ATLS

Advanced Trauma Life Support Course

American College of Surgeons

Advanced Trauma Life Support Course forPhysicians

This program is dedicated to the care of all victims of trauma.
The Role of the Committee on Trauma of the American College of Surgeons

The American College of Surgeons (ACS), founded to improve the care of the surgical patient, has long been a leader in establishing and maintaining the high quality of surgical practice in North America. In accordance with that role, and recognizing that trauma is a surgical disease, the ACS Committee on Trauma has worked to establish standards for the care of the trauma patient.

Accordingly, the Committee sponsors and contributes to the continued development of the Advanced Trauma Life Support (ATLS) Course for Physicians. The ATLS course does not present new concepts in the field of trauma care. It does, however, teach well-established treatment methods and approaches trauma care in a systematized manner, present to the physician a concise method of establishing assessment and management priorities in the care of the trauma patient.

Revision of the ATLS course content material is conducted every four years by the Subcommittee on ATLS of the ACS Committee on Trauma. Thus the material represents a standard and timely approach to the early care of the trauma patient. By introducing this course and maintaining its high quality, the Committee hopes to provide another instrument by which to reduce the mortality and morbidity related to trauma. The Committee on Trauma recommends that physicians participating in the ATLS Student Course retake the entire course every four years, in order to maintain both their current status in the ATLS program, and their knowledge of state-of-the-art trauma care.

American College of Surgeons Committee on Trauma

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Notice

This edition has been prepared for the Committee on Trauma of the American College of Surgeons by members of the Subcommittee on ATLS, other individual Fellows of the College, and nonsurgical consultants to the Subcommittee who were selected for their special competence in the first hour of trauma care, and for their expertise in medical education. The College believes that those having the responsibility for such patients will find the information valuable. It must be recognized that injured patients present a wide range of complex problems. Accordingly, the authors have presented a concise approach to assessing and managing the multiply injured patient in the first hour. The course presents the physician with knowledge and techniques that are comprehensive and easily adapted to fit his needs. The skills presented in this manual recommend one way to perform each technique. The American College of Surgeons recognizes that there are other acceptable approaches.
Statement on AIDS

The Committee on Trauma of the American College of Surgeons urges all physicians who care for trauma patients to be knowledgeable of the Acquired Immune Deficiency Syndrome (AIDS), take precautionary measures when caring for potential AIDS patients, and be instrumental in establishing or following recommended institutional guidelines. Although a number of documents are available on this subject, information changes with some frequency as more data become available. The Committee on Trauma recommends contacting the Center for Disease Control for the latest information and guidelines.
ATLS Core Course Content

Course Overview, Concept, and History

Trauma is the leading cause of death in the first four decades of life in the United States, surpassed only by cancer and atherosclerosis as the cause of death in all age groups. The number of disabling injuries and trauma-related deaths occurring each year is staggering; the cost of human suffering and life, incalculable.

In the 1- to 34-year age group, trauma accounts for more deaths in the United States than all other diseases combined. Fifty million injuries occur annually, ten million of which are disabling. For every death from trauma, there are two permanent disabilities. Annually, over 80,000 people sustain permanently disabling injuries of the brain or spinal cord. The incidence of major trauma is 1.000 per million American population annually. Twelve percent of all hospital beds are occupied by trauma patients. More than 140,000 deaths occur annually from injuries. However, unlike mortality from many serious diseases in the United States, the mortality from injuries is increasing each year. The costs for trauma care in the United States are staggering. Injuries account for one of the most expensive health problems, costing $75 billion to $100 billion annually, directly and indirectly. However, injury research receives less than two cents out of every federal dollar expended for research on health problems.

Trauma, without respect for age, swift in onset and slow in recovery, presents many pitfalls for the responsible physician caring for the trauma patient. Trauma is merciless in its lethal and mangling pathways through our young and potentially productive members of society. Prevention is the best care, but when prevention fails, the physician must be sufficiently knowledgeable to meet the injured patient's needs and reduce the mortality and morbidity of trauma.

Death from trauma has a trimodal distribution. The first peak of death is within seconds to minutes of injury. Deaths occurring during this period are usually due to lacerations of the brain, brain stem, high spinal cord, heart, aorta, or other large vessels. Only a few of these patients can be salvaged and then only in large urban areas where rapid emergency transport is available. The second death peak occurs within minutes to a few hours after injury. Some have referred to this period as the golden hour for the critically injured. The primary focus of the Advanced Trauma Life Support Course is on this first hour of trauma management, when rapid assessment and resuscitation can be carried out to reduce this second peak of trauma deaths. Deaths occurring during this period are usually due to subdural and epidural hematomas, hemopneumothorax, ruptured spleen, lacerations of the liver, pelvic fractures, or multiple injuries associated with significant blood loss. The fundamental principles of trauma care learned in this course can be best applied to these patients. The third death peak occurs several days or weeks after the initial injury, and is almost always due to sepsis and organ failure. Therefore, the first person to assess the patient can affect the final outcome.

As with most critical illnesses, the quality of the initial assessment and management of the severely injured patient influences the final outcome. Trauma cuts across the entire field of medicine, requiring the physician to have a broad knowledge base of treatment
principles and an appreciation for multiple varieties of injury. An organized, consistent approach to the trauma patient affords an optimal outcome.

Properly trained ambulance personnel and adequately equipped vehicles result only from the efforts of physicians who demand to receive their patients in the best possible conditions. Standing orders and established protocols for trauma patients that allow properly trained and certified personnel to initiate life-saving procedures are a necessity in the absence of a physician.

