CHAPTER 37

Neck

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PRINCIPLES

Background

Trauma to the neck comprises a spectrum of injuries ranging from incidental to life threatening and can include airway occlusion, hemorrhagic shock, or acute neurologic/vascular injury. Airway compromise can rapidly ensue, challenging even the most experienced clinician. Stable-appearing patients may harbor insidious injuries associated with high morbidity and mortality if not recognized and treated in a timely manner.

Neck trauma is divided into three major mechanisms: blunt, penetrating, and strangulation/hanging. These mechanisms can be further categorized anatomically into injuries of the laryngotracheal, pharyngoesophageal, and vascular systems. Each has unique features and will be discussed separately.

Anatomy

The neck is a complex, closed anatomic area, dense with vital structures and invested with fascia, creating several compartments. Because of this, vascular injury with hemorrhage may be contained by fascial planes and neighboring structures, leading to occult, life-threatening anatomic distortion, making evaluation and airway management extremely difficult. Anatomically, the neck is divided into anterior and posterior triangles. The *anterior triangle* is densely packed with vital structures including neurovascular and aerodigestive tracts. It is bordered anteriorly by the midline, posteriorly by the sternocleidomastoid muscle, and superiorly by the lower edge of the mandible. The *posterior triangle* is bounded by the sternocleidomastoid muscle anteriorly, the clavicle inferiorly, and the anterior border of the trapezius muscle posteriorly. Excluding spinal trauma, injury to this region often has a more favorable prognosis because of the relative paucity of vital structures.

Historically, for evaluation of penetrating neck trauma, the neck has been divided into *Zones I, II,* and *III* (Fig. 37.1), and the location of an injury within one of these zones guided the management approach. It is useful to maintain an understanding of the neck zones for the purposes of communication with other providers. Many current algorithms use zone driven protocols for diagnostics and management. As technology has continued to improve, multi-detector computed tomography angiography (MDCTA) has become the gold standard for the initial screening of most symptomatic, stable penetrating neck injuries. Use of MDCTA has also demonstrated that penetrating neck injury can span multiple zones not evident from the surface wound, making the surface zone location less relevant, and allowing for more rapid and accurate nonsurgical evaluation than in the past.[1,2] Some practitioners and institutions have abandoned the zone system of nomenclature, but others have continued to use it. Either approach (traditional zone based or modern no-zone) have been shown to be safe and effective. The decision to use one system versus the other will be provider and institution specific, driven by clinical preference and consideration of available resources.[3] *Zone I* (base of neck) extends superiorly from the sternal notch and clavicles to the cricoid cartilage. It includes the thoracic outlet below the cricoid cartilage. Injury to this region can affect both neck and mediastinal structures. *Zone II* (midneck) is the area between the cricoid cartilage and the angle of the mandible. Zone II injuries are therapeutically distinct because they lie in the most exposed region of the neck, making them accessible to direct surgical intervention with access to both proximal and distal vascular control. *Zone III* (upper neck) extends from the angle of the mandible to the base of the skull. As with zone I injuries, proximal and distal vascular control in this region is difficult to achieve (Box 37.1).

Two fascial layers, the superficial fascia and the deep cervical fascia, cover neck structures. The superficial fascia covers the platysma muscle and is located just below the skin. The deep cervical fascia is divided into three parts: the *investing layer* surrounds the neck and splits to encase the sternocleidomastoid and trapezius muscles; the *pretracheal layer* adheres to the cricoid and thyroid cartilages and travels caudally deep to the sternum to insert on the anterior pericardium; and the *prevertebral layer* envelops the cervical prevertebral muscles and extends to form the axillary sheath, which covers the subclavian artery. The pretracheal fascia is clinically important because of its connection from the neck to the anterior mediastinum. Missed aerodigestive injuries can result in mediastinitis because of this anatomic continuity. The carotid sheath is made of portions from all three divisions of the deep cervical fascia. The *platysma muscle,* sandwiched between the superficial and deep cervical fascia, envelopes the anterolateral neck. If the platysma muscle is violated, injury to deep structures should be suspected, and platysmal violation is used to separate superficial, unimportant injuries from those warranting evaluation of the deep structures at risk.

Pathophysiology

Penetrating injuries are most often gunshot wounds (GSWs) or stab wounds (SWs). GSWs are further divided into high-velocity and low-velocity injuries. High-velocity missiles (military-style weapons and hunting rifles) easily penetrate soft tissue and bone. Their pathway is generally predictable, causing both direct injury along the path of travel and remote injury via blast effect. Blast or cavitation effect pertains to moderate or high velocity missiles and is caused by the immediate release of kinetic energy as the bullet enters the tissue. Cavitation can lead to extensive soft tissue damage beyond that caused directly by the bullet's path. Low-velocity injuries result from missiles that travel at significantly slower speed and tend to produce erratic pathways, with injuries often demonstrating no direct relationship to the location of the entrance or exit wounds.[4] Lower-velocity projectiles cause less severe clinical injury than high velocity projectiles, but injuries can be life-threatening, nevertheless. In the past decade, the overall mortality rate for penetrating neck trauma has been reported to be around 5% in civilian victims, comparable to the rate seen in war casualties.[1,5]

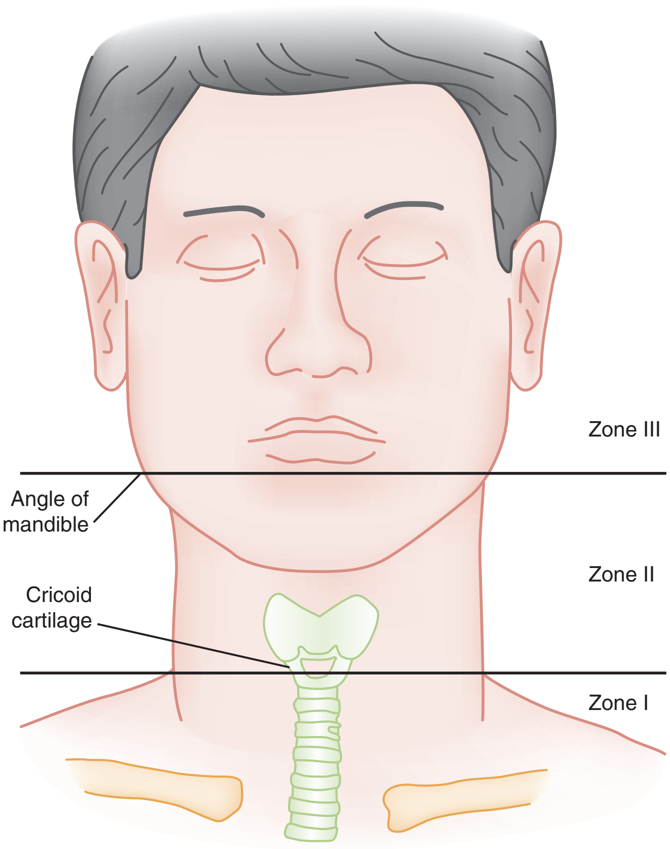

Fig. 37.1. Zones of the neck.

