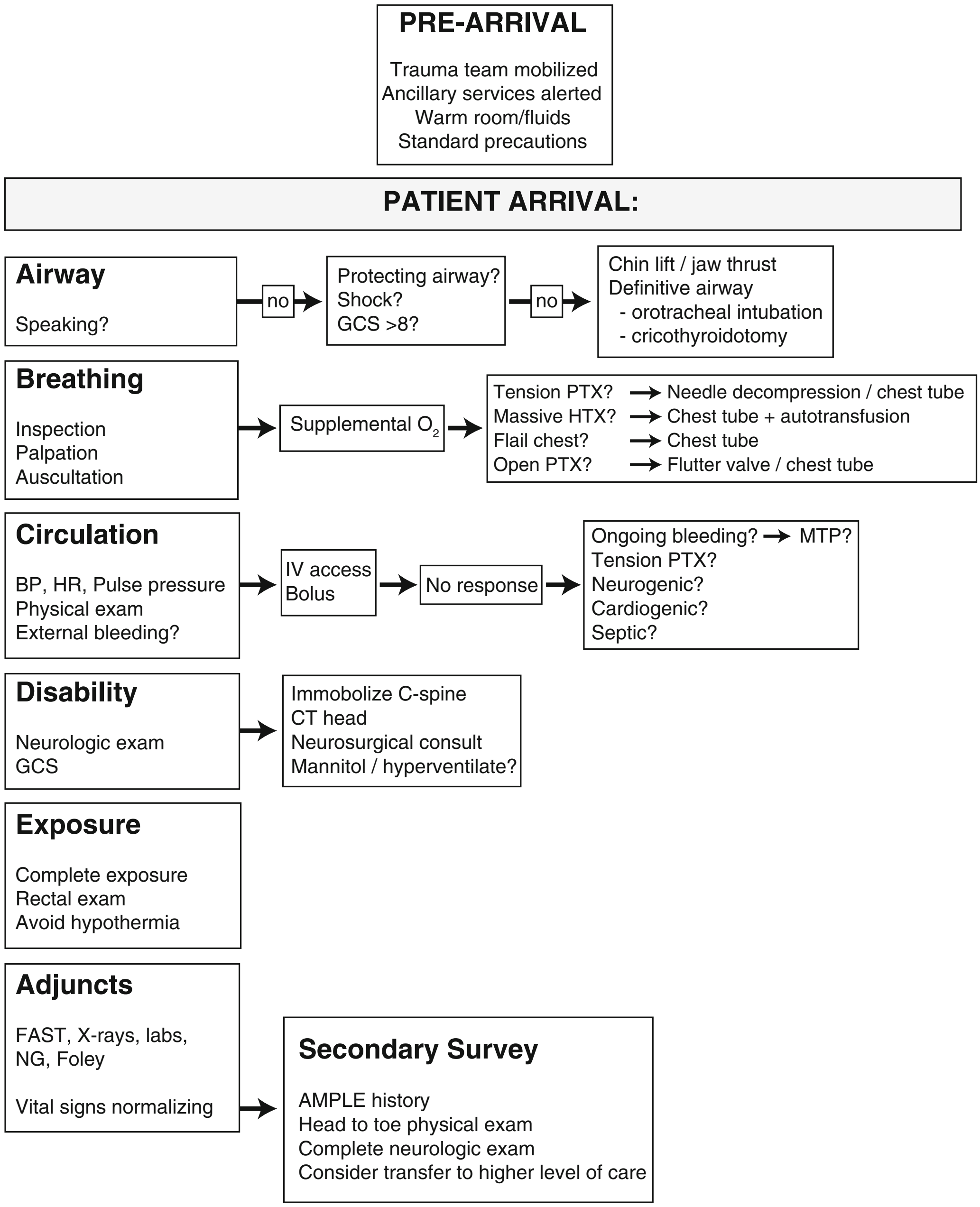

Fig. 6.1 The "ABCDE" primary survey sequence (airway, breathing, circulation, disability, exposure) for assessing and treating trauma, followed by a secondary survey when the patient's vital signs begin to normalize. *GCS* Glasgow Coma Scale, *PTX* pneumothorax, *HTX* hemothorax, *BP* blood pressure, *HR* heart rate, *IV* intravenous, *MTP* massive transfusion protocols, *CT* computed tomography, *FAST* focused assessment with sonography for trauma, *NG* nasogastric, *AMPLE* – A = allergy, M = medications, P = past medical/surgical history, L = last meal, E = events of injury

The chest should also be palpated to identify areas of tenderness or subcutaneous emphysema. Percussion may illicit hyperresonance or dullness, indicating pneumothorax or hemothorax, respectively, though in a noisy trauma bay this may be impractical. Finally, auscultation may demonstrate absent or diminished breath sounds from a hemo-/pneumothorax or malpositioned endotracheal tube. Life-threatening injuries that must be identified and addressed during the primary survey include tension pneumothorax, massive hemothorax, flail chest, and open pneumothorax. A tension pneumothorax should be suspected in a hypotensive patient with absent breath sounds, hyperresonance, distended neck veins, and deviated trachea. Treatment is immediate needle decompression (before the chest X-ray!)

with a large-gauge angiocatheter through the second intercostal space in the midclavicular line. Massive hemothorax is defined as greater than 1,500 mL of blood within the pleural space, and initial treatment requires prompt chest tube placement (36–40 Fr). Adding an autotransfusion canister to the chest tube drainage system should be considered. Flail chest occurs with segmental fractures in three or more adjacent ribs and raises concern for underlying pulmonary injury as well as resultant hypoventilation secondary to pain. Treatment is supportive, occasionally requiring mechanical ventilation. Lastly, an open pneumothorax ("sucking chest wound") occurs with chest wall defects that are greater than 2/3 the diameter of the trachea, resulting in air flowing predominantly through this new path of least resistance. A flutter valve should be created using an occlusive dressing taped on 3 sides, allowing air to flow out but not in with each breath. A chest tube must be inserted and ultimately the defect closed.