Before 1980 the delivery of trauma care by physicians in the United States was inconsistent; national standards for trauma care were nonexistent; and a standardized, national trauma program to train physicians how to care for the trauma patient in the first hour did not exist. In February 1976, a tragic accident occurred which ultimately resulted in conceptualization of the Advanced Trauma Life Support Course. A Nebraskan surgeon, piloting his small fixed-wing plane to Lincoln, crashed in a wooded area. The surgeon sustained serious injuries; three of his children, critical injuries; and one child, minor injuries. His wife was killed instantly. Reportedly, the initial care received by the father and his children was tragically inadequate and far below today's minimum standards of trauma care. As a result of this tragedy and recognizing the need for improved trauma care in the small community hospital, the surgeon approached the staff at the Lincoln Medical Education Foundation (LMEF) and Southeast Nebraska Emergency Medical Services with an educational concept. In his words: "When I can provide better care in the field with limited resources that what my children and I received at the primary care facility - there is something wrong with the system and the system has to be changed."

Other private-practice surgeons and physicians in Nebraska agreed and supported his concept. They identified the need for training in advanced trauma life support using a combined educational format of lecture presentation and associated skill demonstration and practicum. In response to his expressed need, the LMEF Physician's Committee on Trauma developed a prototype Advanced Trauma Life Support (ATLS) Course for physicians. The first ATLS Course was field-tested in conjunction with Southeast Nebraska Emergency Medical Services in 1978.

Based on the original concept, this course is primarily targeted at the physician who does not deal with major trauma on a day-to-day basis, who must evaluate and manage the seriously injured patient during the period immediately after injury. However, over the ensuing years since its inception, the course content is now recognized and accepted as beneficial to all physicians caring for the trauma patient.

Based on well-established objectives of trauma management, this course is intended to provide the physician with one acceptable method of immediate management, and the basic knowledge and skills necessary to:
1. Assess the patient's condition rapidly and accurately.
2. Resuscitate and stabilize the patient on a priority basis.
3. Determine if a patient's needs will likely exceed a facility's capabilities.
4. Arrange for the patient's interhospital transfer.
5. Assure that optimum care is provided each step of the way.

The Advanced Trauma Life Support Course emphasizes the first hour of initial assessment and primary management of the trauma patient, starting at the point and time of injury and continuing through initial assessment; life-saving intervention; re-evaluation; stabilization; and where needed, transfer to another health care facility. The course will consist of pre- and postcourse tests, lectures, case presentations, discussions, and development of life-saving manipulative skills, practical laboratory experience, and a performance proficiency evaluation. Upon completion of this course the physician should feel confident in implementing the basic trauma skill taught in the ATLS Course.

The Committee on Trauma of the American College of Surgeons gratefully acknowledges these organizations for their time and efforts in developing and field testing the Advanced Trauma Life Support concept: The Lincoln Medical Education Foundation, Southeast Nebraska Emergency Medical Services, The University of Nebraska College of Medicine, and the Nebraska State Committee on Trauma of the American College of Surgeons. The Committee on Trauma has borrowed extensively from their experience and material. We are indebted to those Nebraska physicians who encouraged the development of this course, and to those Lincoln Area Mobile Heart Team nurses who shared their time and ideas to help build the ATLS Course.

The Committee on Trauma of the American College of Surgeons hopes that through the application of the skills taught in the Advanced Trauma Life Support Course, a significant reduction in trauma morbidity and subsequent mortality will be accomplished. The establishment of a minimum standard of care in the early assessment and management of the trauma patient most assuredly will bring this about. Through the dedicated efforts of health care professionals, this worthy goal can be achieved.

**General Course Objectives**

The purpose of this course is to orient physicians to the initial assessment and management of the trauma victim. In general, the content and skills presented in the materials are designed to assist physicians in providing the **first hour** of emergency care for the trauma patient. Therefore, this course represents the minimum information necessary to manage the trauma patient in the first hour.

Upon completion of the Advanced Trauma Life Support Course, the physician participant will be able to:

A. Demonstrate concepts and principles of primary and secondary patient assessment.
B. Establish management priorities in a trauma situation.
C. Initiate primary and secondary management necessary within the first hour of emergency care for acute life-threatening emergencies.
D. Demonstrate, in a given simulated clinical and surgical skill practicum, the following skills used in the initial assessment and management of patients with multiple injuries:

1. Primary and secondary assessment of a moulage victim with multiple injuries.
2. Orotracheal and nasotracheal intubation on adult and infant manikins.
3. Cricothyroidotomy.
4. Initiation of central intravenous lifelines with central venous pressure monitoring.
5. Administration of intravenous fluid therapy in conjunction with different types of shock.
6. Venous cutdown.
7. Application, inflation, deflation, and removal of a pneumatic antishock garment.
8. Pleural decompression via needle thoracocentesis and chest tube insertion.
12. Cervical spine and long spine immobilization and stabilization prior to patient transfer.
Chapter 1: Initial Assessment and Management

Objectives:

Upon completion of this topic, the physician will be able to demonstrate an ability to apply the principles of emergency medical care to the multiply injured patient. Specifically, the physician will be able to:

A. Identify the correct sequence of priorities of emergency medical care to be followed in assessing the multiply injured patient.
B. Outline the primary and secondary evaluation surveys to be used in assessing the multiply injured patient.
C. Identify and discuss the key components of and rationale for obtaining the patient's history and the history of the trauma incident.
D. Explain guidelines and techniques to be used in the initial resuscitative and definitive-care phases of treatment of the multiply injured patient.
E. Conduct an initial assessment and management survey on a simulated multiply injured patient, using the correct sequence of priorities and explaining management techniques for primary treatment and stabilization.

I. Introduction

The prioritized assessment and management procedures reviewed in this chapter are identified as sequential steps in order of their importance for purpose of clarity. However, these steps are frequently accomplished simultaneously. For example, while conducting a rapid assessment of the patient's respiratory, circulatory, and neurologic status, the patient's history and events related to the injury must also be obtained.

