Trauma Management

Trauma remains the leading cause of death in all age categories from infancy to middle age (1–44 years) in the United States. In 1984, trauma exceeded cancer and heart disease combined as a measure of years of potential life lost (YPLL) as determined by the Centers for Disease Control and Prevention. By 1988, the estimated total annual cost of accidental trauma, including lost wages, medical expenses, and indirect losses, was estimated to be $180 billion in the United States alone.

Advanced Trauma Life Support (ATLS) courses acknowledge the trimodal pattern of death after trauma. The first cohort, approximately 50% of trauma deaths, occurs in the immediate postinjury period, and represents death from overwhelming injury such as spinal cord transection, aortic disruption, or massive intraabdominal injuries. Recognizing that there is little sophisticated treatment systems can do to salvage these patients, efforts should be directed at prevention.

In the second phase, deaths are usually caused by severe traumatic brain injury or uncontrolled hemorrhage, occur within hours of the injury, and represent perhaps one-third of all trauma deaths. Preventable death studies report reduction in preventable death rates from 20% to 30% to 2% to 9% upon institution of trauma system and/or trauma center development. The third peak occurs 1 day to 1 month post injury and comprises approximately 10% to 20% of deaths. It is most often caused by refractory increased intracranial pressure subsequent to closed head injury or pulmonary complications. With aggressive critical care, nonpulmonary sources of sepsis, renal failure, and multiple organ failure as a cause of death are declining.

Thus, a cornerstone of trauma care is the timely identification and transport to a trauma center of those patients most likely to benefit, that is, the principle of triage. Trauma triage is founded upon the recognition that the nearest emergency room may not be the most appropriate destination.

Current triage schema tend to assess the potential for life- or limb-threatening injury utilizing physiological, anatomical, and mechanism of injury criteria. In general, physiological criteria offer the greatest yield while anatomical criteria are intermediate and mechanism is low yield. Highest yield criteria include prolonged prehospital time, a pedestrian struck at greater than 20 mph, the associated death of another vehicular occupant, and the physiological criteria of systolic blood pressure less than 90 mmHg, respiratory rate less than 10 or greater than 29 breaths per minute, or Glasgow Coma Score less than 13.

The basic tenets of trauma resuscitation focus on addressing the management decisions and algorithms that present in the second phase. To focus on this, the ATLS update retains the mnemonic ABC. Efforts during the initial, primary, survey are directed at establishing a secure Airway, using techniques of rapid sequence intubation (Table 8.1) if necessary, identifying that the patient has adequate Breathing by ruling out or treating immediately life-threatening chest injuries (Table 8.2), and ensuring adequate Circulation by control of obvious hemorrhage. Expeditious hemorrhage control, through operative and nonoperative means, has received increased emphasis over volume normalization through fluid administration and blood pressure maintenance in the new iteration. These treatment principles hold true in both the prehospital environment (EMS, emergency medical services) and the trauma center setting.

The primary survey is brief, requiring no more than 1 to 2 min. A cornerstone of the primary survey concept is the dictum to treat life-threatening injuries as they are identified. Management during the primary survey relies heavily on knowledge of the expected patterns of injury based upon the mechanism of transfer of kinetic energy. Laboratory tests and diagnostic radiology are not emphasized at this point.

Extending the alphabetical mnemonic, evaluation of Disability directs the resuscitation team to assess neurological function and assign a Glasgow Coma Score (GCS). The score derives from assessment of the patient’s best motor, verbal, and eye-opening responses (Table 8.3). The patient is always
assigned the most favorable score (e.g., if the patient is decor-
icate on one side and decerebrate on the other, the higher mo-
tor score is assigned) so that the score is reported as a finite
number and not a range. Often, the trauma patient arrives in
the emergency department intubated or therapeutically para-
lyzed. In these cases, the preintubation GCS should be elicited
from the field personnel for use as the treatment baseline.

Implicit in this neurological assessment is the assumption
that a spine injury is present until proven otherwise, dictating
the need for vigilance in spine immobilization; this is espe-
cially true when concomitant head injury is present, and the
head-and-neck axis should be considered as a single unit.10
Evidence of a significant intracranial edema or space-occupying
lesion, such as a GCS less than 8 or focal findings on cranial
nerve exam, dictate early diagnostic imaging and neurosurgi-
cal consultation. Exposure directs the examiner to remove all
clothing and log roll the patient to fully evaluate for injuries.

The secondary survey naturally follows the primary sur-
vey, and it is here that a more thorough head-to-toe examina-
tion is performed. Definitive hemorrhage control rather than
normalization of volume status is again emphasized as the tar-
et of shock management. Blood loss may be estimated through
assessment of blood pressure, heart rate, and skin color (Table
8.4). Invasive monitoring is not warranted. Hypovolemic hy-
potension requires >15% to 30% blood volume loss, but may
be a late sign in younger patients with good compensatory
mechanisms. Failure to correct hypotension or tachycardia af-
ter rapid infusion of 2 to 3 l of crystalloid solution suggests a
volume deficit of greater than 15% or ongoing losses. Blood
transfusion, using type O if type-specific blood is not available,
should be considered when blood loss exceeds 1 l or if more
than 3 l of crystalloid is needed to maintain blood pressure.

Prophylactic antibiotics should be started for penetrating
trauma or open fractures.11,12 The tetanus immunization sta-
tus of the patient must be ascertained. If the immunization
status is uncertain, or the patient has a tetanus-prone wound,
tetanus immunoglobulin should be administered with the
tetanus toxoid booster. Tetanus-prone wounds include those
more than 6 h old, crush injuries, burns and electrical injuries,
frostbite, high velocity missile injuries, devitalized tissue,
denervated or ischemic tissue, or direct contamination with
dirt or feces.13

Great care should be exercised during resuscitation efforts
to protect against transmission of blood-borne diseases to the
health care staff. Epidemiological studies have identified be-
tween 1% and 16% of trauma patients are infected with the
human immunodeficiency virus (HIV) at time of presenta-
tion.14,15 The incidence increases with the percentage of pen-
etrating trauma within the case mix. The prevalence and risk
of hepatitis B is even greater.

During the secondary survey, injuries are catalogued and
potentially life-threatening or disabling injuries are identified.
A treatment plan and priorities are set. A basic principle of
trauma resuscitation is the need for continual reevaluation
and reassessment. Some authors have published their experi-
ence with regard to a tertiary survey, which can identify a missed
injury rate as high as 5% to 10%.16 Finally, the leader of the
resuscitation team must also be able to accurately assess his
or her facility’s ability to render definitive care and arrange for
transfer to a tertiary facility or trauma center if warranted.
Transfer to a higher level of care must be accomplished through
physician-to-physician communication in a timely fashion and
can be facilitated by preexisting transfer agreements.

### Current Controversies

Not all trauma management decisions fit neatly into this par-
digm, however. Within the Emergency Medical Services (EMS)
community, the debate over “scoop and run” versus “stay and
play” attempts at stabilization in the field continues.17