Blunt neck trauma most frequently results from motor vehicle collisions (MVCs) but can occur after assaults, "clothesline" injuries, strangulation, and sports injuries.

Transcervical gunshot wounds (TC-GSWs) represent a subset of penetrating neck trauma that has been associated with an almost threefold increase in the incidence of serious injury compared with GSWs that do not cross the midline (80% vs. 30%). The most common injuries are to vascular structures and the spinal cord. The decision whether to practice mandatory exploration for these injuries or to use a selective surgical approach with appropriate diagnostic studies and serial examinations is institution specific, and either approach is reasonable.

CLINICAL FEATURES

Patients with neck injury can manifest numerous signs and symptoms, but many are nonspecific and there may be minimal external evidence of injury apparent during early assessment, even when there are serious underlying injuries. Frequent examination and a methodical approach to evaluation are crucial to ensure that serious, occult injuries do not go undetected or evolve to the point that they threaten the patient's airway, circulation, or life. Symptoms and signs of particular importance are dyspnea, dysphonia, stridor, drooling, hematoma, significant external bleeding, bruit, neurological deficit, or shock.

DIFFERENTIAL DIAGNOSIS

With neck trauma, typically the differential diagnosis is limited to injury of the structures of the neck: aerodigestive, vascular, neurological, and glands, and, less commonly, the spinal column or cord, thoracic structures, and brain. The incidence of these injuries from penetrating neck trauma is listed in Table 37-1.

TABLE 37.1

Incidence of Injuries in Penetrating Neck Trauma

LOCATION	NUMBER (1275 TOTAL)	PERCENTAGE*
Arterial	320	12.8
Venous	281	11.3
Tracheolaryngeal	253	10.1
Pharyngoesophageal	240	9.6
Spinal cord	76	3
Neurologic, other	85	3.4
Thoracic duct	20	0

*Incidence based on other reported series.
From McConnell DB, Trunkey D: Management of penetrating trauma to the neck. Adv Surg 27:97, 1994.

BOX 37.1

Vascular and Other Contents in Neck Zones

ZONE I
Proximal common carotid artery
Vertebral artery
Subclavian artery
Major vessels of upper mediastinum
Apices of lungs
Esophagus
Trachea
Thyroid
Thoracic duct
Spinal cord

ZONE II
Carotid artery
Vertebral artery
Larynx
Trachea
Esophagus
Pharynx
Jugular vein
Vagus nerve
Recurrent laryngeal nerve
Spinal cord

ZONE III
Distal carotid artery
Vertebral artery
Distal jugular vein
Salivary and parotid glands
Cranial nerves IX to XII
Spinal cord

DIAGNOSTIC TESTING

Diagnostic testing in the emergency department (ED) will apply primarily to the stable patient. Patients with neck injury should be thought of as in terms of whether or not they will require emergent or urgent surgical intervention in the operating room (OR). They can generally be divided into four categories: (1) hemodynamically unstable, (2) hard signs of injury with or without hemodynamic instability, (3) hemodynamically stable with soft signs of injury, and (4) asymptomatic. Patients in either of the first two categories will most likely go to the OR emergently or urgently. If a patient displays hard signs of injury (defined later), but remains hemodynamically stable, they may go directly to the OR or undergo evaluation and imaging and then be taken to the OR for surgical exploration. Despite variability in the definition of hemodynamic instability, any blood pressure (BP) lower than 90 mm Hg should be considered unstable.[6] Diagnostic testing is indicated for stable patients exhibiting soft signs of injury and, sometimes, for those who present asymptomatically. Airway stabilization should always be of primary concern, and this is discussed in detail in the Management section.

Patients with penetrating neck injury are evaluated for the presence of soft or hard signs of aerodigestive or neurovascular injury during the primary and secondary survey (Box 37.2). Definitions of hard signs of injury vary. Hard signs equate with the need for immediate surgical or endovascular intervention. Not all patients with hard signs are hemodynamically unstable, yet even stable patients will likely need expeditious surgical intervention in the OR. Hard signs are indicative of injury to either the aerodigestive or neurovascular structures. Hard signs of aerodigestive injury include air bubbling from the wound, substantial subcutaneous emphysema, or airway compromise. Hard signs of neurovascular injury include significant hematoma (whether pulsatile or not) significant hemoptysis, active bleeding, shock unresponsive to fluid, decreased or absent radial pulse, vascular bruit or thrill, or cerebral ischemia. Institution specific factors (availability of imaging and surgery subspecialties, for example) determine which variation of these hard signs selects patients for immediate transport to an OR. Despite hard signs being an indication for expedited transfer to the OR, there are times when some pre-OR diagnostic imaging might be helpful in the otherwise stable patient. An example of this would be head and neck computed tomography angiography (CTA) to identify whether unilateral neurological deficit in a MVC victim is caused by injury to the carotid artery or to the brain.

Soft signs of injury (see Box 37.2) necessitate further diagnostic evaluation but are less likely than hard signs to require surgical exploration. Ancillary testing is dependent on several parameters, including location of injury, specific signs and symptoms (soft signs), resource availability, and institution-specific protocols. The most common study obtained is CTA. Other diagnostic tests for particular presentations can include plain radiographs of the neck or chest (primarily to locate the missile or fragments), contrast esophagography, flexible or rigid endoscopy, laryngoscopy or flexible nasopharyngoscopy, duplex ultrasound, magnetic resonance angiography (MRA) or conventional angiography. Indications for these ancillary, diagnostic tests will be addressed under the specific anatomic injury further in this chapter.

Researchers historically remained divided as to whether patients lacking both hard and soft signs required further diagnostic evaluation. Two large prospective studies of patients with penetrating neck wounds found that physical examination and symptoms were reliable in determining which stable patients needed vascular or esophageal diagnostic studies. Currently, management varies in these asymptomatic patients from serial examination and observation to diagnostic studies, such as CTA. The age of the patient, availability of both imaging studies and personnel, ability to perform serial assessment of the wound, and patient's social situation need to be considered in making this decision.

BOX 37.2

"Soft" and "Hard" Signs of Penetrating Neck Trauma

SOFT SIGNS

Minor hemoptysis
Hematemesis
Dysphonia, dysphagia
Subcutaneous or mediastinal air
Nonexpanding hematoma
Oropharyngeal bleeding
Neurological findings
Proximity wound

HARD SIGNS

Rapidly expanding/pulsatile hematoma
Massive hemoptysis
Air bubbling from wound
Severe hemorrhage
Shock not responding to fluids
Decreased or absent radial pulse
Vascular bruit or thrill
Stridor/hoarseness or airway compromise
Cerebral ischemia
+/– Massive subcutaneous emphysema

MANAGEMENT

The evaluation of penetrating neck trauma depends on the anatomic zone of injury, clinical presentation, and hemodynamic stability. Early management is based on whether the patient requires immediate surgery, extensive evaluation for injury to the deep structures of the neck (airway, digestive, vascular, neurological), serial evaluation and observation, or discharge after ED evaluation.