The written description of these steps does not allow for this simultaneous integration, and artificially separates these integrated activities. Although each step is important, some require immediate attention as life-threatening injuries are identified. For example, the patient's response to the question "What happened?" can provide information about his airway, breathing, and neurologic status. Simultaneously, the examiner can assess the patient's pulse, skin color, and capillary refill time. As a result of assessing and managing the patient in this manner, important information concerning the patient's status has been obtained simultaneously in the first 30 seconds of patient contact.

The importance of obtaining the patient's history and history of injury are emphasized in this chapter. Halsted's philosophy relates that obtaining patient and event histories represents 90% of the diagnostic evaluation. This philosophical approach is used when evaluating and managing the trauma patient. If complete histories are not obtained, major injuries may be missed or pre-existing medical factors that may compromise the patient's outcome or prolong the hospital stay may be overlooked. The physician must understand the kinematics of trauma and integrate this knowledge with the trauma-producing episode. Prehospital personnel are the primary source of this important component of the patient's history.
II. Establishing Assessment and Management Priorities

Patients are assessed and treatment priorities established based on their injuries and the stability of their vital signs, and on the mechanism of the traumatic incident. In an emergency involving a critical injury, logical sequential treatment priorities must be established based on the overall patient assessment. The patient's vital functions must be assessed quickly and efficiently. Patient management must consist of a rapid primary evaluation, resuscitation of vital functions, a more detailed secondary assessment, and finally, the initiation of definitive care.

A. Primary Survey: ABCs

During the primary survey, life-threatening conditions are identified and management is begun simultaneously.

1. A - Airway maintenance with cervical spine control.
2. B - Breathing and ventilation.
3. C - Circulation with hemorrhage control.
5. E - Exposure: Completely undress the patient.

B. Resuscitation Phase

Shock management is initiated, management of patient oxygenation is reassessed, and hemorrhage control is re-evaluated. The life-threatening conditions identified in the primary survey are constantly reassessed, as management is continued. Tissue aerobic metabolism is assured by perfusion of all tissue with well-oxygenated red blood cells. Replacement of lost vascular volume with warmed crystalloid fluids and blood is begun, as are other modalities of shock therapy. A urinary catheter and nasogastric tube may also be inserted during this phase, if their use is not contraindicated.

C. Secondary Survey

The secondary survey does not begin until the primary survey (ABCs) has been completed and the resuscitation phase (management of other life-threatening conditions) has begun.

The secondary survey is a head-to-toe evaluation of the trauma patient, which includes vital sign assessment - blood pressure, pulse, respirations, and temperature. This in-depth evaluation employs the look, listen, and feel techniques, evaluating the body by regions. Each region (head, neck, chest, abdomen, extremities, and neurologic) is examined individually. The stethoscope is used over each body cavity and major vessel area. The hands palpate for bony defects and other abnormalities. A neurologic examination, including the Glasgow Coma Scale, completes the secondary assessment. Chest and cervical spine roentgenograms are obtained early as soon as practical. These films take precedence over subsequent roentgenographic evaluation.
Special procedures required for patient assessment, such as peritoneal lavage, radiologic evaluation, and laboratory studies, are also conducted in this phase. Assessment of the eyes, ears, nose, mouth, rectum, and pelvis should not be neglected. This examination can be easily described as "tubes and fingers in every orifice."

**D. Definitive-Care Phase**

In the definitive-care phase, all the patient's injuries are managed. This phase includes comprehensive management, fracture stabilization, and any necessary operative intervention, as well as stabilization of the patient in preparation for appropriate transfer to a facility that can provide a higher level of medical care.

The omission of any of these steps during assessment or treatment of the injured patient can result in unnecessary disability or death. Primarily because prehospital care personnel have improved their knowledge and skills, many of these problems will have been addressed before the patient arrives in the emergency department. Observations may by prehospital personnel concerning the patient and mechanism of injury must be considered while reassessing the patient's condition in the emergency department. Changes in the patient's vital signs, respiratory and circulatory status, and neurologic functions can be expected.

When triage requires identification of patients who must be transported to a trauma center, the **Interhospital Triage Criteria** is a useful reference. (See Chapter 12 - Stabilization and Transport.)

**E. Pediatric Priorities**

Priorities for the care of the pediatric patient are basically the same as for adults. Although the quantities of blood and fluids, the size of the child, degree of heat loss, and injury patterns may differ, assessment and priorities are the same. Specific problems of the pediatric trauma patient are addressed in Chapter 10. The Pediatric Trauma Score is helpful in identifying those severely injured patients who should be transported to a trauma center. (See Appendix B - Pediatric Triage and Injury Scoring.)

**F. Triage**

Triage is a sorting of patients based on need for treatment. A group of injured patients can be satisfactorily evaluated and resuscitation begun with the help of nurses and EMT personnel (when available). Treatment is rendered based on the ABC priorities (Airway with cervical spine control, Breathing, and Circulation with hemorrhage control) as previously outlined.

Two types of triage situations usually exist:

1. The number of patients and the severity of their injuries do **not** exceed the ability of the facility to render care. In this situation, patients with life-threatening problems and those sustaining multiple-system injuries are treated first.
2. The number of patients and the severity of their injuries exceed the capability of the facility and staff. In this situation, those patients with the greatest chance of survival, with the least expenditure of time, equipment, supplies, and personnel, are managed first.

III. Priority Plan - Treatment and Management

A. Primary Survey

1. Airway and cervical spine

   The upper airway should be assessed to ascertain patency. Initial attempts to establish a patent airway include the chin lift or jaw thrust maneuver, or removal of foreign debris. Specific attention should be given to the possibility of cervical spine fractures. Excessive movement of the cervical spine can convert a fracture without neurological damage into a fracture-dislocation with neurologic injury. Therefore, the patient's head and neck should not be hyperextended or hyperflexed to establish or maintain an airway.

