Trauma systems and epidemiology

Deaths due to trauma take a tri-modal distribution of peak incidence from the time of injury. The first peak occurs in the first seconds to minutes after the injury. These types of injuries include massive head trauma, disruption of the great vessels, or uncontrolled hemorrhage. The second peak occurs in the first few hours after the patient’s arrival to the hospital. These injuries are again significant but not enough that they were immediately lethal. They include problems such as aortic ruptures with hematoma formation, pneumothorax, liver and spleen lacerations, or slower uncontrolled hemorrhage. The third peak occurs days to weeks after the injury when treatment in the hospital leads to post-surgical complications, sepsis, or pulmonary emboli.

The value of a systems approach to trauma becomes clear. By passing laws regarding speed limits, helmet use, firearms limitations, and drunken driving we can reduce the trauma deaths in the first peak. By having designated centers with experts in the treatment of the complications (including rehabilitation and social services) of major trauma we can reduce the deaths in the third peak. In the ED we obviously have the greatest effect on the second peak by recognizing and treating possibly occult but life-threatening injuries. The rest of this chapter will be devoted to this issue.

Primary Survey

The treatment of the trauma patient in the ED is directed to identifying immediately life-threatening injuries. These injuries may not be readily apparent. The primary survey is a way of prioritizing the initial assessment. Once an accurate primary survey is complete, a more methodical and comprehensive secondary survey can be done. The primary survey should take approximately 30 – 60 seconds and should only be interrupted to deal with the problems it identifies. If a trauma patient becomes unstable during any part of the assessment, one should go back and quickly reassess the primary survey (That hematoma on the neck that looked benign initially may be expanding and causing airway compromise). It is as easy as ABC:

A – Airway maintenance with C-spine control
B – Breathing/ventilation
C – Circulation with hemorrhage control
D - neurologic Disability
E – Exposure (the patient should be entirely undressed)

While the primary survey is occurring, other members of the team should be “throwing the safety net under the patient.” This means that trauma patients, like all other critically ill patients, should have some level of intervention being performed even before the data is collected. Placing the patient on the monitor, obtaining IV access, and getting high flow oxygen started can easily occur without interrupting the primary survey. The team leader should ensure that all members of the team are working simultaneously without interfering with each other during the resuscitation.

Airway maintenance with C-spine control

Rapid assessment for airway patency includes inspecting for foreign bodies or maxillofacial fractures that may result in airway obstruction. The chin lift or jaw thrust maneuver, or the insertion of an oral or nasal airway, is a first response to a patient making an inadequate respiratory effort. With enough personnel available, one person should be designated to hold in-line stabilization of the cervical spine. Patients who are vomiting should be rolled with maintenance of C-spine immobilization and suctioned. Patients who are talking and able to give even a confused history are unlikely to have an immediate airway problem and you can move on to breathing.

Breathing/ventilation

The patient’s neck and thorax should be inspected, auscultated, and palpated to detect abnormalities such as a deviated trachea, crepitus, flail chest, sucking chest wound, fractured sternum, and absence of breath sounds on either side of the chest. Possible interventions here include application of an occlusive dressing
Trauma
to a sucking chest wound, withdrawal of the endotracheal tube from the right mainstem bronchus,
reintubation of the trachea if no breath sounds are heard, and insertion of a large chest tube to relieve a
hemopneumothorax.

Circulation with hemorrhage control

Hemorrhagic shock, a common cause of postinjury death, should be assumed to be present in any
hypotensive trauma patient until proven otherwise. Direct pressure should be used to control obvious
external bleeding, and a rapid assessment of hemodynamic status is essential during the primary survey.
This includes evaluation of level of consciousness, skin color, and presence and magnitude of peripheral
pulses. Attention should be paid to the specifics of heart rate and blood pulse pressure (systolic minus
diastolic blood pressure), particularly in young, previously healthy patients.

