Evaluation and Management of Neck Trauma
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Blunt and penetrating trauma to the neck can result in life-threatening injuries that demand immediate attention and intervention on the part of the emergency physician and trauma surgeon. This article provides a literature-based update of the evaluation and management of injuries to aerodigestive and vascular organs of the neck. A brief review of cervical spine injuries related to penetrating neck trauma is also included. Airway injuries challenge even the most skilled practitioners; familiarity with multiple approaches to securing a definitive airway is required because success is not guaranteed with any single technique. Esophageal injuries often present in subtle fashion initially, but more than a 24-hour delay in diagnosis is associated with a marked increase in mortality. In total, 7% of injuries to critical structures of the neck involve major arterial vascular structures, including the subclavian and internal, external, and common carotid arteries [1]. Arterial injuries are a major source of morbidity and mortality for these patients. Currently, spinal cord injuries and thrombosis of the common and internal carotid arteries account for 50% of all deaths attributable to blunt and penetrating neck trauma.

Aerodigestive injuries

Epidemiology

Penetrating injuries to the airway and digestive tract are primarily caused by gunshot wounds and stab wounds. Wounds requiring operative repair are extremely rare. In one series of 12,789 consecutive trauma patients...
over an 8-year period, only 12 (0.09%) patients had aerodigestive injuries [2]. Other studies place the injury rate closer to 5%. It is therefore difficult to conduct large-scale studies to determine optimal diagnostic and management decisions, and the existing literature reflects this.

Blunt trauma composes only about 5% of all neck trauma [3]. Aerodigestive injuries are rare but potentially life threatening and require a high index of suspicion to diagnose and treat properly. During a 9-year period (1988–1996) at one level 1 trauma center, 12,789 trauma patients were seen in the emergency department, of whom only 16 (0.13%) had tracheobronchial injuries [2]. Airway occlusion is the most immediately recognizable and rapidly fatal injury, but many other injuries to the aerodigestive tract present more insidiously and prove no less fatal.

The most common mechanism causing blunt trauma to the neck is the motor vehicle collision [4]. These injuries typically result from rapid acceleration and deceleration, or direct blow of the anterior neck on the steering column or dashboard crushing the trachea at the cricoid ring and compressing the esophagus against the cervical vertebrae. They can also occur from increased intrathecal pressure against a closed glottis from improper seat belt use [3].

Strangulation results from hanging, ligature suffocation, manual choking, and excessive manipulation. The usual mechanism of death in hangings occurs from pressure on the jugular veins, preventing venous return from the brain and backing blood up in the brain, resulting in a loss of consciousness. The now unconscious patient falls with all of his weight against the ligature, compressing the trachea and restricting airflow to the lungs. Irreversible asphyxiation follows in minutes [5]. Choke holds, no longer promoted in police training, typically generate greater force and injure by carotid artery occlusion or carotid body reflex. Clothesline injuries occur in sports (football tackle, martial arts), all-terrain vehicles, motorcycles, and snowmobiles. Direct blows by fists, feet, and other blunt weapons, and excessive cervical manipulation account for the remainder [6,7].

Clinical presentation

Any history that the patient is able to communicate about the mechanism of injury should be elicited. If the patient arrives by emergency medical services they should have information, as may friends or family who come with the patient. Clinical symptoms range from patients who have no symptoms to those who have life-threatening airway compromise or profound shock.

Penetrating injuries to the airway may present with dyspnea, hoarseness, and cough. Conversely, progressive airway obstruction from an external source, such as an expanding hematoma, often presents with abnormal respiratory patterns, stridor, dysphonia, tachypnea, or cyanosis. In 1985, Kelly and colleagues published a 20-year study that examined 106 consecutive patients who had neck trauma (100 penetrating and 6 blunt); all 80 patients who had
tracheal injuries had signs of airway compromise in the emergency department. These signs included tachypnea, dyspnea, cyanosis, subcutaneous emphysema, and an abnormal respiratory pattern. Hemoptysis was an unreliable sign of serious injury and patients who had major vascular or tracheal injuries rarely survived [8]. Other investigators have found that breathing difficulties may not be present initially. Other presenting features include voice alteration, stridor, drooling, cervical subcutaneous emphysema, or crepitation, dyspnea, and distortion of the anatomy of anterior neck, including loss of normal landmarks, asymmetry, flattened thyroid prominence, and tracheal deviation [9].