   **Remember:** Assume a cervical spine fracture in any patient with multisystem trauma, especially with a blunt injury above the clavicle. Based on the history of the trauma incident, the loss of integrity of the cervical spine should be suspected. Neurological examination alone does not rule out a cervical spine injury. The integrity of the bony components of the cervical spine can be initially assessed by visualizing all seven cervical vertebrae, including the C-7 to T-1 interspace, on a crosstable lateral cervical spine roentgenogram or a swimmer's view. However, the lateral cervical spine radiograph does not rule out all cervical spine injuries. Based on clinical judgment, immobilization procedures should be maintained until serial roentgenograms of the cervical spine and neurosurgical or orthopedic consultation are obtained.

2. Breathing

   The patient's chest should be exposed to adequately assess ventilatory exchange. Airway patency does not assure adequate ventilation. Adequate air exchange is necessary, in addition to an open airway, for sufficient oxygenation. Until the patient is stable, ventilation should be accomplished with a bag-valve device connected to a mask or endotracheal tube. If the bag-valve mask device is used, the two-man technique should be employed. (See Chapter 2 - Airway Management and Ventilation.) Adequate oxygenation and ventilation of the trauma patient must include the delivery of adequate volume and inspired concentrations of oxygen (eg, FIO₂ greater than 0.85). **This cannot be accomplished with nasal prongs or a simple face mask.** Three traumatic conditions that most often compromise ventilation are: tension pneumothorax, open pneumothorax, and large flail chest with pulmonary contusion. A respiratory rate of greater than 20/minute should alert the examiner to the possibility of respiratory compromise.
3. Circulation

a. Blood volume and cardiac output

Among the causes of early postinjury deaths in the hospital that are amenable to effective treatment, hemorrhage is predominant. Hypotension following injury must be assumed to be hypovolemic in origin until proved otherwise. Rapid and accurate assessment of the injured patient's hemodynamic status is therefore essential. Three elements of observation yield key information within seconds. They are state of consciousness, skin color, and pulse.

1) State of consciousness

When blood volume is reduced by half or more, cerebral perfusion is critically impaired, and unconsciousness results. Conversely, a conscious patient can be presumed to have at least enough blood volume to maintain cerebral perfusion.

2) Skin color

A patient with pink skin, especially in the face and extremities, is rarely critically hypovolemic following injury. Conversely, the ashen, gray skin of the face and the white skin of blood-drained extremities are ominous signs of hypovolemia. These latter signs usually indicate a blood volume loss of at least 30 percent if hypovolemia is the cause.

3) Pulse

Full, slow, regular peripheral pulses are welcome signs in the injured patient. The physician will usually check an easily accessible central pulse initially, and femoral or carotid pulses signify coordinated cardiac action and at least 50 percent of residual blood volume. Rapid, thready pulses are early signs of hypovolemia, but may have other causes as well. An irregular pulse is usually a warning of cardiac impairment. Absent central pulses at more than one site, without local injuries or other factors which preclude accurate palpation of pulses, signify the need for immediate resuscitative action to restore depleted blood volume, effective cardiac output, or both, within seconds or minutes, if death is to be avoided.

b. Bleeding

External, exsanguinating hemorrhage should be identified and controlled in the primary survey. Rapid blood loss is managed by direct pressure on the wound. Pneumatic splints may also help control hemorrhage. The of hemostats is extremely time-consuming and dangerous. Tourniquets ordinarily should not be used because they can produce anaerobic metabolism as well as increased blood loss if incorrectly applied. Occult hemorrhage into the thoracic or abdominal cavities, into the muscle body surrounding a fracture, or as a result of penetrating injury, can account for a major blood loss. Abdominal or lower-extremity hemorrhage can be controlled or reduced significantly with the application and inflation of the pneumatic antishock garment.
4. Brief neurologic evaluation (disability)

A rapid neurologic evaluation is performed at the end of the primary survey. This neurologic evaluation establishes the patient's level of consciousness and pupillary size and reaction.

The AVPU method describes the patient's level of consciousness.

- **A** - Alert
- **V** - Responds to Vocal stimuli
- **P** - Responds to Painful stimuli
- **U** - Unresponsive.

A more detailed quantitative neurologic examination, ie, the Glasgow Coma Scale, should be included in the secondary survey. Changes in the patient's neurologic condition may indicate intracranial pathology or decreased oxygenation of the central nervous system.

A decrease in the level of consciousness may indicate decreased cerebral oxygenation and/or perfusion. Such a change indicates a need for immediate re-evaluation of the patient's oxygenation, ventilation, and perfusion status.

5. Exposure

The patient should be completely undressed to facilitate thorough examination and assessment.

B. Resuscitation

1. Supplemental oxygen therapy is instituted for all trauma patients, preferably via a mask/reservoir device, to achieve an FIO\(_2\) of greater than 0.85.

2. A minimum of **two large-caliber intravenous catheters** (IVs) (#16-gauge or larger) should be established. When initiating the intravenous lines, blood should be drawn for type and crossmatch, and for baseline hematologic and chemical studies.

Vigorous intravenous fluid therapy should be initiated with a balanced salt solution. The maximum rate of fluid administration is determined by the internal diameter of the catheter and inversely by its length, not by the vein in which the catheter is placed. Initiation of peripheral intravenous lines and/or cutdowns is safer and less complicated than central lines.

The shocklike state associated with trauma is most often hypovolemic in nature. After two to three liters of balanced salt solution have been administered, type-specific blood may be used as necessary while blood is being prepared. If type-specific blood is not available, consideration should be given to the use of low-titer type-O blood. For life-threatening blood loss, the use of unmatched, type-specific blood is preferred over type-O blood. Whole blood should be used when available. Hypovolemic shock is not treated by vasopressors, steroids, or sodium bicarbonate.
3. Adequate resuscitation is best assessed by the quantitative improvement of physiologic parameters, ie, ventilatory rate, pulse, blood pressure, pulse pressure, arterial blood gases (ABGs), and urinary output, rather than the qualitative assessment that is done in the primary survey. Actual values should be obtained as soon as practical after completing the primary survey.