Not all hemorrhage results in hemorrhagic shock, and an unsuspecting clinician may fail to appreciate
ongoing hemorrhage with blood loss of up to 30 percent of the circulating blood volume. While Class I
hemorrhage (loss of up to 15 percent of circulating blood volume) is associated with minimal symptoms
and is clearly no shock, Class III hemorrhage associated with gross hypotension is readily appreciated as a
state of hypoperfusion. Yet, consider a young, healthy trauma victim who has lost 25 percent of his
circulating blood volume (Class II hemorrhage) and had a preinjury blood pressure of 130/70 mmHg and a
pulse rate of 60. If this patient experiences a 50 percent increase in his pulse rate (to a rate of 90) and a
greater than 50 percent decrement of his pulse pressure (from 130/70 mmHg pulse pressure of 60 to 116/90
mmHg pulse pressure of 26), the unsuspecting clinician may assume that the patient is “hemodynamically
stable.” A false sense of security may lead to delays in aggressively pursuing the source of bleeding via
ultrasound, peritoneal lavage, operative exploration. From this example it should be clear that the practice
of omitting diastolic blood pressure (and reporting “116/palpable,” thus omitting the pulse pressure) is
potentially hazardous. The alert, suspicious clinician identifies hemorrhage before it reaches the class III
category of obvious shock.

Two large intravenous lines should be established and blood obtained for laboratory studies. While there
are varying preferences, there are significant advantages to a percutaneous large line in the groin for
unstable patients in whom upper extremity peripheral veins are not available. Subclavian lines are
potentially dangerous in the hypovolemic patient, saphenous vein cutdown at the ankle may not be
appropriate for the patient with an injured lower extremity, and complications encountered from the
femoral venous line may be minimized if the line is removed early, on completion of resuscitation in the
early postoperative period. Unstable patients without an obvious indication for surgery should be assessed
for their response to 2 L of rapid infusion of crystalloids. If there is not marked improvement, type O blood
should be transfused (O-negative for females of childbearing age). Auscultation for breath sounds and
heart sounds and inspection of neck veins are included in the assessment of circulation because two major
causes of hypotension may be present in trauma patients with minimal blood loss: cardiac tamponade
(hypotension, agitation, distended neck veins, muffled heart sounds) and tension pneumothorax
(hypotension, distended neck veins, absent breath sounds).

Neurologic disability

An abbreviated neurologic evaluation should be performed. This includes an assessment of the level of
consciousness, pupil size and reactivity, and motor function. The Glasgow Coma Scale(GCS) should be
used to quantify the patient’s level of consciousness. Despite the common presence of alcohol and drugs in
trauma patients, it should be assumed that alterations in level of consciousness are due to head injury. A
GCS between 13 and 15 is considered mild, between 9 and 12, moderate. Patients with a GCS of 8 or less
have a severe head injury and should be intubated regardless of their airway and breathing status. Further
investigation of the head injury with a CT should occur as soon as possible after the patient’s other injuries
have been stabilized.

Peripheral neurologic disability must also be rapidly assessed and spinal immobilization maintained until
instability has been ruled out. A complete cervical spine series must include AP, lateral, and odontoid
views. Obtaining only a lateral film can result in missed fractures in as many as 15% of C-spine injuries.
An intoxicated patient cannot be cleared with radiographs as ligamentous instability can still be present
despite normal x-rays. A recent study with over 34,000 patients enrolled has suggested criteria which can
safely be used to clear the cervical spine without x-rays. Patients who are not intoxicated, with no
Trauma alterations in mental status, have no peripheral neurologic deficits, no distracting injuries, and no cervical spine tenderness can be cleared from immobilization without radiographs. Of course, x-rays of the neck, chest, and pelvis, which are considered standard on all major multi-system trauma patients should wait for the secondary survey.

Exposure

No primary survey is complete without thoroughly disrobing the patient and examining the total body surface area carefully for bruises, lacerations, impaled foreign bodies, and open fractures. If hemodynamically stable and with a stable airway, the patient should be log-rolled with one attendant assigned to maintain cervical stabilization. Check the back and thoracic and lumbar spine for tenderness. Check the gluteal cleft and perineum for injury. When the exam is completed, the patient should be covered with warm blankets to prevent hypothermia.