The evaluation of blunt neck trauma begins with the airway. Greene [10] evaluated the clinical signs of laryngeal fracture according to anatomic location. Injuries above the glottis presented with cervical emphysema, progressive airway obstruction, palpable thyroid cartilage disruption, dysphagia, and hoarseness. Although injuries located below the glottis were not associated with swallowing difficulties and did not have early signs of airway compromise, they did present with hemoptysis and persistent air leak from the endotracheal tube in intubated patients [10].

Early detection of penetrating esophageal injuries remains difficult. The average delay to diagnosis from time of injury is usually many hours when using a selective approach, and the resultant morbidity and mortality are significant [11,12]. Although more than 90% of patients survive if the injury is detected within 24 hours, the survival rate drops precipitously after this time, usually from infectious complications, such as mediastinitis. Clinical findings of dysphagia, odynophagia, drooling, and hematemesis are approximately 80% sensitive for injury [10]. Clinical signs of esophageal injury are infrequently present, although crepitus in the neck or a sucking neck wound may be found on physical examination. Subcutaneous emphysema may be seen on plain radiographs.

Blunt esophageal injuries are uncommon. Dysphagia, blood in oral gastric and nasogastric aspirate, and crepitus are all signs of blunt esophageal rupture. In some cases there may be no initial signs of significant injury. This phenomenon is particularly relevant in the elderly population. Keogh and colleagues [13] describe two cases in which minor neck trauma caused significant airway compromise from delayed neck hematomas. Both patients were anticoagulated with warfarin.

Diagnostic evaluation

Penetrating injuries

Stable patients are approached from a selective set of criteria that are outlined in detail in Fig. 1. Lateral neck plain films and chest radiographs are useful initial tests. Subcutaneous emphysema is often the most common presenting sign in significant injury to the aerodigestive tracts [14]. In patients who have airway disruption, the surgical anatomy of the rupture creates
predictable patterns of air leak on plain films. Patients who have laryngeal transection may have gross, deep, and superficial cervicofacial emphysema, whereas patients who have tracheal rupture often present with massive mediastinal and deep cervical emphysema without pneumothorax [15].

The improvement in speed and resolution of images by multidetector computed tomography (MDCT), including the 16-row multiplanar reconstructions, has had a significant impact on the adoption of selective management of penetrating neck injuries. CT can accurately identify extrapulmonary air, directly visualize tracheal wall disruption and signs of transtracheal balloon herniation in intubated patients, and locate extratracheal endotracheal tube position [16]. In cadaveric intubations with tracheal disruption, CT images closely match those compared with matched live cases, and equally good results comparing CT images to bronchoscopic images confirm the accuracy.

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**Diagnostic Algorithm for Penetrating Neck Trauma**

**Penetrating neck trauma**

- **Stable**
  - Physical exam
  - AP Chest x-ray
  - AP/lateral soft tissue neck x-ray
  - normal
  - abnormal
  - Observation

- **Unstable**
  - -hemorrhagic shock
  - -evolving stroke
  - -expanding hematoma
  - -unstable airway
  - Surgical exploration

**Zones I, II, III**

**MDCT/Conventional Angiography**

- Suspicion of Aerodigestive injury
- Esophagoscopy
- Laryngoscopy

- Vascular injury
- Surgical exploration

**No injury**

- Observation

**injury**

- Surgical exploration

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**Fig. 1. Diagnostic algorithm for penetrating neck trauma.**
of CT. The reconstructions also help the surgeon to choose the optimal surgical approach. These studies also note that it takes an extreme amount of pressure to rupture the tracheal rings in cadavers, suggesting it would be unlikely for routine endotracheal balloon inflation during intubation to cause additional airway compromise in penetrating neck injuries [17,18].

Stable patients who have suspected airway injury should be evaluated with a combination of careful physical examination, plain films, CT, and bronchoscopy, depending on the institutional approach. Although three-dimensional (3D) reconstructive CT is extremely good at identifying and locating tracheal injuries, bronchoscopy must still be considered the gold standard test.