4. Careful electrocardiographic (ECG) monitoring of all trauma patients is required. Dysrhythmias, including unexplained tachycardia, atrial fibrillation, premature ventricular contractions, and ST segment changes, may indicate cardiac contusion. Electromechanical dissociation (EMD) may indicate cardiac tamponade, tension pneumothorax, and/or profound hypovolemia. When bradycardia, aberrant conduction, and premature beats are present, hypoxia and hypoperfusion should be suspected immediately. Hypothermia will also produce these dysrhythmias.

5. The placement of urinary and gastric catheters should now be considered. Urethral transection and cribriform plate fractures, respectively, contraindicate insertion.

For male victims of blunt trauma resulting in suspected urethral transection, insertion of a urinary catheter **should not be attempted** before an examination of the rectum and genitalia has been performed. Urinary catheter insertion, without a preceding urethrogram, is usually contraindicated if there is 1) blood at the meatus, 2) blood in the scrotum, and 3) the prostate cannot be palpated or is high-riding.

If the cribriform plate is fractured, the nasogastric tube may be inserted unintentionally into the intracranial cavity. Therefore, in cases of blunt head trauma, nonclotting blood from the ears, nose, or mouth should be evaluated using the "halo" or "double-ring" test before insertion of the nasogastric tube. (See Chapter 6 - Head Trauma.)

**Remember:** Airway maintenance, cardiopulmonary resuscitation, and other life-saving modalities for patient care should be initiated when the problem is identified, rather than after the primary survey. After the primary survey and resuscitation phase, the evaluating physician frequently has enough information to indicate the need to transfer the patient to another facility. This transfer process should be initiated immediately by administrative personnel, while additional patient care and evaluation are being managed by the examining physician. The receiving physician should be contacted, and the appropriate mode of transportation identified and mobilized with the proper personnel and equipment.

C. Secondary Survey

1. Head

The secondary survey begins with evaluation of the head and identification of all related and significant injuries. The eyes should be re-evaluated for pupillary size, fundi for hemorrhages, lens for dislocation, conjunctive for hemorrhages and any penetrating injuries. In addition, assess for the presence of contact lenses and remove them before edema occurs. Do a quick visual confrontation examination of both eyes by having the patient read either a Snellen Chart or words on the side of an intravenous container. This procedure frequently identifies optic injuries not otherwise apparent. (See Appendix A - Ocular Trauma.)
2. Maxillofacial trauma

Maxillofacial trauma not associated with airway obstruction should be treated only after the patient is completely stabilized and is not suffering from any other major life-threatening injuries. Adequate treatment can be initiated within seven to ten days of the injury, although earlier treatment may be instituted as the patient's condition permits.

Patients with midfacial fractures may have a fracture of the cribriform plate. For these patients, gastric intubation should be performed via the oral route or through a soft nasopharyngeal airway, rather than nasally.

3. Cervical spine/neck

All patients with maxillofacial trauma produced by blunt injury should be presumed to have a cervical spine fracture, and the neck should be protected until injury is ruled out. Examination of the neck includes both visual inspection and palpation. The absence of neurological deficit or pain does not rule out injury to the cervical spine. Such an injury should be presumed present until ruled out by adequate roentgenographic examination.

Patients wearing any type of sports helmet should have their head and neck held in a neutral position while the helmet is removed. During this two-person procedure, incline manual immobilization is applied from below, and the helmet is expanded laterally. Inline manual immobilization is then re-established from above, and the patient is adequately immobilized.

In penetrating trauma, wounds that extend through the platysma should not be manually explored in the emergency department. This type of injury requires surgical evaluation. Nonoperative measures performed by a surgeon include observation, arteriography, bronchoscopy, esophagoscopy, and esophagography.

4. Chest

Visual evaluation of the chest, both anterior and posterior, will identify sucking chest injuries and perhaps a large flail segment. A complete evaluation of the chest wall requires palpation of the entire chest cage, feeling each rib and the clavicles individually. Blunt sternal pressure may be painful if any attached ribs are fractured. Contusions and hematomas of the chest wall should alert the physician to the possibility of more occult injury.

Evaluation of the internal structures is done with the stethoscope, followed by a roentgenogram of the chest. Breath sounds are auscultated high on the anterior chest for pneumothorax and at the posterior bases for hemothorax. Auscultatory findings may be difficult to evaluate in the noisy emergency department. Distant heart sounds and distended neck veins may indicate cardiac tamponade. However, neck veins may be not distended because of associated hypovolemia. A narrow pulse pressure may be the only reliable indication of cardiac tamponade. Of the five major signs, decreased breath sounds may be the only indication of a tension pneumothorax and the need to initiate chest decompression.
5. Abdomen

Any abdominal injury is potentially dangerous and must be diagnosed and treated aggressively. The specific diagnosis is not as important as the fact that an abdominal injury exists, and surgical intervention may be needed. Initial examination of the abdomen may not be representative of the patient’s condition one to several hours later. Close observation and frequent re-evaluation of the abdomen is important in management of blunt abdominal trauma. A change in the patient’s overall condition or progression of abdominal pathology may alter these findings over time.

When intra-abdominal hemorrhage is suspected, particularly when associated with shock, properly applied pneumatic antishock trousers may slow continued blood loss. Once initiated, this indirect pressure on the hemorrhage site can be beneficial while the patient is en route to the operating room or to a referral hospital. The pneumatic antishock garment is not designed to supplant volume resuscitation. (See Chapter 3 - Shock.)