Whenever feasible, patients with neck injury should be transported to a trauma center. Despite a stable initial appearance, airway compromise can ensue rapidly, and intervention is essential at the first sign of airway threat, ideally before respiratory symptoms develop. Necessary stabilization procedures should be initiated during transport to the ED when possible rather than at the scene to avoid delays in definitive care.

Airway

Airway management is the highest initial priority in any patient with neck trauma. Bag mask ventilation may be hazardous because it may force air into injured tissue planes, resulting in massive subcutaneous emphysema and subsequent airway distortion or, rarely, air embolus. Aside from obvious injury to the airway or overt airway distress or compromise, the clinician should look for signs of impending or future compromise of the airway. These can include neck hematoma, upper airway hemorrhage or hematoma, voice change or significant subcutaneous emphysema, any of which can progress to distort or occlude the airway. These are all considered indications for early airway stabilization (see also Chapter 1).

Although the ideal technique to secure a definitive airway for patients with neck trauma has been heavily debated, orotracheal intubation with rapid sequence intubation (RSI) has been shown to be safe and effective and should be considered the first-line airway technique in the emergent situation, preferably using a video laryngoscope.[7] Video laryngoscopy confers advantage through improved glottic views and less need for neck manipulation.[8,9] If the cervical spine must remain immobilized during orotracheal intubation, an assistant should hold inline stabilization of the head and neck. Relative contraindications to RSI include significant anatomical disruption of the face or neck, massive hematemesis, or concern that RSI will not succeed and the patient will not be successfully oxygenated using a bag and mask, laryngeal mask airway, or other device. If time and resources allow, fiberoptic laryngoscopy may be preferable; however, this procedure requires skill with endoscopy and is not feasible when there is significant bleeding.[10] Institution-appropriate rescue and surgical airway equipment should be available if standard orotracheal intubation fails.

Blind nasotracheal intubation has been associated with serious complications, including false passage, and is contraindicated in patients with penetrating neck trauma. If endotracheal intubation is not possible, cricothyrotomy may be required (see Chapter 1).

Breathing

When the airway has been stabilized, breathing assessment is standard, with consideration of the associated risk of hemothorax or pneumothorax, seen primarily with penetrating zone I injuries.

Circulation

Open wounds should be covered and sufficient compression applied to control bleeding and prevent air embolus without occluding the airway or blood flow to the brain. Wounds with active bleeding or blood clots should not be probed because massive hemorrhage can ensue. Ideally, bleeding is controlled by direct pressure. Blind clamping of active bleeding sites should be avoided because of the high concentration of neurovascular structures in the neck. Intravenous (IV) access is best placed on the uninjured side, avoiding the ipsilateral neck or upper extremity.

Occasionally, exsanguination from penetrating trauma in the ED is imminent. In those cases, direct pressure on the wound is first-line treatment, followed by insertion of fingers into the wound or packing the wound to facilitate compression if direct pressure alone is unsuccessful. Occasionally, these measures will fail, particularly in zone III wounds. Insertion of a 16- or 18-French ballooned catheter into the wound with inflation of the balloon to tamponade bleeding during transport to the operating suite may be helpful.[11]

Cervical Spine

The placement of a cervical collar is unnecessary in most cases of penetrating neck trauma without neurological deficits. One large series found an overall incidence of 0.4% unstable cervical spine injuries in patients who had sustained penetrating neck injury.[12] Cervical collars can obscure neck pathology and preclude adequate examination. In any patient with blunt neck or multisystem trauma, and in particular if altered, there should be greater concern for occult or overt cervical spine injury.

Thoracotomy

In patients presenting to the ED with cardiopulmonary resuscitation (CPR) in progress, the indication for resuscitative thoracotomy is CPR for less than 15 minutes with penetrating neck trauma or less than 10 minutes of CPR with any blunt trauma. Arrest in the ED, or profound, refractory shock are also indications in either scenario. Mortality from resuscitative thoracotomy for any type of blunt trauma resulting in CPR is exceedingly high with survival rates cited in the 1% to 2% range.[13]

Venous/Arterial Air Embolism

Venous air embolism (VAE) causes profound shock or cardiopulmonary arrest unresponsive to fluids or thoracotomy. If VAE is suspected, placing the patient in a head-down, left lateral decubitus position will cause intra-cardiac air to accumulate in the apex of the right ventricle. If shock persists, aspiration of air from the apex of the right ventricle either by use of an ultrasound-guided pericardiocentesis needle or under direct visualization after ED thoracotomy can be lifesaving. Neurologic sequela or any otherwise unexplained stroke-like syndrome should prompt consideration of arterial air embolism. Controversy surrounds the best patient position when considering the diagnosis of arterial air embolus, and there are no large trials to provide a definitive answer. Because arterial emboli can lead to cerebral edema, we recommend placing the patient in a neutral position after cardiac aspiration is completed and vital signs restored.

Nasogastric Tubes

Placement of a nasogastric tube (NGT) is relatively contraindicated in patients with penetrating neck injury and should be avoided if at all possible. Exceptions are when placement is required to decompress a stomach distended by positive pressure ventilation to permit improved respiratory support. Ideally, placement is deferred until after intubation, because it may no longer be deemed necessary, and, if necessary, can be inserted gently and with endoscopic guidance, if available. The NGT aspirate may be helpful because bloody aspiration implies visceral injury.

PHARYNGOESOPHAGEAL TRAUMA

PRINCIPLES

Epidemiology

Esophageal injuries are rare, and most are due to penetrating trauma and involve the cervical segment.[14] Injury from blunt trauma is typically associated with hyperextension or cervical spine fractures.[15]

Pathophysiology

Early diagnosis of esophageal injury is crucial because spillage of orogastric contents with bacterial contamination can lead to florid inflammation, abscess, and mediastinitis. Delayed diagnosis of esophageal injuries contributes to their mortality rate of up to 20%.[16-18]

CLINICAL FEATURES

In penetrating trauma, air leaking out through the wound site is the most compelling indicator of an underlying esophageal or airway injury. Otherwise, there are no pathognomonic signs of esophageal injury. Soft signs of injury include hematemesis, odynophagia, dysphagia, subcutaneous emphysema, and blood in the saliva or NGT aspirate (see earlier discussion of placement of NGT). Other associated findings include dyspnea, hoarseness, stridor, cough, pain and tenderness in the neck, and resistance to passive neck movement. Physical examination is unreliable in diagnosing esophageal injury, and a normal examination does not exclude aerodigestive injury.[19] However, absence of any symptoms or soft signs, coupled with a normal physical examination makes esophageal injury extremely unlikely, and serial evaluation can replace any other further diagnostic testing in this setting, depending on institution-specific protocols.

