

# Penetrating nontorso trauma: the head and the neck

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## SUMMARY

Acute penetrating injuries to the head and neck cause considerable anxiety for most clinicians owing to concern for airway control and neurologic injury and to limited clinician experience in most centres. This article discusses an organized approach to the evaluation and initial treatment of penetrating injuries to the head and neck based on regional anatomy and clinical examination. The approach is particularly helpful in the context of ongoing hemorrhage and/or airway compromise.

**A**cute penetrating injuries to the head and neck continue to induce considerable anxiety for most clinicians. This reality is founded in an appropriate concern for both airway control and neurologic injury, as well as in limited clinician experience in most centres. The focus of this article is to deliver a concise and efficient diagnostic and initial management plan for patients with penetrating injuries to the head and neck.

## BRAIN AND FACE INJURIES

Penetrating brain injuries can be particularly lethal. As with torso and extremity penetrating trauma, high-fidelity cross-sectional imaging with computed tomography (CT) represents the gold standard diagnostic investigation for penetrating brain injuries. This method allows a rapid and detailed evaluation of the skull, face, sinuses, intracranial blood vessels and brain parenchyma. Although these wounds can be dramatic in appearance and presentation, the trajectory is particularly important in the case of gunshot wounds (GSWs). Transcranial wounds (i.e., wounds that cross the midline) are almost uniformly fatal. Notable exceptions include isolated frontal lobe transcranial wounds as well as a minority of occipital transcranial trajectories. Gunshot injuries that remain ipsilateral, however, generally have a much better prognosis. In this setting, immediate guidance from a neurosurgeon is mandatory, as full neurologic rescue manoeuvres are common. It is interesting to note that many GSWs to the skull provide pressure decompression via the wounds themselves.

Given the vascular nature of the head and face, ongoing massive hemorrhage is not infrequent. As noted elsewhere, balloon tamponade can be particularly helpful in the initial arrest of hemorrhage, as can simple intraoral finger pressure or packing pressure.<sup>1</sup> Similarly, capturing an airway is typically the most urgent matter in patients who present with massive destruction of their mandible and midface following coronal GSWs. Obtaining an airway is often simple in these patients, using the exposed tongue as a guide; obtaining an airway must precede the diagnostic workup for concurrent brain and/or other injuries. A surgical cricothyroidotomy remains the resident rescue airway.

It should also be noted that foreign bodies (missiles, shrapnel, dirt, glass) within the orbits, eyes and scalp lacerations must be ruled out via imaging or clinical examination. Retained debris in these areas is particularly problematic with regard to both function and sepsis.

## NECK INJURIES

Penetrating neck injuries are variable with respect to the occurrence of injury (GSWs 50%, stab wounds 10%–20%). As with torso trauma, the approach to

penetrating trauma of the neck is based on regional anatomy. The modern division of the anterior neck comprises 3 zones: zone 3 above the angle of the mandible, zone 2 between the angle of the jaw and the cricothyroid membrane and zone 1 between the cricothyroid membrane and the clavicles/manubrium (Box 1). Penetrating injuries to zones 1 and 3 parlay notorious difficulty in obtaining emergent surgical access and therefore require an urgent CT screening examination to rule out injury in the presence of any abnormality detected on physical examination or chest radiograph.<sup>2</sup> Vascular injury in particular can be studied with CT angiography,<sup>3</sup> percutaneous angiography or duplex ultrasonography,<sup>4</sup> depending on the resource profile of a given centre. Metal fragments (missile, shrapnel) may create artifact limitations that are more easily bypassed using formal percutaneous angiography. Despite the impressive reliability and sensitivity of the physical examination for detecting clinically relevant penetrating cervical vascular injuries (false-negative rate 1%),<sup>2,3,5-7</sup> angiography should be considered mandatory in cases of injury that traverse 2 neck zones, cross the midline, have concurrent head injury and resulted from shotgun blasts and/or multiple missile tracts. Because of the ease of surgical access, zone 2 has undergone a series of liberal versus conservative approaches over the past decades. Current evidence clearly supports a selective nonoperative algorithm in cases where hemodynamic and airway stability are evident. Nontherapeutic neck explorations in this scenario approach 67% in some series.<sup>6-8</sup> When patients require investigations to rule out vascular (carotid and vertebral arteries), digestive (esophagus) and/or airway (trachea) injuries, some authors advocate multidetector CT as an isolated test to rule out all 3 systems.<sup>3</sup> Additive bronchoscopy, esophagoscopy and contrast fluoroscopy examinations can also be extremely helpful.<sup>6,7</sup> The combination of endoscopic and radiologic examination of the esophagus in particular is known to improve the sensitivity of each test in isolation. As always, hard signs of cervical aerodigestive and/or vascular injury mandate immediate operative or percutaneous exploration. These include ongoing hemorrhage, enlarging/pulsatile hematoma, bruit (carotid-jugular arteriovenous fistula), pulse deficit, pending airway compromise,

bubbling from the wound, acute focal neurologic deficits (including hemiparesis), large-volume hemoptysis or hematemesis, or concern for complete airway transection (i.e., respiratory distress/stridor). Approximately 3% of patients with soft signs of injury (subcutaneous emphysema, hoarseness, odynophagia) will require a therapeutic operative intervention. As with extremity trauma, injuries with shotgun or explosive mechanisms should undergo a complete angiographic evaluation of regional vasculature to rule out the presence of multiple injuries. Unlike extremity trauma, however, there remains no reliable equivalent of an ankle-brachial index for the brain. As a result, massive bleeding at the scene, proximity to trajectory and a nonpulsatile hematoma are considered to be soft signs of potential vascular injury that should illicit further investigations. It must be emphasized that there remains no role for probing neck wounds. If the wound has penetrated the platysma, there is a 45% chance of an underlying injury. Balloon tamponade can be particularly expedient at arresting hemorrhage in the neck and has been advocated as a definitive treatment for venous injuries in some centres.<sup>1,9,10</sup>

Clinically significant cervical spine injuries caused as a result of penetrating trauma are rare. If a patient arrives with an intact neurologic examination despite GSW or stab wounds to the neck, the incidence of a cervical spine injury that requires a therapeutic intervention is minute. As a result, in a neurologically intact and examinable patient, a cervical collar should be immediately removed to facilitate the remaining components of the diagnostic evaluation.

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### Box 1. Organs of potential concern within the anterior cervical zones

Zone	Anatomical structures involved
Zone 1	Great vessels Esophagus Trachea Phrenic nerve Vagus nerve
Zone 2	Carotid and vertebral arteries Esophagus Airway
Zone 3	Base of skull Carotid and vertebral arteries Oropharynx