Patients with neurological injury, impaired sensorium secondary to alcohol or drugs, or equivocal abdominal findings should be considered candidates for peritoneal lavage. Fractures of the pelvis or the lower rib cage may also hinder adequate diagnostic examination of the abdomen.

6. Rectum

A rectal examination is an essential part of the secondary survey. Specifically, the physician should assess for the presence of blood within the bowel lumen, a high-riding prostate, the presence of pelvic fractures, the integrity of the rectal wall, and the quality of the sphincter tone.

7. Fractures

Extremities should be visually evaluated for contusions or deformity. Palpation of the bones with rotational or three-point pressure, checking for tenderness, crepitation, or abnormal movements along the shaft, helps identify fractures where alignment has been maintained. Anterior to posterior pressure with the heels of the hands on both anterior superior iliac spines and the symphysis pubis can identify pelvic fractures. In addition, all peripheral pulses should be assessed and their presence or absence documented, along with neurologic findings.

Thoracic and lumbar spinal fractures must be considered based on physical findings and mechanism(s) of injury. Other injuries may mask the physical findings of spinal injuries, which may go unsuspected unless the physician obtains appropriate roentgenograms.

8. Neurologic

A comprehensive neurological examination includes not only motor and sensory evaluation of the extremities, but also re-evaluation of the patient’s level of consciousness and pupils. A numerical evaluation such as the Glasgow Coma Scale facilitates detection of early changes.
Any evidence of paralysis or paresis suggests major injury to the spinal column or peripheral nervous system. Immobilization of the entire patient, using short or long spine boards and semirigid cervical collar, must be established first. Patient transport to a definitive-care facility requires the same type of adequate immobilization.

A neurosurgeon should treat acute epidural or subdural hematomas, depressed skull fractures, and other intracranial injuries. Changes in intracranial status may be associated with alterations in the level of consciousness. If a patient with a head injury deteriorates neurologically, management and treatment priorities may change. Oxygenation and perfusion of the brain and the adequacy of ventilation should be reassessed. If these parameters are unchanged, intracranial surgical intervention may be indicated. In a community where a neurosurgeon is not available, patients with signs and symptoms of neurologic deterioration should be considered for immediate transfer. A telephone consultation is recommended.

D. Definitive Care

The interhospital triage criteria helps determine the level, pace, and intensity of initial management of the multiply injured patient. It takes into account the patient's physiologic status, obvious anatomic injury, mechanism of injury, concurrent diseases, and factors that may alter the patient's prognosis. Emergency department and surgical personnel should use these criteria to determine if the patient requires transfer to a facility capable of providing more specialized care. (See Chapter 12 - Stabilization and Transport.)

IV. Re-evaluate the Patient

The trauma patient should be re-evaluated continuously so that any new signs and symptoms are not overlooked. As initial life-threatening injuries are managed, other equally life-threatening problems may become apparent, and less severe injuries or underlying medical problems may become evident. A high index of suspicion and constant alertness facilitate early diagnosis and management.

Continuous monitoring of vital signs and urinary output is essential. For the adult patient, maintenance of a urinary output of 50 mL/hour is desirable. In the pediatric patient over one year of age, an output of 1 mL/kg/hour should be adequate. Arterial blood gas and central cardiac monitoring devices should be employed for all critical patients.

V. History

A. Patient

The patient's pertinent past history must be assessed; the "AMPLE" history is a useful mnemonic.

A - Allergies
M - Medications currently taken
P - Past Illnesses
L - Last meal
E - Events/environments related to the injury.
B. Mechanism of Injury

A history of the injury or examination of the injury-producing mechanism is very helpful in identifying specific types of injuries. Injury types can be classified according to the direction and amount of energy force. The energy wave extends away from the point of impact in blunt trauma, and laterally from the missile pathway in penetrating trauma.

It is important to recognize that a temporary cavity forms as a result of both types of energy transmission. The examiner must realize that because of the extreme elasticity of the body tissues, the extent of such trauma is not visualized when the patient is first seen in the emergency department. Intrusion into the body cavity occurs even in blunt trauma.

1. Blunt trauma

The severity of injury varies according to the amount of energy transferred from an object to the human body. The automobile accounts for a major portion of severe blunt trauma, and is exemplified in this chapter. However, the physician must also understand the injuries associated with falls, and motorcycle and bicycle trauma.

The direction of impact determines the pattern of injuries. Prehospital personnel should describe the appearance of the vehicle and the damage sustained to the passenger compartment. The occupant usually is injured in the same projection of the car. Because the body's elastic tissue rebounds to its original position, and the metal of the car does not, the deformation of the car can be used to gauge the damage to the patient. Restraining devices, such as seat belts, significantly reduce or prevent many types of injuries. Body cavity injuries are produced by compression and deceleration.

With this information, the physician can judge what portion of the body absorbed the greatest transfer of energy, and what injury patterns are likely in the affected cavities.

a. A frontal impact with a bent steering wheel, knee imprint on the dashboard, and bull's-eye fracture of the windshield should alert the examining physician to the potential for cervical spine injuries, central flail chest, myocardial contusion, pneumothorax, fractured spleen or liver, and posterior fracture-dislocation of the hip.

b. A side impact may cause contralateral neck sprain or cervical fracture, lateral flail chest, pneumothorax, acceleration injury to the aorta, fractured spleen or liver (depending upon the side of impact), and fractured pelvis or acetabulum.

c. Rear-impact collisions can result in neck injuries (ie, cervical strain). Usually there is a frontal-impact component as well because the occupant is projected into the steering wheel.

d. Ejection from a vehicle can result in multiple injuries, including a cervical spine fracture, depending on which part of the body impacted first. The risk of injury increases by 300% when the occupant is ejected from the vehicle.
2. Penetrating trauma

Two factors determine the type of injury and subsequent management.

a. The **region** of the body sustaining the injury determines the potential for specific organ injury.

b. The **transfer** of energy determine the injury itself. The **velocity** of the missile and its mass further determines the amount of energy dissipated. The **distance** from the source is important to identify the amount of energy dissipated before impact with the patient. Energy transfer is determined by the **rate or change in speed**, or energy loss while the missile is inside the patient's body.