DIAGNOSTIC TESTING

Timely diagnosis is associated with decreased morbidity and mortality, with poorer outcomes found in patients treated beyond

24 hours from the time of injury.[20] Plain films of the neck and chest alone are inadequate but may suggest esophageal perforation if pneumomediastinum, hydrothorax, or retropharyngeal air is present.

Contrast esophagography, which requires the patient's cooperation, has a sensitivity of 90% for esophageal injuries. Typically, water-soluble contrast (eg, diatrizoate meglumine and diatrizoate sodium [Gastrografin]) is used. Barium has greater sensitivity, but has more danger associated with extravasation. A thin barium swallow can be used to increase sensitivity if the Gastrografin swallow is negative. Flexible endoscopy follows a negative contrast esophagography study. This combination of tests has a sensitivity approaching 100%.[11]

Sole reliance on CTA, without oral contrast, for diagnosis of esophageal injuries is currently not supported by the literature. Although computed tomography (CT) scan can be useful to look at the wound track or trajectory of a bullet to determine if a proximity wound is likely, its sensitivity is variable and is as low as 50%.[15,19] Extravasation of contrast is rarely seen, and non-oral contrast CT depends on visualization of indirect signs, such as paraesophageal air or fluid, esophageal wall thickening, or edema.[20] In patients in whom the pre-test suspicion is low, CT demonstration of a wound track distant from the esophagus may be sufficient. In higher risk injuries, addition of a contrast swallowing study is recommended. If available, thin (5 mm) section contrast CT esophagography has test characteristics comparable to standard barium swallow and is an alternative option.[21] Additionally, evaluation for vascular or airway injury is recommended prior to repair of the esophageal damage; half of patients with penetrating esophageal injuries will have a concurrent laryngotracheal injury.[22]

MANAGEMENT

When esophageal injury is suspected, broad-spectrum antibiotics with anaerobic coverage (eg, piperacillin and tazobactam IV 3.375 grams every 6 hours) should be administered, and the patient should receive nothing by mouth. Preoperative placement of an NGT under endoscopic guidance may reduce the spillage of gastric contents into the wound. Any uncontained perforation of the esophagus requires prompt surgery, whereas small contained perforations may be candidates for observation and reimaging.[23]

Esophageal stents are gaining popularity for certain nontraumatic perforations and may have applications in trauma as well.[17,23] Isolated pharyngeal injury can be managed nonoperatively in the majority of cases.

LARYNGOTRACHEAL TRAUMA

PRINCIPLES

Laryngotracheal injuries account for less than 1% of all trauma injuries, but a substantial proportion of immediate mortality. Most blunt laryngotracheal injuries result from direct blunt force sustained in MVCs, often without a shoulder restraint, in which the extended neck strikes the steering wheel or dashboard and the larynx is compressed between the fixed object and the cervical spine. Other mechanisms leading to laryngotracheal injuries include clothesline injuries, improperly fitting shoulder harnesses, near hanging, assaults, athletic events, attempted strangulation, and iatrogenic wounds.

The cricoid cartilage is the only complete solid ring in the larynx. Fractures of the cricoid cartilage can lead to death through acute airway obstruction and are the most serious laryngeal injuries. Calcification of the laryngeal cartilages begins during the teenage years. The degree of airway obstruction after blunt trauma to the larynx is inversely related to the degree of cartilage calcification, putting children at highest risk of respiratory compromise after injury.[24] These injuries can lead to long-term sequelae, including recurrent pneumonia, dyspnea, voice change, dysphagia, laryngeal stenosis, and chronic pain, and risk and severity of sequelae increases with delayed or missed diagnosis.

CLINICAL FEATURES

Not all surgically significant laryngotracheal injuries will manifest clinically at the time of initial evaluation in the ED, particularly in the case of blunt trauma.[25] Bubbling or air leakage from a neck wound signals injury to the respiratory tract and is considered a hard sign of laryngotracheal injury. Massive subcutaneous air and crepitus over the larynx (caused by laryngeal fracture) represent laryngotracheal injury until proven otherwise. A clothesline mechanism of injury makes laryngotracheal injury more likely than other blunt mechanisms. Other clinical features of laryngotracheal injury include dysphonia, aphonia, dyspnea, stridor, hemoptysis, subcutaneous emphysema, laryngeal crepitus, neck tenderness or pain over the larynx, a visible neck wound, or loss of anatomic landmarks secondary to hematoma. However, each individual finding occurs in fewer than 50% of cases.[26] Pain with tongue movement or rotation of the head implies injury to the hyoid bone or laryngeal cartilage.[27] Patients with laryngotracheal injury may be unable to tolerate lying flat.[28] Soft tissue surrounding the injury can serve as a makeshift air conduit, and minimize respiratory distress initially, even with complete laryngotracheal separation.[29] Because blunt laryngotracheal injuries are often seen in association with multisystem trauma, they can be easily overlooked; however, they portend a higher mortality and often mandate early airway management.

DIAGNOSTIC TESTING

Plain radiographs, if performed, should be evaluated for extraluminal air, edema, foreign bodies, and fracture or disruption of the cartilaginous laryngeal structures. Laryngoscopy or flexible nasopharyngoscopy allows direct evaluation of laryngeal integrity. With appropriate local anesthesia, laryngoscopy is well tolerated by most patients, even those in cervical spine immobilization collars. Anesthesia and preparation for an emergent airway should precede laryngoscopy in the semi-stable patient, because instrumentation-related irritation and cough can cause sudden laryngospasm or airway disruption.[29] Rigid endoscopy is useful to evaluate injury distal to the larynx but is performed in the OR under general anesthesia.

With a sensitivity approaching 100%, CT scanning is the imaging modality of choice, providing detailed information about laryngeal integrity and the surrounding region.[30] When soft tissue anterior neck injury is suspected, 1-mm cuts of the larynx should be obtained and multiplanar reconstructions performed to optimize the study. CT is useful for assessing airway diameter and vocal cord integrity, as well as for detecting fractures of the hyoid bone, disrupted laryngeal or tracheal cartilages, significant exolaryngeal or endolaryngeal hematoma, and dislocations of the cricothyroid or cricoarytenoid joints. It is less useful for the detection of mucosal perforations, degloving injuries of the cartilage with denuded mucosa, certain types of minor laryngotracheal separation, particularly when there are poorly calcified pediatric cartilaginous structures. Typically, injuries missed by CT scan are unlikely to require surgical management.[31]

Widespread access to ultrasound has led to an increase in its use for trauma patients. Whereas some advocate ultrasound to detect blunt laryngotracheal injuries such as laryngotracheal separation, larger studies are needed before we can recommend this modality.

