Blunt and penetrating cervical trauma

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Abstract

Trauma to the cervical region may result in critical injury to the airway, the neck vasculature, and the pharynx or oesophagus. These three systems should be systematically assessed, alongside ATLS protocols, in all patients presenting with blunt or penetrating trauma to the head and neck region. The majority of trauma centres now have a policy of selective neck exploration based on clinical and radiological findings. It is therefore essential to be aware of the symptoms and clinical signs of injury of key neck structures, so that neck exploration can be performed promptly in patients who require it.

Keywords Haemorrhage; laceration; neck trauma; perforation; vascular injury

Introduction

Trauma to the cervical region can occur from a wide variety of mechanisms of injury, and due to the anatomical complexity of the neck, should be managed by a multidisciplinary team of surgeons, radiologists and anaesthetists. The neck is often relatively protected from blunt trauma, but severe or penetrating injuries pose the threat of rapid exsanguination from major vessels, potentially fatal airway compromise and cervical cord disruption. There is no level 1 evidence on the management of cervical trauma, and practice is therefore informed by retrospective and prospective observational trials and expert opinion. This article details the management of blunt and penetrating trauma to the neck region; facial trauma and detailed head and neck anatomy are covered in other articles.

The cervical region is anatomically subdivided into triangles, and in the case of trauma, into vertical zones. These regions are useful for the clear description of neck injuries, but also to focus the surgeon on the anatomical structures most at risk. The anterior triangle is bounded posteriorly by the posterior border of sternocleidomastoid, superiorly by the mandible, and anteriorly by the midline. The posterior triangle is bounded anteriorly by the posterior border of sternocleidomastoid, posteriorly by the anterior border of trapezius, and inferiorly by the clavicle.

Roon and Christensen first described the vertical zones of the neck in the context of trauma in 1979: zone 1 lies between the thoracic inlet and the cricoid cartilage; zone 2 between the cricoid and the angle of the mandible; and zone 3 between the angle of the mandible and the skull base.[1] Injuries to zone 1 may affect the trachea or oesophagus, the major vessels of the thoracic inlet (brachiocephalic and subclavian veins, common carotid arteries, jugular veins), as well as the lung apices. The clinical signs in a zone 1 may be less overt than in other zones. Zone 2 is the most commonly affected by trauma, and is the most readily accessible surgically. Injuries here may affect the larynx, pharynx, the jugular veins, the carotid vessels and branches of the external carotid artery, the cervical spine and cord, and the lower cranial nerves. Zone 3 injuries may affect the external or internal carotid arteries, the internal jugular, the lower cranial nerves and the cervical cord, and the major salivary glands. The proximity to the skull base makes surgical access and control of haemorrhage more challenging (Figure 1).

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ATLS protocol

Advanced Trauma Life Support protocol is a universal algorithm for managing traumatized patients, with cervical trauma especially applicable. In the face of complex pathology, it is vital to conduct a systematic assessment without being distracted by dramatic injuries. In high-velocity blunt trauma or where there is evidence of a neurological deficit, the cervical spine will often be immobilized: this should be maintained until the cervical spine has been cleared, unless it is absolutely necessary to remove precautions to secure a critical airway. However, in penetrating trauma there is evidence that the rate of concurrent cervical spine injury is extremely low, and that the use of C-spine fixation is associated with increased mortality, because the neck is then not properly assessed.[2]

Management of the traumatized airway

The assessment of the airway takes precedence over all other injuries. In a large proportion of cervical trauma, the airway is not affected, and a rapid assessment of the patient's respiratory pattern, added respiratory sounds and voice may be sufficient, provided that the team remains vigilant for any sign of deterioration. It is vital to remember that, even if there is no physical injury or impingement of the airway, the patient can become unable to safeguard their own airway due to a fall in GCS for any reason. If there is a suggestion of airway compromise, a more detailed assessment must be carried out immediately, ideally by an anaesthetist in conjunction with an ENT surgeon.

The upper airway can be impinged at multiple levels, from the oral cavity to the trachea. Blood, debris, teeth or other foreign material in the oral cavity and oropharynx may compromise the airway, and should be cleared with suction and/or Magill's forceps. Fractures of the mandible and facial skeleton may lead to haematoma and soft tissue disruption, which can compromise the upper airway and preclude endotracheal intubation. The oropharynx and hypopharynx can be compromised by bleeding from direct laceration, extrinsic compression from haematoma, or foreign bodies. The larynx and trachea can additionally be compromised by oedema caused by blunt trauma, or fractures of their cartilaginous skeleton, leading to disruption of airway anatomy at its narrowest point, the glottis.

