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Updates in management of penetrating neck trauma

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Signature

Introduction

Penetrating wounds of the neck are common in the civilian trauma population. Risk of significant injury to vital structures in the neck is dependent upon the penetrating object. For gunshot wounds, approximately 50% (higher with high velocity weapons) of victims have significant injuries, whereas this risk may be only 10-20% with stab wounds (***Bumpous et al., 2000)***.

The management of penetrating neck trauma presents a significant challenge to emergency personnel. Penetrating injuries to the neck present a challenging diagnostic and therapeutic dilemma because the spectrum of injuries ranges from minor to acutely life threatening. Successful management requires a practical understanding of the anatomy of the neck and the tremendous number of vital structures in close proximity (***Thompson et al., 2001).***

The etiology of penetrating neck injuries can be divided into three categories: gunshots, stabbings, and miscellaneous. Each category has different predisposing factors and injury patterns. Gun shot wounds and other high-velocity injuries generally produce greater damage and thus are more likely to require surgical exploration. Injuries from gunshots and stabbings most often have a clear etiology, and their epidemiological patterns vary according to causal factors (e.g., crime rates, hunting accidents, military activity).Concomitant injury patterns obviously must be diagnosed and managed. The miscellaneous category represents a broad spectrum of injury by various other penetrating objects from automobile glass secondary to car collisions to impalement from airborne objects. Associated injury patterns can be as broad and unpredictable as the mechanism of injury itself. The pediatric patient with penetrating neck trauma represents a unique management challenge. This type of injury is uncommon

in the pediatric population, but the potential injuries and complications can be devastating **(*Abujamra and Joseph, 2003)*.**

In the study by Ramasamy et al, of 90 patients with a penetrating neck injury, 66 (73%) were from explosions and 24 (27%) were from gunshot wounds. In 20 (22%) patients, cervical spine injuries were present; only 6 (7%) survived to reach the hospital, and 4 of these 6 died within 72 hours of their injuries.Tow of 56 survivors that reached a surgical facility, only 1 (1.8%) had an unstable cervical spine injury requiring surgical stabilization, and this patient subsequently died due to a concomitant head injury (***Ramasamy et al., 2010***).

The pathophysiology of penetrating injury is relatively straight forward. Traditionally, gunshot wounds are divided into low-velocity weapons (< 1000 ft/sec) and high-velocity weapons (>2500 ft/sec). Low-velocity weapons, which includes most handguns, tend to cause direct vascular injury. High-velocity weapons

(e.g., hunting rifles and assault rifles) cause cavitation or disruption of tissue well removed from the tract (***Britt and Peyser, 2004)***.

Basic knowledge of the anatomy of the neck is essential in appreciating the complex nature of these injuries and serves as a landmark in the management of these injuries. The neck is divided into three anatomic zones. This helps in the categorisation and management of neck wounds. Zone I extends from the bottom of the cricoid cartilage to the clavicles and thoracic outlet. Zone II includes the area between the cricoid cartilage and the angle of the mandible. Zone III involves the area above the angle of the mandible up to the base of the skull (***Moeng and Boffard, 2002)***.

The choice of investigation will be influenced by the condition of the patient. Stable patients can be investigated fully according to the clinical findings, where as instability may only allow for a few emergency room investigations or nothing at all before exploration

in theatre. Investigation does not replace good thorough clinical examination but complements the findings. As a minimum, a chest X-ray and an X-ray of the cervical spine will allow assessment for haemothorax, pneumothorax, surgical emphysema, cervical spine injury and to check for foreign bodies. These can be used to augment clinical findings and help in directing further management (***Moeng and Boffard, 2002)***.

Angiogram is considered the "gold standard" for arterial injury investigation. It is an invasive investigation associated with some complications in about 1 % of the cases and false positives and false negatives do occur in about 3 % of cases (***Douglas, 1992)***.

Recently, Colour Flow Duplex imaging has been shown to be safe and effective as a screening procedure with fewer side effects and at a less cost Oesophagography and oroesophagoscopy may be required in the investigation of oesophageal

injuries.Laryngoscopy and bronchoscopy may be used to assess the airway injury (***Corr, 1999)***.

Other tests include magnetic resonance imaging (MRI) angiography and helical (spiral) CT angiography for vascular work-up, and CT scanning of the brain or neck tissues (***Moeng and Boffard, 2002).***

The initial management of a patient with penetrating neck trauma is similar to any potential major trauma patient. Of primary concern in a patient with this type of injury is airway compromise and extensive bleeding. The status of the airway can deteriorate precipitously due to edema and bleeding. The primary survey is rapidly performed with concurrent evaluation and management using a team approach if such resources are available. Supplemental oxygen should be provided, monitoring performed, and vascular access should be established. This access should be established on the opposite side of the injury (***Desjardins and Varon, 2001)***.

