Penetrating Neck Trauma

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PATHOPHYSIOLOGY

Unstable cervical spine fractures and spinal cord injuries are extremely unlikely in the presence of low-risk National Emergency X-radiography Utilization Study I (NEXUS I) criteria—that is, the patient:

1. Is alert and awake
2. Is not intoxicated
3. Has no signs or symptoms of neurologic injury
4. Has no spinous process tenderness

ANATOMY

The neck consists of three anatomic zones (see Fig. 77.1):

- Zone I—base of the neck to the cricoid cartilage (Fig. 77.2)
- Zone II—cricoid cartilage to the angle of the mandible
- Zone III—above the angle of the mandible (Fig. 77.3)

The major muscles of the neck are the platysma muscles, which extend from the lower jaw to the clavicle (Fig. 77.4). Other critical structures are shown in Figures 77.5 through 77.7.

PRESENTING SIGNS AND SYMPTOMS

AIRWAY INJURY

Symptoms of airway injury include dyspnea, hemoptysis, subcutaneous air, stridor, hoarseness, and dysphonia (Fig. 77.8).

VASCULAR INJURY

“Hard signs” that indicate severe vascular injury include the following:

- Bruit or thrill suggestive of a traumatic arteriovenous fistula
- Expanding or pulsatile hematoma
- Pulsatile or severe hemorrhage
- Pulse deficit—pulses may be normal in patients with nonocclusive injuries that require surgical repair, such as intimal flaps or pseudoaneurysms
“Soft signs,” which are less predictive of severe vascular injury, include the following:

- Hypotension and shock
- Stable, nonpulsatile hematoma
- Central nervous system ischemia—a neurologic deficit that develops over the course of 1 to 2 hours after injury is consistent with ischemic neurologic injury; an immediate deficit is more likely to be due to a primary neurologic injury

- Proximity to a major vascular structure is not considered a high-risk feature in the absence of the preceding criteria (Fig. 77.9)

**DIGESTIVE TRACT**

The pharynx must be examined by visual inspection. Under normal conditions, the esophagus is mobile and collapsed. Symptoms and signs of esophageal injury include
subcutaneous air, crepitus, dysphagia, odynophagia, drooling, and hematemesis.

**DIAGNOSTIC TESTING**

**VASCULAR INJURY**

**Conventional Angiography**

The “gold standard” of diagnostic modalities is four-vessel angiography with venous-phase imaging (sensitivity > 99%) (Fig. 77.10). Very rarely do injuries missed by angiography require repair. A normal study is highly predictive of survival from vessel injury.³

**Duplex Ultrasonography**

Duplex ultrasonography is noninvasive, convenient, and relatively inexpensive, but its sensitivity in detecting vascular injury is highly operator dependent. However, its sensitivity in comparison with conventional angiography is 90% to 100% for injuries requiring intervention.³ Duplex ultrasonography can miss nonocclusive injuries with preserved flow, such as intimal flaps and pseudoaneurysms.
Multidetector Helical Computed Tomographic Angiography

This diagnostic modality has largely supplanted duplex ultrasonography in patients without obvious indications for immediate operative intervention (Fig. 77.11). The sensitivity of multidetector computed tomographic (MDCT) angiography is 90% to 100% with respect to conventional angiography and surgical exploration. Sensitivity is further improved with high-resolution computed tomography scanning, such as 64-row technology, and with increased technical experience using this modality. When compared with conventional angiography, MDCT...
angiography is faster, less expensive, and noninvasive and does not involve interventional radiology.

**PHARYNGEAL INJURY**
Hypopharyngeal injuries may be difficult to visualize on radiographic contrast swallow studies, especially if patients are intubated. Videolaryngoscopy is an alternative diagnostic modality that is effective in detecting these injuries.6

![Angiogram revealing extravasation of contrast agent caused by a stab wound in the subclavian artery.](image)

**ESOPHAGEAL INJURY**
Esophageal injuries may be clinically silent initially. Radiographs do not exclude esophageal injury. Contrast-enhanced studies have a sensitivity of 50% to 90%. Esophagoscopy has a sensitivity of 43% to 100% (Table 77.2).

Rigid endoscopy has higher diagnostic yield than flexible endoscopy does; however, it is associated with a higher incidence of complications, including iatrogenic rupture. A combined approach that includes both contrast-enhanced studies and esophagoscopy has a sensitivity of 100%.7,8

<table>
<thead>
<tr>
<th>Diagnostic Test</th>
<th>Sensitivity (%)</th>
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<tbody>
<tr>
<td>Physical examination</td>
<td>80</td>
</tr>
<tr>
<td>Contrast-enhanced study</td>
<td>89</td>
</tr>
<tr>
<td>Rigid esophagoscopy</td>
<td>89</td>
</tr>
<tr>
<td>Contrast-enhanced study plus esophagoscopy</td>
<td>100</td>
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</tbody>
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![Gunshot wound to the mandible. A and B, Helical computed tomographic angiography reveals diminished flow through the right common carotid artery (arrow). C and D, Conventional angiography demonstrates a pseudoaneurysm (arrow) of the vessel proximal to its bifurcation.](image)
SELECTIVE EVALUATION

Selective surgical exploration is recommended for patients without obvious indications for surgical repair. Nonoperative techniques (Fig. 77.12) are sufficiently sensitive to safely rule out injuries that require an operation. Esophageal and arterial injuries have reportedly been missed during exploration. A selective approach is more cost-effective than mandatory exploration.