MANAGEMENT

Airway compromise in patients with laryngotracheal trauma can be immediate or delayed. Because delayed airway occlusion can be rapid and life-threatening, these patients require close monitoring. When laryngotracheal injury is suspected, early laryngoscopy is indicated to identify injuries and determine the need to secure the airway.[25] When emergent airway management is required, the approach should be individualized, based on the suspected injuries, the patient's overall status, and the ability to tolerate examination by laryngoscopy under local anesthesia, without or without sedation. If available, an awake, fiberoptic-guided oral intubation is likely the best route.[25,32] If this is not feasible given the status of the patient, or availability of equipment and operator, and anatomy is reasonably preserved, "awake" intubation using a video laryngoscope (see Chapter 1) is a good alternative. If an awake technique is not feasible, the best approach often is a single attempt at orotracheal intubation under a "double set-up," using RSI, but with preparations in place to move immediately to a surgical airway (cricothyroidotomy or tracheostomy) if intubation is not successful on the first attempt.[33] The airway lumen may be compromised by edema or hematoma, so endotracheal tubes of varying sizes, including several sizes smaller than would normally be used for the patient, should be prepared for use. A tube one size smaller than what is typically used is a good first selection.

Most patients can be intubated in a standard fashion, but the laryngoscope (unless a flexible scope is used) is not capable of visualizing the airway below the vocal cords, so the tube must be placed very gently and guided down the airway with the least contact or friction. This will minimize the possibility of completing a partial laryngotracheal separation or creating a false passage. Depending on the location and extent of the injury, tracheostomy may be preferred over cricothyrotomy because of the potential for the latter to further damage an injured larynx. When the airway is managed in the OR, tracheostomy is preferred. In the ED, management is often more time pressured, and cricothyroidotomy, provided the anatomy is preserved, usually is preferred, because it is faster and easier to perform. In cases with a large neck wound, intubation can be performed through the wound, provided the trachea can be visualized.

Complete laryngotracheal separation is often fatal. If complete laryngotracheal separation is present with distal retraction of the trachea, orotracheal intubation is unlikely to be successful, but may be tried, as described earlier, using a small (cuffed) tube and gentle technique, if flexible endoscopy is not available. If a surgical approach is chosen, after vertical incision in the neck, tracheal hooks can be used to recover the distal end of the trachea, and tracheostomy performed at the fourth or fifth tracheal ring to avoid the larynx. Blind nasotracheal intubation or use of positive pressure supraglottic ventilation (eg, bag/mask or laryngeal mask airway) is contraindicated in these injuries. The risk of decompensation with intubation, the condition of the patient, and the available resources/consultants must all be weighed carefully.

For the majority of injuries, a period of hospitalization for observation is required. Patients with no identifiable injury, beyond laryngeal tenderness, but who had a significant mechanism of injury (significant energy transfer to the larynx) can be observed for 12 hours in the ED or an ED observation unit and discharged home if no additional symptoms or signs develop, voice and swallowing are normal, and discomfort is minimal and abating. These patients should have their first 6 hours of observation in the ED to ensure stability before transfer to the observation unit for the remainder of their visit.[25] Most small mucosal injuries, hematomas, and nondisplaced fractures can be managed conservatively with analgesia, humidified air, elevation of the head of the bed, antibiotics, steroids, antireflux medications, vocal rest, and a clear diet. Unstable patients or those with higher-grade injuries require surgical repair.

VASCULAR TRAUMA

PRINCIPLES

The great vessels of concern in the neck include the carotid, subclavian, and vertebral arteries and the internal and external jugular veins. Morbidity and mortality occurs via exsanguination, hematoma expansion with subsequent airway distortion and compromise, direct vessel injury leading to vascular occlusion, or embolization of a foreign body (eg, shotgun pellet to brain or heart). Delayed-onset, evolving, central neurologic deficits in a patient with any neck trauma should prompt assessment of the carotid arteries for dissection.

Penetrating Injury

Arterial injuries, including extravasation, pseudoaneurysm, occlusion, dissection, and atrioventricular fistula formation, occur in 25% of all penetrating neck wounds, and 37% of deep penetrating neck wounds have some vascular injury.[2,34] Vessels are injured directly in most cases, although the blast effect can cause indirect intimal injury. Mortality rates range from 10% to 50%.

Blunt Injury

Blunt cerebrovascular injuries (BCVIs) are rare, occurring in less than 2% of blunt trauma victims.[35,36] Mortality rates for blunt cervical vascular injuries range to 60%.[37] The internal carotid artery is the most frequently injured artery, followed by the vertebral artery.[38] Blunt trauma to the cervical vessels can result in a spectrum of arterial injuries, including intimal tears, thrombosis, dissection, and pseudoaneurysm.[37] Embolization can then occur from a thrombus that develops at the injury site. The most common mechanism for blunt internal carotid artery injury is sudden, forceful hyperextension and lateral rotation of the neck. This mechanism can cause stretching of the carotid artery over the transverse processes of the upper cervical vertebrae, resulting in intimal injury.[37] Other mechanisms responsible for this type of injury include direct blunt force to the side of the neck, intraoral trauma, and basilar skull fractures involving the petrous or sphenoid portions of the carotid canal. Blunt carotid artery injuries most often result from MVCs but have also been reported after fights, athletic events, seat belt injuries, and strangulations. Vertebrobasilar arterial injuries may follow relatively minor trauma, such as chiropractic neck manipulation, but most commonly occur in association with fractures of the spinal column.

CLINICAL FEATURES

Penetrating Injury

Hard signs of arterial injury include active hemorrhage, hematoma that is expanding or is pulsatile, new bruit, fluid-unresponsive shock, massive hematemesis or hemoptysis, or appropriate focal neurologic deficits. Over 80% of patients with penetrating neck trauma and hard signs of vascular neck or aerodigestive injury (air leaking through injury site or significant subcutaneous emphysema) will have vascular or aerodigestive injuries identified. By contrast, fewer than 20% of patients with soft signs of vascular injury (non-pulsatile, nonexpanding hematomas, minor hemoptysis) or aerodigestive injury (eg, dysphonia, dysphagia, any subcutaneous emphysema) will have a significant injury to either of these systems confirmed. For patients with neither hard nor soft signs, the likelihood of significant injury approaches zero, even when there is a wound in proximity to a vital structure, attesting to the value of risk-stratification of penetrating neck trauma patients based on the presence of physical examination findings.[39] The decision to obtain diagnostic studies or to observe the asymptomatic patient with isolated neck trauma, particularly one with a wound proximal to a vascular structure, is guided by institutional policy and practice, and depends on the availability of imaging, ability of the provider to assess the patient, and potential for ongoing observation both in the ED and following discharge at home.