No role exists for probing or local exploration of the neck in the trauma bay or emergency department because this may dislodge a clot and initiate uncontrollable hemorrhage. If no significant injuries requiring surgery are present, surgical therapy is unnecessary and observation or expectant management may proceed (***Ramasamy et al., 2010***)

Before World War II non-operative management resulted in mortality rates as high as 16 %, which prompted subsequent exploration of injuries penetrating the platysma. It was further shown that mortality associated with mandatory exploration could be improved from 35 % to 6 % if patients were operated on earlier. Numerous centres have challenged the principle of mandatory exploration in the recent years. Currently civilian mortality figures are expected at 2–6 % and can be as high as 11 %.Most of these cases are associated

with vascular injuries(carotid arteries, subclavian vessels) and spinal injuries **(*Thal and Meyer, 1992).***

Aim of the work

The aim of this work is to highlight the different causes of penetrating neck.

Describe the various modalities of investigations used in the management of penetrating neck injuries.

Discussing the available guidelines and protocols of management in penetrating neck trauma.

Illustrate several surgical techniques of management, as well as identification of possible intraoperative and post operative complications.

Anatomy of the neck

SKIN:

The skin in the neck is normally under tension, and the direction in which this is greatest varies regionally. In the living face, these lines often coincide with wrinkle lines. Lines of greatest tension have been termed 'relaxed skin tension lines': surgical incisions made along these lines are said to heal with minimal postoperative scarring ***(Arababi et al., 2006)***.

Cutaneous vascular supply and lymphatic drainage:

The blood vessels supplying the skin of the neck are derived chiefly from the facial, occipital, posterior auricular and subclavian arteries. They form a rich network within platysma and in the subdermal plexus, and account for the viability of the various skin flaps raised during block dissection of the neck, irrespective

of whether they include platysma ***(McConnell and Trunkey, 2004).***

The vessels supplying the anterior skin of the neck are derived mainly from the superior thyroid artery and the transverse cervical branch of the subclavian artery. The posterior skin is supplied by branches from the occipital artery and the deep cervical and transverse cervical branches of the subclavian artery. Superiorly, the skin is supplied from the occipital artery and its upper sternocleidomastoid branch, and the submandibular and submental branches of the facial artery. Inferiorly, the skin of the neck is supplied from the transverse cervical and/or suprascapular branches of the subclavian artery

(Berkovitz et al., 2002).

The pattern of venous drainage of the skin of the neck mirrors the arterial supply, and drains into the jugular and facial veins ***(Susan et al., 2004)***.

Cutaneous innervation:

The skin of the neck is innervated by branches of cervical spinal nerves, via both dorsal and ventral rami. The dorsal rami supply skin over the back of the neck and scalp, and the ventral rami supply skin covering the lateral and anterior portions of the neck, and extend onto the face over the angle of the mandible. The medial branches of the dorsal rami of the third, fourth and fifth cervical nerves pierce trapezius to supply skin over the back of the neck sequentially. The ventral rami of the second, third and fourth cervical nerves supply named cutaneous branches (the lesser occipital, great auricular, transverse cutaneous and supraclavicular nerves), via the cervical plexus located deep to sternocleidomastoid ***(Richardson et al.,2002).***

The lesser occipital nerve is derived mainly from the second cervical nerve.It supplies the skin and connects with the great auricular and greater occipital nerves and the auricular branch of the facial nerve. Its auricular branch supplies the skin on the upper third of the medial

aspect of the auricle and connects with the posterior branch of the great auricular nerve. The auricular branch is occasionally derived from the greater occipital nerve.It has been suggested that compression or stretching of the lesser occipital nerve contributes to cervicogenic headache ***(Byron and Lippincott, 1998)***.

Great auricular nerve this is the largest ascending branch of the cervical plexus. It arises from the second and third cervical rami.It divides into anterior and posterior branches. The anterior branch is distributed to the facial skin over the parotid gland, connecting in the gland with the facial nerve. The posterior branch supplies the skin over the mastoid process and on the back of the auricle (except its upper part); a filament pierces the auricle to reach the lateral surface where it is distributed to the lobule and concha. The posterior branch communicates with the lesser occipital, the auricular branch of the vagus and the posterior auricular branch of the facial nerve ***(Susan et al., 2004).***