The frontal impact areas of the missile determines the number of tissue particles impacted, which in turn (along with the tissue density and elasticity) determines the rate of energy exchange. Tumble, fragmentation, and deformation modify the frontal impact area and change the amount and rate of exchange of energy from the missile to the body.

The amount of energy itself is determined by this formula:

\[ KE = \frac{1}{2} MV^2 \]

where:
- KE = Kinetic energy
- M = Mass
- V = Velocity.

For most penetrating injuries, the speed of the missile is the most important factor in determining energy.

3. Burns

Burns are significant because of the thermal injury to the skin, as well as smoke inhalation and heat injury to the lungs, carbon monoxide inhalation, and effects of any chemical involved. Thermal injuries may also be associated with blunt trauma and fractures resulting from an explosion, falling debris, or the patient's attempt to escape the fire.

4. Hypothermia and cold injuries

Acute or chronic reduction of the temperature without adequate protection against heat loss produces either local or generalized hypothermic injuries. Loss of heat into the external environment may occur at moderate temperatures (15 to 20 degrees centigrade) when wet clothes, decreased activity, or vasodilatation caused by alcohol or drugs compromises the patient's ability to conserve heat.

Patients may also become hypothermic during resuscitation in the emergency department, with the rapid administration of room temperature fluids. Control of the patient's body temperature during the resuscitation phase is an important adjunct.
5. Hazardous environment

Chemicals, toxins, and radiation can produce a variety of cutaneous, pulmonary, cardiac, or internal organ derangement. These chemicals can present a hazard not only to patients but to health care providers as well. When such injuries occur, the physician must identify the specific substance involved and its potential for injury. Frequently, the physician's only means of preparation is to have knowledge of the general principles of management of such agents and immediate access to the Regional Poison Center.

VI. Disaster

Disasters frequently overwhelm local and regional resources. Plans for management of such conditions must be evaluated and rehearsed frequently to enhance the possibility of significant salvage of injured patients.

VII. Records and Legal Considerations

A. Records

Meticulous record-keeping is very important. Often more than one physician cares for the patient. Precise records are essential to evaluate the patient's needs and clinical status. Do not rely solely on memory.

Medico-legal problems arise frequently, and precise records are helpful for all concerned. Chronologic reporting with flow sheets helps both the attending physician and any other consulting physician to quickly assess changes in the patient's condition.

B. Consent for Treatment

Consent is sought before treatment for obvious reasons. In life-threatening emergencies, the necessary treatment should be given first and formal consent obtained later.

C. Forensic Evidence

If trauma due to criminal activity is suspected, the personnel caring for the patient must preserve the evidence. All items, such as bullets and clothing, must be saved for law enforcement personnel. Entrance and exit wounds should be identified and documented.

VIII. Summary

The injured patient must be evaluated rapidly and thoroughly. The physician must develop priorities for the patient. Treatment priorities must be considered in the overall management of the patient, so no steps in the process are omitted. An adequate patient history and accounting of the incidence is also important in evaluating and managing the trauma patient.

Evaluation and care are divided into four phases.
A. Primary Survey - Assessment of ABCs

1. Airway and cervical spine control.
2. Breathing.
3. Circulation with hemorrhage control.
4. Disability: Brief neurological evaluation.
5. Exposure: Completely undress the patient.

B. Resuscitation

1. Shock management - intravenous lines, Ringer's lactate.
2. The management of life-threatening problems identified in the primary survey is continued.
3. Electrocardiographic monitoring.

C. Secondary Survey - Total Evaluation of the Patient

1. Head and skull
2. Maxillofacial injuries
3. Neck
4. Chest
5. Abdomen
6. Perineum/rectum
7. Extremities - fractures
8. Complete neurological examination
9. Appropriate roentgenograms, laboratory tests, and special studies.
10. "Tubes and fingers" in every orifice.

D. Definitive Care

After identifying the patient's injuries, managing life-threatening problems, and obtaining special studies, definitive care begins. Definitive care, associated with the major trauma entities, is described in later chapters.

E. Transfer

If the patient's injuries exceed the institution's immediate treatment capabilities, the process of transferring the patient is initiated as soon as the need is identified. Delay in transferring the patient to a facility with a higher level of care may significantly increase the patient's risk of mortality.
Skill Station I: Initial Assessment

Equipment

1. Live patient model
2. Nurse assistant
3. Case scenarios with related roentgenograms
4. Blanket and sheet (or sufficient table padding for patient comfort)
5. Makeup and moulage
   a. Moulage piece: open femur fracture with blood adapter (optional)
   b. Makeup for bruises, abrasions, lacerations, and burns
   c. Artificial blood - various types
6. Items needed for each scenario:
   a. 4x4s, roller bandage, and tape
   b. Blood pressure cuff and stethoscope
   c. Penlite flashlight (optional)
   d. 1000 mL Ringer's lactate - two or three per patient
   e. Assorted intravenous catheters and needles, ie, #14-16-gauge over-the-needle catheter, #20-gauge Butterfly needle - two to four per patient
   f. Spine boards: long and short (optional)
   g. Semirigid cervical collar
   h. Oxygen masks
   i. Oral airway
   j. Leg traction splint; molded splints
   k. X-ray view box (optional)
   l. Laryngoscope blade, handle, and ET tube
   m. #5 tracheostomy tube for cricothyroidotomy
   n. #36-40 French chest tube and drainage collection device
   o. Scalpel handle
   p. Nasogastric tube
   q. Peritoneal lavage kit
   r. 12 mL and 50 mL syringes
   s. Indwelling urinary catheter and collection bag
   t. Bag-valve mask device and face mask (type that includes a one-way valve preventing back flow or air and secretions)
   u. Soft and rigid suction devices
   v. Portable electrocardiograph monitor (optional)
   w. Pneumatic antishock garment (optional).