Blunt Trauma

Half the patients with dissection from blunt trauma are neurologically asymptomatic. When symptomatic, carotid injuries cause either transient or fixed contralateral sensory or motor deficits, aphasia, dysphasia, and Horner syndrome, whereas vertebral injuries can cause ataxia, vertigo, emesis, and visual field deficits.[40] Neurological symptoms are often delayed. Most symptoms develop 10 to 72 hours post-injury with a median of 12.5 hours.[38,40] Up to one-third of patients may not develop deficits for more than 24 hours.[35] Delay in onset of neurological sequelae of weeks to years has been reported. Any unexplained focal neurologic abnormality after blunt or penetrating trauma involving the head or neck should prompt consideration of vascular injuries. Similarly, patients with arterial epistaxis are at risk and should be evaluated.

Because of the potential for delay in symptom onset and catastrophic outcome, screening of asymptomatic patients with associated injuries has become standard. Cervical spine injury, mandible fracture, basilar skull fracture, high injury severity score, and low ED Glasgow Coma Score (GCS; below 6 or 8) have been found independently predictive of a BCVI in an otherwise asymptomatic patient.[41] Cervical spine injury is the strongest risk factor, with an associated BCVI in up to 45% of isolated cervical spine fractures.[42,43] Screening criteria differ slightly between authors, centers, and organizations, and those from the Western and Eastern Trauma Associations are listed in Table 37.2.[44,45] Unfortunately, screening guidelines, such as the Eastern Association for the Surgery of Trauma (EAST) screening criteria, typically miss about 20% of injured patients.[46] Expanding these criteria to include all cervical spine fractures and select patients with complex facial fractures or mandible fractures may increase sensitivity of clinical criteria for BCVI screening.[41,46,47] At a minimum, screening should be performed in patients with cervical spine fractures or injuries in C1 to C3, transverse foramen fracture at any level, low GCS, LeFort II or III fracture, basilar skull fracture involving the petrous bone, and patients with an appropriate mechanism of hyperextension or hyperflexion with rotation and significant injuries to the head, face, and neck.

Seat-belt signs, or visible abrasions on the neck, are often a concern for physicians evaluating these injuries. Firstly, a "seat-belt sign" should be differentiated from a large hematoma, which is of greater concern. Secondly, several authors have included "seat-belt sign" in the list of variables evaluated, without proving them contributory in multivariate analysis. In two recent studies focused specifically on the impact of the seat-belt sign, no vascular injury was found in a single patient with an isolated seat-belt sign without signs of vascular injury or criteria for asymptomatic screening.[48,49]

In children, the rate of BVCI is lower, likely about 0.4%.[50] Evaluation and management mirrors that of the adult patient.

TABLE 37.2

Trauma Association Criteria for Blunt Cerebrovascular Injury Screening

	WESTERN TRAUMA ASSOCIATION	EASTERN TRAUMA ASSOCIATION
Symptomatic	Arterial hemorrhage from the neck, mouth, nose, ears Large or expanding cervical hematoma Cervical bruit in patient <50 years old Focal neurological deficit Evidence of cerebral infarct Neurologic deficit incongruous with CT/MRI findings	Unexplained neurological injury Arterial epistaxis
Asymptomatic	Cervical hyperextension or hyperflexion with rotation Direct cervical trauma Intraoral trauma Basilar skull fracture involving the carotid canal LeFort II or III Head injury with GCS <6 Fracture of C1 to C3 Vertebral body or transverse foramen fracture, subluxation, or ligamentous injury at any level Hanging with cerebral anoxia Seat-belt sign or clothesline injury with significant cervical pain, swelling, AMS	GCS <9 Petrous bone fracture Diffuse axonal injury Cervical spine fracture (especially C1-3, transverse foramen, or subluxation/ rotational component) LeFort II or III fracture

AMS, altered mental status; *CT,* computed tomography; *GCS,* Glasgow Coma Score; *MRI,* magnetic resonance imaging.

DIAGNOSTIC TESTING

Penetrating Trauma

Traditionally, for cases without overt hard signs of vascular injury, the less accessible zones I and III were evaluated radiographically, whereas the more surgically accessible zone II injuries underwent operative exploration. However, many patients with penetrating mechanisms will have injuries outside of the zone cutaneously affected.[1]

CTA has a 90% to 100% sensitivity and 99% to 100% specificity for vascular injury in penetrating neck trauma.[39,51,52] Both direct CT signs (wall irregularity, contrast extravasation, lack of vascular enhancement, and caliber changes) and indirect signs (sheath hematoma, bone or bullet fragments <5 mm from a major vessel) are used in diagnosis.[2] CTA may help surgical planning in the stable patient with loss of the carotid pulse lacking neurologic deficits or a new bruit.[11] However, it is primarily useful in evaluating patients with soft signs of injury, as patients with hard signs will typically need operative management.

Blunt Trauma

Historically, conventional arteriography (digital subtraction angiography [DSA]) has been used extensively to detect vascular injury in patients with both blunt and penetrating injuries. DSA should include the intracranial portion of the carotid artery with zone III injuries or suspected blunt cervical trauma. Zone I injuries should include the aortic arch with its branches.

Sensitivity and specificity are nearly 100% and complication rates are less than 2%.[53]

For blunt trauma, CTA has become standard, and few patients with a negative CTA develop adverse neurological outcomes.[54,55] However, its sensitivity is still substantially lower when compared to DSA (51% to 89%).[54,56-58] Nearly 80% of the lesions missed by CTA are grade 2 or higher.[56] False positives are frequently reported as well. Therefore, for patients in whom the pre-test probability is high and a CTA is therefore unexpectedly negative, further testing (eg, DSA) should be undertaken unless clinical evaluation suggests the contrary.

Other Radiographic Options

Although not indicated in most cases of suspected vascular injury, plain films can occasionally be useful. Anteroposterior and lateral neck films can help determine a bullet trajectory. Chest radiographs allow evaluation of the mediastinum and identification of hemothorax or pneumothorax.

Duplex ultrasonography has shown variable performance in the evaluation of cervical vascular injury in patients with both penetrating and blunt trauma, risking misses of zone I and zone III injuries. For penetrating injury, carotid duplex Doppler has higher sensitivity, but for symptomatic dissection patients without obvious evidence of stroke, sensitivity of ultrasound is inadequate.

MRA has additional distinct disadvantages that include remote location in many centers, the contraindication of metallic foreign bodies (bullet fragments), length, cost, availability, and the inability to directly visualize the neck during the procedure for expanding hematoma. Reports of sensitivity are variable, but it is likely equivalent to that of CTA for carotid injury and possibly inferior for vertebral dissections.