Barium swallow, flexible endoscopy, and rigid endoscopy all have sensitivities approaching 90%. In one study the combination of rigid endoscope and barium swallow found 100% of esophageal injuries [19]. MDCT may demonstrate free air in the neck caused by esophageal perforation or rupture (Fig. 2); however, this diagnostic modality cannot presently be considered a gold standard because large-scale studies have not been performed to measure its sensitivity for this potentially catastrophic entity. The combination of a barium swallow and endoscopy must be pursued if a high suspicion for esophageal perforation persists despite a negative MDCT.

**Blunt injuries**

Fig. 3 presents an approach for the diagnostic evaluation of blunt injuries. Imaging of the patient who has a blunt neck injury has evolved with the advent of high-resolution CT. Although lateral soft tissue neck

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**Fig. 2.** Multidetector CT of the neck reveals free air adjacent to the esophagus secondary to a traumatic perforation (arrows).
radiographs are rarely used exclusively to rule out aerodigestive injuries, significant injuries can be diagnosed reliably [15]. A chest radiograph remains a mainstay of the initial trauma workup in assessing for pneumothorax, hemothorax, and pneumomediastinum.

CT scanning is the initial imaging modality of choice in the hemodynamically stable patient and is used to guide selective operative management. Chen and colleagues [16] found that CT accurately diagnosed tracheal rupture with deep cervical air in intubated cadavers. Moriwaki studied 3-D reconstructed CT for diagnosing tracheal injury site. 3-D CT accurately identified the site of injury, as confirmed by bronchoscopy [17]. In conjunction with CT, panendoscopy ensures complete evaluation of aerodigestive injuries.

Fig. 3. Blunt neck trauma: vascular and aerodigestive injuries.
Schaefer and Brown [20] developed a classification system for laryngeal injuries based on a combination of CT scanning and endoscopy (Table 1).

Fiberoptic nasopharyngoscopy for a preliminary assessment of the extent of trauma and evaluation of vocal cord function, direct laryngoscopy for a detailed view of the larynx, bronchoscopy to examine the subglottic larynx, and esophagoscopy for evaluation of esophageal mucosa are all recommended in the workup of blunt neck trauma patients who have signs of injury. Additionally, barium swallow has been studied for esophageal injuries. Weigelt and colleagues [19] looked at 118 stable patients who had cervical trauma and compared barium swallow with endoscopy. All 10 esophageal injuries were identified when the two modalities were combined. Water-soluble radiocontrast agent has replaced barium, but a swallow study alone does not rule out pharyngoesophageal leak. Before embarking on endoscopy, airway patency should be assessed and secured.

Management

Early and rapid airway assessment followed by definitive airway protection is the key to neck trauma management. The airway must be secured, and any hemorrhage must be staunched and replaced with blood products. These principles apply to penetrating and blunt neck injury. Most patients who have blunt neck trauma are wearing cervical spine collars that complicate the intubation. In-line cervical traction is a safe method for stabilizing the cervical spine during intubation. The optimal technique for intubating a patient who has penetrating neck injuries is by direct laryngoscopy, although it has not been studied at length. It is not clear when a patient should be observed expectantly for impending airway compromise or when the patient should be intubated to avoid a situation in which the anatomy becomes so distorted as to make the procedure more difficult or impossible leading to an emergent surgical airway. These remain clinical

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<th>Group</th>
<th>Symptoms</th>
<th>Signs</th>
<th>Management</th>
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<tr>
<td>1</td>
<td>Minor airway symptoms</td>
<td>Minor hematoma, no fracture</td>
<td>Observation, humidified O₂</td>
</tr>
<tr>
<td>2</td>
<td>Airway compromise</td>
<td>Edema, mucosal disruption</td>
<td>Tracheostomy, direct laryngoscopy, esophagoscopy</td>
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<tr>
<td>3</td>
<td>Airway compromise</td>
<td>Massive edema, exposed cartilage, vocal cord immobility</td>
<td>Tracheostomy, exploration/repair</td>
</tr>
<tr>
<td>4</td>
<td>Airway compromise</td>
<td>Massive edema, exposed cartilage</td>
<td>Tracheostomy, exploration/repair, stent required</td>
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judgments. Clearly any patient in shock, with hypoxia, or with clear airway compromise needs immediate intubation.