Performance at this station will allow the participant to practice and demonstrate the following activities in a simulated clinical situation:

1. Using the four phases of patient assessment and management, verbalize to the instructor while systematically demonstrating the initial management required to stabilize each patient.

2. Using the primary survey assessment techniques, determine and demonstrate:
a. Airway patency and cervical spine control.
b. Breathing efficacy.
c. Circulatory status with hemorrhage control.
d. Disability: Neurological status.
e. Exposure: Undress the patient.

3. Establish resuscitation (management) priorities in the multiply injured patient based upon findings from the primary survey.

4. Integrate appropriate history-taking as an invaluable aid in the assessment of the patient situation.

5. Identify the injury-producing mechanism and discuss the injuries that may exist and/or may be anticipated as a result of the mechanism of injury.

6. Using secondary survey techniques, assess the patient from head to toe.

7. Given a series of roentgenograms,
   a. Diagnose fractures.
   b. Differentiate associated injuries.

8. Outline the definitive care and management necessary to stabilize each patient in preparation for possible transport to a definitive-care facility.
Skills Procedures

Initial Assessment and Management

The history of a multiply injured patient will be presented to the participant. The participant is to demonstrate patient assessment and give directions for primary treatment and stabilization. Minimal resuscitation equipment, roentgenograms, and an assistant are available to the participant to simulate management procedures. The instructor will provide answers to the participant's questions, and physical findings. The participant should complete the patient survey in the sequence given.

Note: An evaluation listing critical treatment decisions for each patient situation is included in Section IV of the ATLS Instructor Manual. These evaluation forms and accompanying instructions will facilitate the faculty's evaluation of each student's performance.

I. Primary Survey and Resuscitation

The student should indicate the patient is to be undressed.

A. Airway Patency with Cervical Spine Control

1. Assessment
   a. Chin lift or jaw thrust
   b. Clear the airway of foreign bodies
   c. Oropharyngeal airway
   d. Orotracheal or nasotracheal intubation
   e. Cricothyroidotomy
3. Maintain the cervical spine in a neutral position with manual immobilization as necessary when establishing an airway.

B. Breathing Control

1. Assessment
   a. Expose the chest.
   b. Determine the rate and depth of respirations.
   c. Inspect and palpate for unilateral and bilateral chest movement, and any signs of injury.
   d. Auscultate the chest bilaterally.
2. Management
   a. Administer high concentrations of oxygen.
   b. Alleviate tension pneumothorax.
   C. Seal open pneumothorax.
C. Circulatory and Hemorrhage Control

1. Assessment
   a. Pulse.
   1) Quality
   2) Rate
   3) Regularity
   b. Color of skin
   c. Capillary blanch test
   d. Identify exsanguinating hemorrhage
2. Management
   a. Initial two large-caliber intravenous catheters.
   b. Simultaneously obtain blood for hematologic and chemical analyses, type and crossmatch, and arterial blood gases.
   c. Initiate Ringer's lactate solution and blood.
   d. Apply the pneumatic antishock garment as indicated or necessary.
   e. Apply direct pressure to bleeding site.
   f. Apply the pneumatic antishock garment or pneumatic splints to control hemorrhage.
   g. Attach the patient to an electrocardiographic monitor.
   h. Insert urinary and nasogastric catheters unless contraindicated.

D. Disability - Brief Neurological Examination

1. Determine the level of consciousness using the AVPU method.
2. Assess the pupils for size, equality and reaction.

E. Exposure

Completely undress the patient.

II. Secondary Survey and Management

A. Head and Face

1. Assessment
   a. Inspection
   b. Palpation
   c. Re-evaluate pupils
   d. Cranial nerve function
2. Management
   a. Maintain airway
   b. Hemorrhage control

B. Neck

1. Assessment
   a. Inspection
   b. Palpation
C. Auscultation
d. Lateral, crosstable cervical spine roentgenogram.
2. Management
Maintain adequate inline immobilization of the cervical spine.

C. Chest

1. Assessment
   a. Inspection
   b. Auscultation
   c. Percussion
   d. Palpation
2. Management
   a. Pleural decompression
   b. Thoracocentesis
   c. Pericardiocentesis
d. Chest roentgenogram

D. Abdomen

1. Assessment
   a. Inspection
   b. Auscultation
   c. Percussion
   d. Palpation
2. Management
   a. Peritoneal lavage, if indicated
   b. Application of pneumatic antishock garment, if indicated

E. Perineal and Rectal Exam

Evaluate for:

1. Anal sphincter tone
2. Rectal blood
3. Bowel wall integrity
4. Prostate position
5. Blood at the urinary meatus
6. Scrotal hematoma

F. Back

Evaluate for:

1. Bony deformity
2. Evidence of penetrating or blunt trauma
G. Extremities

1. Assessment
   a. Inspection: Deformity, expanding hematoma
   b. Palpation: Tenderness, crepitation, abnormal movement
2. Management
   a. Appropriate splinting for fractures
   b. Use of pneumatic antishock garment
   c. Relief of pain
   d. Tetanus immunization

H. Neurologic

1. Assessment
   a. Sensorineural evaluation
   b. Paralysis
   c. Paresis
2. Management
   Adequate immobilization of entire patient.

IV. Stabilization and Transport

Outline rationale for patient transfer, transfer procedures, and patient's needs during transfer.