MANAGEMENT

The goals of management are twofold: repair of acute life-threatening hemorrhage and prevention of stroke. Mortality in patients suffering a stroke following a vascular injury is significantly higher than those who do not (34% vs. 7%).[56]

Penetrating Injury

The ideal management strategy for injuries of the vascular system resulting from penetrating trauma has not been determined, although surgical repair is common. In cases with brisk hemorrhage or those in whom reperfusion might convert an ischemic infarction to a hemorrhagic infarction in patients with profound neurologic deficit, some prefer selected ligation over repair. Vertebral artery injuries are often more amenable to endovascular repair.[59]

Blunt Injury

Treatment options for blunt arterial injuries depend in part on the mechanism, type of injury, and location of the lesion. Injuries are typically graded as 1 (intimal irregularity with <25% narrowing), 2 (dissection or intramural hematoma with ≥25% narrowing), 3 (pseudoaneurysm), 4 (occlusion), and 5 (transection with extravasation). Treatment modalities include anticoagulation, surgery, and observation. Anticoagulation is widely used for dissection, although there is no convincing evidence that it clearly improves outcome. For anticoagulation, antiplatelet agents and heparin have comparable injury healing rates, and no difference was noted between outcomes in patients given heparin, aspirin, or a combination of aspirin and clopidogrel.[60] Because of high complication rates in trauma patients, treatment should be initiated with appropriate consultation with vascular surgery or neurosurgery. Surgical treatment includes ligation, resection, thrombectomy, endovascular stent placement, and, in the case of severe hemorrhage in a small vessel with collateral circulation, transarterial embolization. Endovascular stent therapy is less invasive than surgery and considerably easier to perform in less surgically accessible regions. In non-randomized studies, endovascular stents were typically used in higher-grade lesions, with comparable outcomes to medical management. Stent patients are generally managed with a week of heparin, followed by 6 months of aspirin or a combination of aspirin and clopidogrel.[61] For low-grade lesions, particularly dissection, long-term occlusion outcomes are better with anticoagulation and antiplatelet therapy compared to stenting.[62] Appropriate treatment reduces stroke rate from about one-quarter of patients to 3.9%.[40] Repeat imaging in 7 to 10 days assesses recannulation, as well as pseudoaneurysm formation. Enlarging or symptomatic pseudoaneurysms merit treatment, particularly in patients with questionable follow-up.

NERVOUS SYSTEM, GLANDULAR, AND RETROPHARYNGEAL INJURIES

The brachial plexus, peripheral nerve roots, cervical sympathetic chain, the spinal cord, and cranial nerves VII, IX, X, XI, and XII are vulnerable to trauma. Neurologic deficit can also result from vascular injury with subsequent cerebral ischemia. Complete cord injury can result in spinal (neurogenic) shock with paraplegia, bradycardia, and hypotension. Brown-Séquard syndrome (hemisection of the spinal cord) arises with ipsilateral hemiplegia and contralateral sensory deficit. Cervical spine fractures and cord injuries are most commonly found in GSWs (1.35% and 0.94%, respectively), followed by direct blunt trauma. Either injury is rare from SWs (0.12% and 0.11%).[63] Brachial plexus, spinal root, and peripheral nerve injuries have been reported after neck trauma and can result in both sensory and motor deficits. Phrenic nerve injury may compromise spontaneous respiration by causing ipsilateral diaphragmatic paralysis. Hoarseness can result from direct laryngeal trauma but also from injury to the recurrent laryngeal nerve, which branches off the vagus nerve (cranial nerve X), leading to vocal cord paralysis. Sixty percent of patients with transection of the cervical trachea will experience recurrent laryngeal nerve damage.[64]

Other less common injuries have been reported in association with neck trauma with variable signs and symptoms. Thoracic duct injuries are less likely to be apparent initially and are frequently diagnosed intraoperatively or after chylothorax develops. Glandular wounds, including those of the thyroid, parathyroid, and salivary glands, are reported rarely. Thyroid rupture or hemorrhage can occur, with an expanding hematoma causing increasing respiratory distress over the 24 hours following an injury.[65,66] Isolated retropharyngeal hematomas, typically from a whiplash mechanism, are also extremely rare but can result in life-threatening airway compromise.[67]

NEAR HANGING AND STRANGULATION

PRINCIPLES

The terms *hanging* and *strangulation* are often used interchangeably, with hanging being a subset of strangulation. *Judicial* hanging victims classically fell at least the height of their body, whereas most suicides fall little to no distance and are termed *non-judicial*. *Complete hanging* refers to the victim who is freely suspended, while *incomplete hanging* refers to the partial suspension of the victim's body with some part still in contact with the ground. *Typical hanging* refers to the ligature knot being midline directly under the occiput. *Atypical hanging* refers to all other knot placements. The maximal force is applied immediately opposite to the placement of the knot; therefore, typical hanging portends highest risk of arterial occlusion. *Near-hanging* is a common term referring to survivors of an attempted hanging.

Manual strangulation and *ligature strangulation* refer to external compression of the neck, usually by hands or ligature, but independent of the weight of the victim. *Postural strangulation,* generally seen in the younger pediatric population, refers to death sustained by the victim's body weight compressing the anterior neck against a firm object.

Judicial hanging involving an adequate fall distance results in forceful distraction of the head from the neck and body, and this leads to high cervical fractures, such as the classic hangman's fracture (fracture through both pedicles of C2), complete cord transection, and death. Non-judicial hangings frequently occur at less than 2.7 meters, usually inadequate to injure the cervical spine, except in the elderly population.[68-70]

In essentially all types of non-judicial strangulation, the ligature or external force causes venous congestion with stasis of cerebral blood flow leading to unconsciousness. Once the person is limp, the ligature or external force can tighten further, leading to complete arterial occlusion and ultimately to brain injury or death. Vagal reflexes resulting from pressure on the carotid body may contribute to fatal dysrhythmias, as may increased sympathetic tone from pericarotid sinus pressure. Compression of the airway does not play as significant a role.

Survivors of hanging can suffer sequelae in other systems; hypoxic-ischemic brain injury is the driving factor in the high mortality and neurologic morbidity. Pulmonary edema can occur from several mechanisms: *neurogenic* pulmonary edema from centrally mediated, massive sympathetic discharge; *postobstructive* from relief of the marked negative intrapleural pressure generated by forceful inspiratory effort against an extrathoracic obstruction; and *cardiogenic* pulmonary edema, which is increasingly recognized as a result of hanging-associated Takotsubo cardiomyopathy.[71]

CLINICAL FEATURES

External trauma may or may not be evident. Ligature marks, fingernail scratches, abrasions, and contusions are variably present on the external neck as well. *Tardieu spots* are highly correlated with asphyxial deaths; these petechial hemorrhages are seen in the conjunctiva, mucous membranes, and skin cephalad to the ligature marks.

Thyroid cartilage fractures and/or hyoid bone fractures are seen in approximately half of all non-judicial hanging deaths.[70] More commonly seen with manual strangulation, cricoid cartilage fractures are rarely reported in suicidal hangings, and there are few survivors.[72] These are significant less common (≈7%) in survivors of near-hanging.