It is safe to use rapid sequence intubation using a short-acting paralytic along with an induction agent. In the most recent series in the literature, 100% of 39 patients were successfully intubated using succinylcholine. In total, 12 patients underwent fiberoptic intubation by otolaryngology clinicians with 3 failures. Interestingly, those 3 patients were subsequently successfully intubated using rapid sequence intubation [21]. This example underscores the vital importance of the clinician using the technique with which he is most comfortable during emergent airway management. If the airway can be visualized through the traumatic wound because of tracheal disruption, it may be possible to intubate the trachea directly through the wound. A single case report describes the use of the gum elastic bougie to facilitate the intubation of a patient who had a self-induced deep slash wound to zone II and complete tracheal transection. When blind intubation failed, the bougie was used to intubate the trachea, the tracheal rings caused the typical clicking to confirm the bougie’s location, and the endotracheal tube was successfully placed into the trachea over the bougie [22].

There are numerous alternative intubation methods if direct laryngoscopy fails or cannot be used. Flexible fiberoptic endoscopes can be used for orotracheal and nasotracheal intubations. These techniques require patient preparation with topical anesthetics and often intravenous sedation, and are therefore time consuming and depend on the experience of the operator. Newer rigid fiberoptic endoscopes and videolaryngoscope blades may aid in finding the vocal cords for intubation, although all of the fiberoptic methods are difficult to use in the presence of bleeding or heavy secretions.

Blind nasotracheal intubation historically has been discouraged because of a perceived high failure rate and potential for complications. A recent study of 40 patients intubated prehospital demonstrated a 90% success rate with a similar mortality rate to matched patients who were orotracheally intubated [23]. It is reasonable to consider this a technique in the prehospital setting where emergency orotracheal intubation is not possible. A surgical airway may be used as a last resort. Cricothyrotomy, or occasionally tracheostomy, is the required procedure because of altered anatomy. There is a risk that the operator could open an otherwise stable hematoma while incising through fascial planes and obscure the operative field along with causing significant hemorrhage.

The wound should be examined with care for degree of penetration, although probing is discouraged because it may inadvertently open a hematoma that was otherwise not actively bleeding. Patients who have progressive subcutaneous or mediastinal emphysema, severe dyspnea requiring intubation, difficulty in mechanical ventilation, uncontrolled hemorrhage, or patients who have an air leak from their chest tubes should all be directed to the operating room for definitive surgical management [24].
Penetrating injuries to the cervical spine

There are no reports of unstable cervical spine injuries in penetrating neck trauma by stab wounds. It is a rare individual who may possess the strength and ferocity to fracture the vertebral column during such an attack, let alone to create an unstable fracture. Gunshot wounds to the neck would need to fracture the cervical vertebrae in two columns to create an unstable fracture. The bullet must traverse the spinal cord to cause this injury, and the patient presents with neurologic signs. A 14-year study of patients sustaining gunshot wounds to the face and neck showed that all patients who had unstable cervical spine fractures also presented with neurologic signs [25]. In this study, 3 awake and neurologically intact individuals presented with gunshot wounds to the face resulting in stable cervical spine fractures A prior series found no cervical spine injuries in 174 patients who had gunshot wounds to the head [26]. Based on these results, immediate urgent treatment of the penetrating neck wound should take precedence over concerns for the cervical spine, including removing a cervical collar to gain access to the injury. All patients who have gunshot wounds to the neck and face should subsequently have a CT of the bony cervical spine to look for occult fractures, and once the injury has been addressed the collar should be replaced until radiography definitively shows there is no fracture.

Direct laryngoscopy using a Macintosh or Miller laryngoscope blade causes minimal movement of the cervical spine in healthy patients positioned on a rigid board (10–11 degrees of movement) before intubation [27]. Patients who need to be intubated can be safely managed with in-line traction and care to keep movement of the neck to a minimum during the procedure.