NEUROLOGIC INJURY

Fortunately, injuries to the brain, spinal cord, and peripheral nerves are uncommon (Fig. 77.13; see Table 77.1). Patients with primary neurologic injuries are seen initially with focal deficits or alteration in mental status.

TREATMENT

PREHOSPITAL MANAGEMENT

Prehospital care should focus on maintenance of an open airway. Establishment of a definite airway should be performed only when absolutely necessary because of the complexity of the procedure in these patients. Partial airway injuries may lead to complete airway obstruction during endotracheal intubation. Hemorrhage should be controlled with direct pressure only. Spine immobilization is secondary to airway maintenance and control of bleeding in patients who are neurologically intact and awake.

AIRWAY INTERVENTIONS

Direct visualization of the airway is optimal, and orotracheal intubation is the initial method of choice because the procedure is frequently performed and rarely associated with complications. Ideally, intubation is accomplished with topical anesthesia while the patient is awake. If not possible, rapid-sequence induction should be performed. Fiberoptic intubation is reserved for semielective airway management unless an experienced operator and the necessary equipment are immediately available. Visualization may be impaired because of extensive hemorrhage and secretions.

Cricothyrotomy or tracheostomy is necessary if orotracheal or fiberoptic intubation is unsuccessful. A surgical airway should not be delayed because an expanding hematoma can quickly distort the anatomy and result in complications. Intubation through an accessible neck wound has a very high success rate (Fig. 77.14). In this instance, care must be taken to control the proximal end of the trachea so that it does not retract into the thorax.

Nasotracheal intubation is not a preferred airway technique. Its success rate varies from 0% to 75%. It is potentially
associated with complications because of the “blind” nature of the procedure. A more direct, visualized approach is suggested (Fig. 77.15).

When diagnosed, injuries to the larynx or trachea are treated by primary surgical repair in the operating room. Immediate surgical exploration should also be performed in patients with progressive subcutaneous or mediastinal emphysema, pneumothorax, severe dyspnea, or associated esophageal trauma. This is followed by a mid or low tracheostomy, depending on the site of the injury.

WOUND CARE AND EVALUATION

The emergency physician (EP) may gently spread the wound edges without probing. The patient should be placed in the Trendelenburg position if there is any concern about internal jugular vein injury and possible air embolism. Wounds should be closed only if the depth is clearly visualized; caution is urged because assessment of depth is difficult. The EP must suspect deep penetration and ensure complete diagnostic evaluation.

Vascular Injury

Direct pressure should be used; blindly clamping structures with poor visualization should be avoided. Pharyngeal packing for severe oral bleeding may be necessary. Subclavian vein injury should be suspected in patients with zone I injuries. Intravenous access should be established on the side opposite the injury to avoid potential extravasation of fluids.

Emergency department thoracotomy is indicated for patients with zone I injuries and refractory shock. Subclavian artery injury should be suspected in these cases. Treatment is determined by angiographic grading of the vascular injuries. Primary repair is preferred over graft placement when possible.

Surgical repair of carotid and vertebral artery injuries is preferred over ligation except in the following cases:

- Coma without antegrade flow because of the high risk of converting an ischemic to a hemorrhagic brain injury
- Uncontrollable hemorrhage
- Inability to place a temporary shunt

Esophageal Injury

Delay in diagnosis and repair of esophageal injuries is associated with increased morbidity and mortality because of the potential for mediastinitis. When surgery is performed less than 24 hours after the injury, the survival rate is greater than 90%; when surgery is performed more than 24 hours after the injury, it is just 65%.

Cervical Spine Injury

Rigorous spinal precautions should not be maintained at the expense of managing life-threatening airway or vascular injuries in patients who are awake and neurologically intact without focal deficits. Unstable spine fractures are almost...
invariably associated with focal neurologic deficits or altered mental status. Early fracture stabilization and fixation are mandatory. Corticosteroids have no role in spinal cord injury caused by penetrating trauma.

**ADMISSION AND DISCHARGE**

Admission criteria include (1) any signs or symptoms of organ damage and (2) penetration of the platysma, which is only 2 to 3 mm in depth.

**REFERENCES**

References can be found on Expert Consult @ www.expertconsult.com.
REFERENCES