Vascular injury leading to delayed neurologic sequelae after near-hanging is rare. Carotid injury occurs in only a tiny fraction of near-hangings. In a study of 56 survivors of manual strangulation, 16% of whom lost consciousness and 63% of whom had a neck hematoma, no laryngeal, hyoid, or vascular damage was identified on magnetic resonance imaging (MRI).[73]

DIAGNOSTIC TESTING

Suggested radiographic evaluation for hanging or strangulation with suspected injury includes head CT and neck CTA.

MANAGEMENT

Techniques for managing the airway are as for other blunt neck trauma. The addition of positive end-expiratory pressure is often necessary, especially when pulmonary edema or acute respiratory distress syndrome (ARDS) develops. Full resuscitative effort is warranted even in the unconscious patient, because full recovery is possible. The altered or comatose patient should be assumed to have cerebral edema with elevated intracranial pressure, and cerebral resuscitation measures should be initiated.

Definitive studies providing guidelines for the management of hypoxic brain injury specifically related to near-hanging or strangulation injuries are lacking. Case series indicate a potential role for induced mild hypothermia in comatose survivors of strangulation.[74,75] One study demonstrated a 43% rate of survival to discharge and 6% return of neurological function in hanging patients treated with hypothermia after arrest.[76] Case reports have suggested use of thrombolysis for carotid injury related stroke in survivors of near-hanging, although this is not widely studied.[77] However, the data are not sufficient at this point to recommend either for clinical practice.

DISPOSITION

Most patients with penetrating or blunt neck trauma warrant admission to the hospital, especially when their condition justifies further diagnostic studies, surgery, or intensive care. All patients with platysma muscle violation should be admitted to the surgical service or the observation unit for ongoing observation, regardless of their stability. Careful observation should be maintained for patients with blunt neck injury, because they can manifest delayed signs and symptoms of visceral or vascular injury with serious consequences. Some patients may require transfer to trauma centers, if required services are not available at the initial receiving facility. Pediatric trauma victims fare better when transferred directly to a trauma center.[78,79]

KEY CONCEPTS

- Neck trauma results from three major mechanisms: blunt injury, penetrating injury, or near hanging or strangulation. Platysma violation defines a penetrating injury.
- The external neck is divided into zones I, II, and III. Zone designation has anatomic, diagnostic, and management implications in penetrating trauma, but use of computed tomography angiography (CTA) has greatly simplified the approach to the evaluation. Many injuries involve more than one zone.
- Zone I and III respectively encompass the thoracic inlet and base of skull, and penetrating injuries to these regions risk more occult vascular injury.
- Airway stabilization is the first priority in neck trauma. In most instances, flexible endoscopy is preferred, if possible, but orotracheal rapid sequence intubation (RSI), using a double set-up is also a valid approach. A surgical airway option should be available.
- Cervical spine injury in penetrating neck trauma without neurological deficits is extremely rare.
- Esophageal injuries are uncommon but represent the most frequently missed neck injury. Delays in diagnosis carry an extremely high mortality.
- Hard signs of vascular injury following penetrating trauma include rapidly expanding or pulsatile hematoma, massive hemoptysis, severe

KEY CONCEPTS—cont'd

hemorrhage, shock not responding to fluids, decreased or absent pulse, vascular bruit or thrill, respiratory distress, and/or cerebral ischemia. Hard signs of aerodigestive injury include air bubbling from wound or extensive subcutaneous emphysema. Typically, patients with hard signs require prompt surgical intervention.

- Blunt vascular injuries are often asymptomatic but can present with immediate or delayed neurological sequelae. Cerebral ischemia, aphasia, dysphagia, Horner syndrome, ataxia, vertigo, visual field defects, and emesis should prompt consideration of anterior or posterior circulation vascular injury.
- Seat-belt signs should be differentiated from neck hematomas (the latter being of greater concern). The literature does not support an isolated cervical seat-belt sign as a sign of vascular injury.
- CTA is more than 90% sensitive for the detection of vascular injury with penetrating neck trauma but less sensitive for identifying vascular injury in blunt trauma. Digital subtraction angiography (DSA) is indicated for patients with high pre-test probability of injury but a normal CTA.
- A leading cause of in-hospital death following near-hanging or strangulation are pulmonary complications, including pulmonary edema, which has three primary etiologies: postobstructive, neurogenic, and cardiac.

The references for this chapter can be found online by accessing the accompanying Expert Consult website.

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CHAPTER 37: QUESTIONS & ANSWERS

37.1. The presence of which of the following signs after penetrating neck trauma would indicate a likely benefit from surgical intervention?

A. Decreased or absent radial pulse
B. Small degree of hemoptysis
C. Horner syndrome
D. Muffled voice
E. Stable hematoma

Answer: A. "Hard" signs of penetrating neck trauma are the presence of an expanding hematoma, severe active bleeding, shock not responding to fluids, decreased/absent radial pulse, vascular bruit/thrill, cerebral ischemia, and airway obstruction. Most patients with hard signs benefit from surgical intervention.

37.2. Which of the following statements regarding airway management after penetrating neck trauma is true?

A. Awake fiberoptic intubation is the first-line technique.
B. Bag-valve-mask ventilation should be high tidal volume, low rate.
C. Cervical spine immobilization is typically unnecessary.
D. Nasotracheal intubation position is relatively contraindicated in neck trauma.
E. Preintubation nasogastric tube (NGT) placement may be lifesaving.

Answer: C. Unless there is concomitant blunt injury or evidence of spinal cord injury, cervical immobilization is not needed. Classic oral intubation after rapid sequence intubation (RSI) is the technique of choice and is successful in almost all cases. Although rarely a first line choice, nasotracheal intubation has been used successfully in these trauma patients. Gentle bag-valve-mask technique with low pressures is indicated to avoid venous air embolism (VAE) and subcutaneous emphysema. NGT placement, if done at all, should be gentle and placed after intubation.

37.3. A 21-year-old male presents after a small-caliber gunshot wound (GSW) to the left neck. He is hypotensive, hypoxic, and lethargic, but physical examination is remarkable only for a small zone I penetrating wound on the left side, with no gross swelling or crepitus. Oral intubation and rapid crystalloid infusion fail to improve his blood pressure (BP) or oxygen saturation. A portable chest radiograph is negative. While still in the emergency department (ED), his systolic blood pressure (SBP) drops to the 30s and is fluid unresponsive. What is the most appropriate next step in management?

A. Computed tomography (CT) scan of the neck and chest
B. Dopamine infusion at 20 μg/kg/min
C. Emergent blood transfusion
D. Emergent surgical consultation for neck exploration
E. Resuscitative thoracotomy

Answer: E. After penetrating trauma, the presence of profound shock or cardiopulmonary arrest unresponsive to fluids should prompt the initiation of a resuscitative ED thoracotomy. During that procedure, options C and D should already be in place, but this patient is too unstable to be transported to CT scan and while in extremis, should remain in the ED for the thoracotomy. Another consideration if the thoracotomy does not yield hemodynamic improvement is that of a venous air embolus.