Vascular injuries

Epidemiology

Most penetrating neck injuries are caused by knives and low-energy gunshot wounds. Fortunately, these weapons impart a low level of kinetic energy to tissues compared with military rifles and shotguns. The mortality rate from these injuries is approximately 2% to 6%. The victims are primarily young men who have injuries sustained as a result of interpersonal violence.

Significant vascular injuries of the neck occur in approximately 1% to 3% of all major blunt trauma victims [28–31]. High-speed motor vehicle accidents cause most of these injuries [32]. Other mechanisms include motorcycle crashes, pedestrians struck by motor vehicles, falls, assaults, and hangings and near-hangings [33]. Although these injuries are rare, the morbidity and mortality rates are significantly higher than for penetrating trauma. The overall mortality related to blunt injuries is 20% to 30%; in
addition, 37% to 58% of patients develop permanent neurologic deficits attributable to central nervous system ischemia [34].

In blunt trauma, injury to the cervical arteries is likely caused by rapid deceleration associated with hyperflexion, hyperextension, and rotation. Vascular structures are stretched over the cervical spine and shearing forces create intimal tears in the vessel wall [35]. Both blunt and penetrating vascular injuries result in the formation of pseudoaneurysm, dissection, arteriovenous fistula, complete transection, and thrombus formation with occlusion attributable to disruption of atherosclerotic plaque. Stroke in these patients is believed to be caused by occlusive thromboembolus. Compromise of collateral flow is presumably responsible for worse outcomes in patients who have atherosclerotic vascular disease [36].

Clinical presentation

The challenge for the emergency physician is to detect subtle but significant injuries that require intervention. This pertains specifically to patients who have no immediate indication for operative intervention because of airway compromise or hemodynamic instability. The presence of “hard signs” (Box 1) on physical examination indicates a high risk for vascular injury. Pulse deficit is not a sensitive indicator of significant injury because the pulses may be normal with nonocclusive injuries, such as an intimal flap or pseudoaneurysm, that nonetheless require surgical intervention. A bruit or thrill is pathognomonic of a traumatic arteriovenous fistula that typically needs surgical repair. “Soft” signs are less predictive of vascular injury and these are listed in Box 2. Central nervous system ischemia is considered a soft sign. A primary neurologic injury presents as an immediate deficit, whereas a neurologic injury caused by ischemia typically becomes evident over the course of minutes to hours. Proximity to a major vascular structure is not considered a high-risk feature in the absence of hard signs.

Blunt vascular injuries involving the carotid or the vertebral arteries are rare and the clinical presentation is often subtle and nonspecific. McKevitt documented that 60% of blunt cervical injuries were unsuspected at initial evaluation, and symptoms often were masked by concomitant head or thoracic injuries in multiple blunt trauma victims [36]. If identified and treated early, the likelihood of permanent devastating neurologic dysfunction is

<table>
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<th>Box 1. Hard signs of vascular injury</th>
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<tr>
<td>Bruit or thrill</td>
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<tr>
<td>Expanding or pulsatile hematoma</td>
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<tr>
<td>Pulsatile or severe hemorrhage</td>
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<tr>
<td>Pulse deficit</td>
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Box 2. Soft signs of vascular injury

- Hypotension and shock
- Stable, nonpulsatile hematoma
- Central or peripheral nervous system ischemia
- Proximity to a major vascular structure

decreased. The recognition of symptoms is typically delayed, and almost 25% of patients first develop signs and symptoms 24 hours postinjury. Often, the initial manifestation of a blunt vascular injury is an acute ischemic stroke attributable to a thromboembolic event.

The classic presentation is a neurologically intact victim who subsequently develops hemiparesis after a high-speed motor vehicle crash. There are no reliable clinical means with which to diagnose blunt carotid injury before development of neurologic deficits or stroke [37]. The vast majority of patients manifest neurologic deficits at the time of diagnosis of blunt carotid injury [28]. Definitive diagnostic testing should be pursued for patients who demonstrate any of the high-risk features listed in Box 3. With this approach, 72% of all blunt vascular injuries can be identified before the onset of neurologic deficits [34]. The incidence of blunt vascular injury in patients who have an ecchymosis from the shoulder seat belt is three times higher than the incidence in blunt trauma victims in general [31].