Circulation

Shock, defined as inadequate organ perfusion and tissue oxygenation, can be categorized as hemorrhagic, neurogenic, cardiogenic, or septic. Hypotension in a trauma patient is due to blood loss until proven otherwise, and the degree of hemorrhage can be estimated quickly by physical exam. Level of consciousness, skin color, pulse rate, and pulse pressure rapidly reflect volume status. Systolic blood pressure, however, usually does not fall until 30 % of the blood volume is lost (class 3 hemorrhagic shock) and therefore may deceive one into a false sense of security. The most important concept is *locate and stop the bleeding*. External bleeding must be identified and controlled, usually with direct pressure. Other possible locations of hemorrhage include the thorax, abdomen, retroperitoneum, and extremities. Intravenous access must be established, generally with two 16 gauge (or larger) antecubital IVs, and a 2 l bolus of lactated Ringer's solution is given. Triple lumen catheters should be avoided due to their high resistance to flow (long tube and small diameter). Instead, a 7.5 French Cordis is preferable, generally placed in the femoral vein. If the patient improves hemodynamically, the fluids are decreased to a maintenance rate. If there is no response to the initial bolus, one must consider transfusing blood (O negative or type-specific). Many trauma centers have developed massive transfusion protocols (MTP) that facilitate rapid delivery of large quantities of blood to the exsanguinating patient. Not only are packed red blood cells (PRBCs) provided but also fresh frozen plasma (FFP) and platelets. Recent literature reports improved survival if administering these blood products in a 1:1:1 ratio. In addition to bleeding, other potential causes of shock must be entertained. Tension pneumothorax has been discussed. Neurogenic shock is characterized by hypotension in the face of a normal heart rate (or even bradycardia due to unopposed vagal cardiac stimulation). It occurs with spinal cord injury above the mid-thoracic level and *not* brain injury, and treatment consists of fluids initially, followed by vasopressors if necessary. Pericardial tamponade is generally associated with penetrating injuries and can be recognized by hypotension, tachycardia, jugular venous distension (JVD), and muffled heart sounds. Echocardiography is the mainstay of diagnosis. Treatment is immediate operation, though pericardiocentesis can stabilize the patient until the operating room is available or transfer to an appropriate facility can be achieved. Cardiogenic shock can also be due to blunt cardiac injury, which is diagnosed by EKG and echocardiogram. Treatment is supportive. Septic shock is extremely rare in the acute trauma setting.

Disability

Brain or spinal cord injury can be detected by a brief neurologic exam. Before any paralytic agents are given for intubation, movement of all four extremities should be assessed and lateralizing signs noted. Abnormal pupillary exam, including size and reactivity, can indicate intracranial injury. The Glasgow Coma Scale is the most widely used assessment of level of consciousness and incorporates the best exam score in three categories: eye opening, verbal response, and motor response. Scores range from 3 (worst) to 15 (best). One advantage of using the GCS is its reproducibility and simplicity, allowing frequent reevaluations by different physicians. All patients with suspected head injury require emergent noncontrast head computed tomography (CT) for rapid diagnosis and differentiation of operative and nonoperative pathology. Severe head injury with elevated intracranial pressure and signs of herniation is treated initially with mannitol and MILD hyperventilation ($PaCO_2$ 30–35). More vigorous hyperventilation is discouraged and leads to cerebral vasoconstriction, limiting cerebral oxygen delivery. Cervical spine injury must be assumed with all blunt trauma, and cervical immobilization with a C-collar is employed until bony and ligamentous injury can be ruled out. Currently, the use of steroids for suspected or confirmed blunt spinal cord injury is discouraged by all major neurosurgical and orthopedic societies.

Exposure

The patient should be completely exposed (including rolling) and the entire body examined for signs of injury. A rectal exam should be performed. To avoid hypothermia, the patient should then be covered with warm blankets once the inspection is complete. Again, IV fluids and blood should be warmed.

Adjuncts

During the primary survey, blood pressure, EKG, and pulse oximeter monitors should be placed. Supplemental oxygen should be administered. If clinically indicated, a nasogastric tube and Foley catheter are inserted. Basic imaging can also be obtained at this point, including chest, pelvis, and lateral cervical spine radiographs. Focused assessment with sonography for trauma (FAST) is often included at the end of the primary survey and is particularly useful in multisystem blunt trauma patients with hypotension of unknown origin. FAST exam allows rapid detection of hemopericardium and hemoperitoneum while, in the trauma bay, sparing the unstable patient from a potentially disastrous trip to the CT scanner. Extended FAST is also being used to evaluate for pneumothorax and hemothorax.

Secondary Survey

Once the primary survey is completed and the patient's vital signs are normalizing, a thorough head-to-toe exam is performed. A complete neurologic exam is performed. A brief "AMPLE" history (A = allergy, M = medications, P = past medical/surgical history, L = last meal, E = events of injury) should be taken. Any change in the patient's condition mandates reassessment of the primary survey. If the patient's injuries require management not immediately available at the current hospital, transfer to a higher level of care must be considered and arrangements initiated. Diagnostic studies should not delay transfer to definitive care.