Assessment of the airway

The key symptoms of airway compromise are a raised respiratory rate, stertor, stridor, gurgling (implying blood in the airway), a

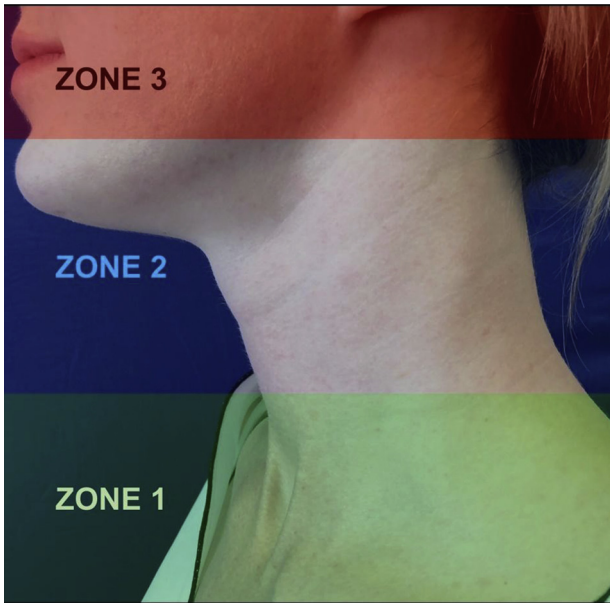

Figure 1 Zones of the neck in penetrating cervical trauma, as per Roon & Christensen (1979).[1]

bubbling or sucking neck wound, surgical emphysema, the use of accessory muscles, and subcostal, intercostal or suprasternal recession. It is essential to differentiate stertor from stridor, as this gives information about the likely site of obstruction. Stertor is a 'snoring' or gurgling sound generated from the oropharynx or hypopharynx. Stridor is a higher-pitched sound caused by obstruction at the level of the larynx or trachea. Stridor, which is inspiratory, originates from the supraglottis or glottis, as the narrowing is dynamic and caused by indrawing of the soft tissues on inspiration. Biphasic stridor originates in the subglottis or trachea; the tissues in this region are rigid, thus any narrowing is *static*, and so the noise is present on both inspiration or expiration.

Patients with signs of airway obstruction can deteriorate rapidly, and should be managed alongside an anaesthetist and/or ENT surgeon, in a place of safety — either the resuscitation area or an operating theatre. The patient should be sat upright (if safe), with suction available to clear the airway, and supplemental oxygen. The airway should be examined via the mouth, including examination for any missing teeth (which could potentially have been ingested or aspirated). Further examination with flexible nasendoscopy should be performed jointly with ENT if there is any doubt about the patency of the airway.

It is important to remember that, as per Poiseuille's law, a very small reduction in airway diameter produces a large increase in the patient's symptoms. A high dose of intravenous steroid should therefore be given unless contraindicated, as well as adrenaline nebulizers, which produce a small degree of vasoconstriction and reduced oedema. A nasopharyngeal airway can be a helpful adjunct in patients with head and neck trauma.

Securing the airway

Patients with a significant work of breathing due to upper airway compromise, or who show signs of deterioration or tiring, must receive a *definitive airway*. The airway should be secured early, rather than waiting for further deterioration. It can be very helpful to perform fibreoptic nasendoscopy to visualize the airway jointly, and make a plan of action for intubation. In the large majority of cases, endotracheal intubation is suitable for securing the airway. This can be performed using a conventional orotracheal technique, with or without adjuncts such as video laryngoscopy. Alternatively, awake fibreoptic intubation can be performed via the nose or mouth, to help in navigating any airway abnormality, while avoiding extension of the cervical spine.

The difficult intubation guidelines (2015) published by the Difficulty Airway Society provide a simplified algorithm for managing situations were endotracheal intubation is challenging or impossible.[3] A supraglottic device (e.g. laryngeal mask airway) may be used as a 'rescue' method, but in the setting of trauma to the head and neck is unlikely to represent a safe airway in the longer term. In patients where intubation is likely to be challenging, the potential for requiring front-of-neck access (FONA) should be anticipated and equipment made available in advance. FONA may represent the only suitable method of securing the airway in select cases, particular in severe oropharyngeal injuries or laryngeal disruption, and in this case it is better performed under local anaesthesia in a controlled manner, in the form of a surgical tracheostomy.

If endotracheal intubation fails, and non-invasive ventilation does not stabilize the patient, the preferred method of emergency front-of-neck access is the scalpel-bougie cricothyroidotomy. This is the simplest method for securing the airway and is preferable to vertical-incision tracheostomy in all but the most experienced hands. All anaesthetic and trauma clinicians should have training in performing the technique in a 'can't intubate, can't ventilate' (CICO) scenario. In anticipated difficult intubation, it can be helpful to mark the laryngeal landmarks on the skin before commencing anaesthesia. The cricothyroid membrane is palpable as a soft area just superior to the superior edge of the cricoid cartilage (Figure 2, dotted line). A horizontal stab incision is made directly into the airway with a size 10 blade. The blade is twisted slightly to allow the passage of a slim bougie into the airway. A small endotracheal tube or tracheostomy tube is then inserted.

Tracheal injury

Direct laceration of the trachea is uncommon. The patient may present with haemoptysis, dyspnoea or surgical emphysema if a penetrating injury has breached the tracheal mucosa. A small puncture wound may be seen to be bubbling with surrounding surgical emphysema. Tracheal lacerations should be repaired with an extramucosal monofilament suture such as 3-0 PDS. Consider a covering tracheostomy in any significant laryngeal or tracheal laceration during the immediate healing period.

Fractures of the laryngeal skeleton

Blunt trauma to the anterior neck may rarely result in direct injury to the laryngotracheal complex. Even in the absence of a fracture of the cartilaginous framework of the larynx, a significant blow to the area can result in delayed-onset stridor and respiratory decompensation due to tissue oedema and/or haematoma. Laryngotracheal injury should be suspected in a trauma patient with hoarseness, stridor or laryngeal pain, bruising or swelling in the anterior neck, or haemoptysis from blunt trauma.