Vertebral artery injuries are associated closely with cervical spine injuries [33]. Some 33% of cervical spine fractures are associated with a vertebral artery injury after excluding simple spinous process fractures. Fractures involving the transverse foramen are present in 78% of these patients, whereas subluxation is associated with most of the remaining injuries. At

Box 3. High-risk criteria to for blunt cerebrovascular injuries

- Severe hyperextension or flexion and rotation of neck
- Significant soft tissue injury or large hematoma of the anterior neck
- Cervical spine fracture
- Seat belt sign across the neck
- Massive epistaxis attributable to a carotid-cavernous sinus fistula,
- Bruit or thrill
- Stroke or transient ischemic attack
- Unexplained neurologic abnormalities
- Basilar skull fracture involving the petrous bone
least one of these bony injuries is present in 92% of patients who have vertebral artery injury. Bilateral injuries occur in approximately 15% of all patients [28,34]. Concurrent injuries are common; McKevitt and colleagues [36] found that almost 95% of patients who had blunt vascular injuries of the neck had a concomitant major thoracic injury or a Glasgow Coma Scale score less than 8.

Diagnostic evaluation

Conventional four-vessel cerebral angiogram remains the reference standard for evaluating the carotid and the vertebral arteries with a sensitivity in excess of 99%. It provides accurate assessment of the vessels with respect to the presence of dissection, pseudoaneurysm, occlusion, and transection. Rarely do injuries missed by angiography require repair and a normal study is highly predictive of survival from vessel injury [38,39]. Conversely, angiography is invasive, expensive, and resource intensive, and involves mobilizing interventional radiology. The complication rate is approximately 1%, usually involving the catheter insertion site or reactions to the intravenous contrast. Biffl and colleagues [35] developed a classification system for blunt carotid artery injuries based on the angiographic findings (Table 2). The system is successfully used to guide further management.

MDCT angiography has evolved as a sensitive, readily available, and less invasive diagnostic technique tool for the purpose of assessing patients at risk. In series of penetrating neck injuries, the sensitivity of MDCT angiography is 90% to 100% compared with conventional angiography and surgical exploration [40,41]. Most patients who meet screening criteria for blunt vascular injury currently undergo MDCT scanning for other reasons. Adding this technique to clinical evaluation reportedly increased the rate of identification of injuries by a factor of three, decreased the mean time to

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<th>Grade</th>
<th>Angiographic findings</th>
<th>Prognosis</th>
<th>Treatment</th>
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<tr>
<td>I</td>
<td>Vessel wall irregularity or dissection with &lt;25% of luminal diameter</td>
<td>Good, 7% progress</td>
<td>Systemic anticoagulation controversial</td>
</tr>
<tr>
<td>II</td>
<td>Raised intimal flap, thrombus, dissection, or hematomas &gt;25% of luminal diameter</td>
<td>Fair with treatment, 70% progress</td>
<td>Systemic anticoagulation</td>
</tr>
<tr>
<td>III</td>
<td>Pseudoaneurysm</td>
<td>Require intervention</td>
<td>Surgery or stenting</td>
</tr>
<tr>
<td>IV</td>
<td>Total vessel occlusion</td>
<td>Outcome assured at the time of diagnosis</td>
<td>Systemic anticoagulation</td>
</tr>
<tr>
<td>V</td>
<td>Transection</td>
<td>Very poor, high mortality</td>
<td>Surgery</td>
</tr>
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diagnosis and decreased the rate of permanent neurologic sequelae from carotid arterial injuries [34]. In comparison with conventional angiography, MDCT angiography has a sensitivity of 68% and a specificity of 67%. MDCT angiography missed 55% of grade I injuries, 14% of grade II injuries, and 13% of grade III injuries (see Table 2) [42]. The modality missed 53% of carotid injuries and 47% of vertebral injuries; approximately one third of the missed injuries were significant lesions, causing stroke in carotid distribution territory. Higher resolution, 64-slice technology will likely improve the sensitivity and specificity of MDCT angiography. The modality is limited by artifacts from metallic fragments and occasionally by abundant soft tissue air. In such cases, conventional angiography is required for optimal assessment.