Secondary Survey

An AMPLE history should be obtained from the patient once a primary survey is completed. It is certainly possible to obtain the history during the primary survey; however, the initial priority should be on securing the airway, breathing, and circulation of the patient. The AMPLE history consists of:

A - allergies. It is important to know the medication (and other) allergies of a patient as the patient may soon be receiving antibiotics, tetanus, and anesthetics.
M – medications. Knowing the patient’s medications will not only give you an idea of expected drug-drug interactions but it gives you an idea of the physiologic status of the patient. For instance, the patient on beta-blockers may not have an appropriate tachycardia.
P – past medical history. Again, it is important to know the patient’s underlying diseases. A patient with chest pain may be having an MI or the patient may have had a significant syncopal event leading to the accident.
L – last meal. A patient may have gastric distension or be at risk for aspiration if taken to the operating room.
E- events. This is the history of the mechanism of the trauma. It will tell you what to look for in terms of injury pattern and will heighten your awareness to certain types of injuries. Don’t forget that the medics who were at the scene are a valuable source of information in estimating the speeds involved and the extent of the injuries and blood loss.

The secondary survey is a more thorough assessment of the trauma patient which includes a detailed exam of the head and neck, exploration of wounds, and a more careful neurologic exam. A rectal and bimanual pelvic exam should be performed. This is done simultaneously with the performance of indicated x-rays. As already stated, x-rays of the chest, cervical spine, and pelvis are standard on the multi-system trauma patient. If the patient, however, is acting appropriately, gives a good history, and can be adequately assessed, not all of these films are indicated. The chest x-ray is the single most valuable film in the unstable trauma patient.

A significantly injured trauma patient should also receive “tubes and lines in every orifice.” An NG tube may help prevent aspiration and the stomach must be decompressed prior to a diagnostic peritoneal lavage (DPL). A foley catheter will help monitor urine output. A foley also must be placed prior to a DPL. Remember, the rectal exam should be performed prior to the placement of the foley to prevent pushing the foley through a disrupted urethra. Other invasive monitoring may be required such as arterial lines, CVP monitoring, or a Swan-Ganz catheter.

Further diagnostic testing

A whole book could be written about the use of the following tests and procedures and a discussion of their limitations is beyond the scope of this chapter. The following table is simply a starting point.
Trauma

<table>
<thead>
<tr>
<th>Test</th>
<th>Indications</th>
<th>Limitations</th>
<th>Contraindications</th>
</tr>
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<tbody>
<tr>
<td>CT of the abdomen</td>
<td>Suspected intra-abdominal or retroperitoneal injuries due to blunt force trauma</td>
<td>Poor with diaphragmatic injuries Limited with penetrating injuries to the bowel Possible reactions to dye load</td>
<td>Do not perform if patient has not been reasonably stabilized</td>
</tr>
<tr>
<td>CT of the head</td>
<td>Suspected intracranial hemorrhage or edema due to blunt force trauma</td>
<td>Few limitations other than time in the scanner for an unstable patient</td>
<td>Do not perform if patient has not been reasonably stabilized</td>
</tr>
<tr>
<td>Diagnostic Peritoneal lavage</td>
<td>Intra-abdominal or diaphragmatic injuries due to blunt or penetrating trauma</td>
<td>Sensitive but not specific for injuries Not for use if retroperitoneal injury is suspected</td>
<td>Do not perform without and NGT and Foley in place</td>
</tr>
<tr>
<td>Abdominal Ultrasound</td>
<td>Suspected intra-abdominal or retroperitoneal injuries due to blunt force trauma</td>
<td>Operator dependent Cannot diagnose bowel injuries</td>
<td>Few contraindications. This is a fast, noninvasive bedside test</td>
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Summary

The care of the trauma patient should be a coordinated effort. This effort certainly must come from the treating team in the hospital with pre-determined tasks for each member of the team. The effort must also come from the system in which the triage mechanism and pre-hospital protocols mesh with the treating trauma service.

Using a systematic approach to the critically injured patient is mandatory. A high index of suspicion should exist for occult life-threatening injuries and a reassessment made on a nearly continuous basis.