Magnetic resonance angiography has shown some promise in assessing the presence for blunt vascular injury in patients who are hemodynamically stable and can undergo the procedure. Biffi and colleagues [43] demonstrated a sensitivity of 75% and specificity of 67%, magnetic resonance angiography compared with conventional angiography. Because of a marginal improvement in sensitivity over MDCT angiography, lack of routine availability and applicability to the acutely injured patient, magnetic resonance angiography is unlikely to become a routine screening tool for blunt vascular injuries of the neck.

Duplex ultrasonography is noninvasive, convenient, and low cost, but the sensitivity for vascular injury is highly operator dependent. In the hands of experienced technicians, the sensitivity of duplex ultrasound versus conventional angiography as the reference standard is 90% to 95% for injuries requiring intervention [44]. Duplex ultrasonography can miss nonocclusive injuries with preserved flow, such as intimal flaps and pseudoaneurysms. The technique is also limited by the ability to evaluate only the common carotid and external carotid arteries. Most injuries involve the internal carotid artery, which is not evaluated well by ultrasound.

Management

Definitive treatment is determined by the angiographic grading of vascular injury. In general, surgical repair is preferred over ligation except in the case of coma without antegrade flow. These cases are associated with a high risk for converting an ischemic to a hemorrhagic brain injury, uncontrollable hemorrhage, and inability to place a temporary shunt. Primary repair is preferred over graft placement when possible.

Surgical intervention for blunt injuries is an option for accessible lesions and includes resection, thrombectomy, and ligation of lesions involving the common or external carotid. Unfortunately, most blunt injuries involve the internal carotid artery, which is less accessible. Anticoagulation therapy has been instituted to reduce morbidity and mortality related to specific grades of injury to the carotid or vertebral arteries [33]. The grading system for
these lesions proposed by Biffl and colleagues group these lesions into categories based on size, outcome, and treatment options for each (see Table 2). The rate of subsequent stroke in patients who were initially asymptomatic has been decreased by as much as 75% when systemic anticoagulation was instituted. These studies must be interpreted with caution, because a control group was not included. Some patients were also excluded because of coexisting traumatic injuries. Antiplatelet therapy has been used when concurrent injuries present a contraindication to systemic anticoagulation. Anticoagulation therapy also has proved to be beneficial in patients who have vertebral artery injuries. When treated with anticoagulation using heparin, aspirin, or aspirin and clopidogrel, neurologically intact patients who have early detection of blunt vertebral artery injury had a 0% incidence of stroke [34]. Other studies have similarly found that anticoagulation decreases the rate of neurologic morbidity in posterior circulation stroke [33].

Percutaneous angioplasty with stent placement after follow-up angiography has been used for the treatment of persistent blunt carotid injuries [45,46]. This intervention has raised concern regarding the danger of iatrogenic stroke and has yet to obtain wide acceptance [47,48]. Currently, it seems that the risks exceed the benefits, especially for carotid artery lesions.

Summary

Early airway management is crucial to successful management of severe penetrating and blunt neck injuries. Orotracheal intubation is the initial method of choice; however, no single method is successful 100% of the time. It is therefore crucial that practitioners are skilled in several different approaches to airway management, including providing a surgical airway. In patients who do not have obvious indications for operative intervention initially, evaluation for hard signs of vascular injury should be pursued. Hard signs include bruit, thrill, expanding or pulsatile hematoma, pulsatile or severe hemorrhage, pulse deficit, and central nervous system ischemia. A high degree of suspicion should be maintained for esophageal injury; unfortunately, radiographs do not exclude esophageal injury and triple endoscopy is the optimal diagnostic method for the evaluation of aerodigestive injury. The reference standard for vascular injury is conventional angiography. MDCT angiography is a noninvasive, less expensive, and more convenient alternative that is rapidly becoming the diagnostic tool of choice in the evaluation of cervical vascular injury caused by penetrating and blunt trauma.

References

EVALUATION AND MANAGEMENT OF NECK TRAUMA