

## Cervical penetrating trauma: literature review

### Trauma cervical penetrante: revisão de literatura

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#### ABSTRACT

Penetrating neck injuries are a major cause of morbidity and mortality in emergency admissions and surgical emergency services, so it is extremely important the anatomical and functional knowledge of the main structures affected during trauma. This article is a literature review of the major anatomical divisions, besides directing the physician to the diagnosis and best choice through selective management that seeks to identify patients who could benefit from surgical treatment of their wounds in an attempt to decrease the number of operations unnecessary.

**Keywords:** *Cervical trauma, penetrating neck injury, surgical exploration, conservative treatment.*

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## **RESUMO**

Lesões cervicais penetrantes são uma importante causa de morbi-mortalidade nos serviços de urgência e emergência cirúrgica, por isso, é de suma importância o conhecimento anatômico-funcional das principais estruturas acometidas durante o trauma. O presente artigo faz uma revisão bibliográfica das principais divisões anatômicas, além de direcionar o diagnóstico e a melhor escolha através da gestão seletiva que busca identificar os pacientes que podem se beneficiar de tratamento cirúrgico de seus ferimentos. Tudo com o objetivo de sistematizar a melhor conduta cirúrgica e diminuir o número de operações desnecessárias.

Descritores: Trauma cervical, Lesão cervical penetrante, Exploração cirúrgica, Tratamento conservador.

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## **INTRODUCTION**

Cervical penetrating injuries (CPIs) are an important cause of morbidity and mortality, defined as any injury that exceeds the platysma muscle of the neck<sup>1-3</sup>. The PNIs were described in 1500, when the military surgeons reported vessel ligation achieved in attempts to control external bleeding<sup>1</sup>. This technique improved survival, but was accompanied by significant morbidity, particularly by the stroke.

The concept of selective non-surgical treatment of these lesions was introduced around 1980, in response to the observation that, while rates of operative mortality were declining, the number of negative surgical explorations were increasing<sup>1</sup>. The goal of selective management is to identify patients who could benefit from surgical treatment of their injuries in an attempt to reduce the number of unnecessary operations<sup>1</sup>.

Cervical penetrating injuries (CPIs) are responsible for 5% to 10% of all trauma admissions and can be quite complicated, since the complex anatomy of the neck requires careful planning to treatment<sup>4-6</sup>. Seven major components are present in this location: vascular system - common carotid, external and internal artery, jugular venous system and vertebral arteries; the gastrointestinal system - oropharynx and esophagus; the respiratory system - laryngo-tracheal structures; the endocrine system - thyroid and parathyroid gland; lymphatic system; skeletal structures - spine, mandible and hyoid bone; and the nervous system - cranial and spinal nerves<sup>7</sup>.

Penetrating venous lesions are seen in 16-18% of patients with PNT. Historically, venous cervical lesions (VCL) were identified in surgical exploration, but the change to the selective management has reduced the number of these interventions. Thus, despite the ideal for the diagnosis of VCL has not yet been determined, computed tomography angiography has been the best way to demonstrate these injuries, which are overlooked in the physical examination<sup>3</sup>. Penetrating cervical spine trauma account for about 11-14% of spine injuries and diagnosis is made by angiotomography.

Injury by firearms which extends through the spinal canal implies the presence of a spinal cord injury. However, even if the projectile does not penetrate into the spinal canal, spinal cord injury can occur in a secondary cavitation caused by high kinetic energy<sup>3</sup>. It is noteworthy that the ideal treatment of penetrating neck injuries continues to be debated today<sup>1</sup>.

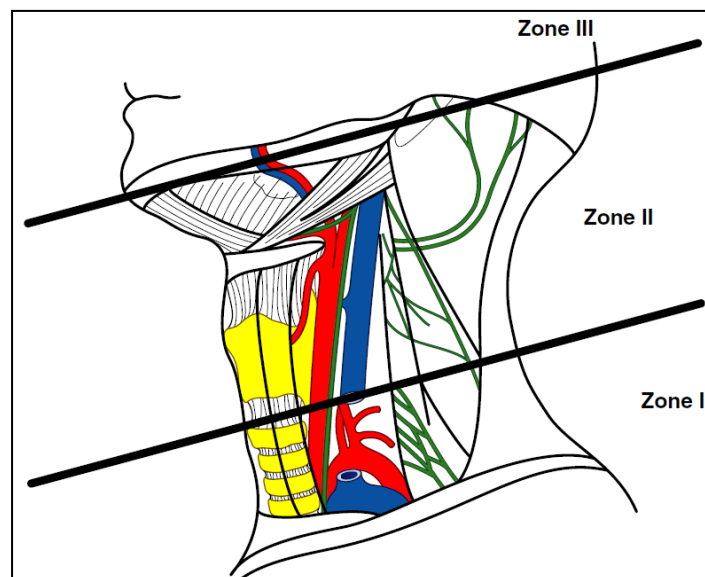
## METHODS

This is a literature review of neck trauma, which was drawn from other studies on the topic, using the keywords cervical trauma, penetrating neck injury, surgical exploration, conservative treatment. The search was performed in PubMed, Embase and Scopus databases from the descriptive analysis of articles published from 1979 to 2012.

## ANATOMICAL DIVISION OF CERVICAL REGION

The clinical and anatomical division described by Roon and Christensen, also proposed by Monson et al. is widely accepted and divides the neck in 3 specific areas (Figure 1), which guide the surgeon to a quick understanding of the risks, prognosis, evolution of lesions and facilitate to clarify communication<sup>1,3,6-8</sup>.

Zone I is the lowest of the three and is defined as the area beginning at 1 cm below the junction claviculomanubrial to the cricoid cartilage<sup>1,2</sup>. This area are segments of arteries and subclavian veins, common carotid and vertebral arteries, esophagus, trachea and thyroid part. In some patients, the aortic arch and lung apices can extend to the area I<sup>3</sup>. Zone II extends from the cricoid cartilage to the angle of the jaw<sup>1,2</sup>. The common, internal and external carotid arteries and jugular veins, larynx, pharynx, upper esophagus and veins are located in this region of the neck<sup>3</sup>. Zone III comprises the area from the level of the angle of the mandible to the skull base<sup>1,2</sup>. The internal carotid arteries and vertebral branches of the external carotid artery, internal jugular vein and pharynx are in this fone<sup>3</sup>.



**Figure 1** – Division of Clinical-anatomic neck. Zone I – begins 1 cm below the clavicle-manubrial junction until the cricoid cartilage. Zone II extends from the cricoid cartilage to the angle of the jaw. Zone III comprises the area from the mandible angle to the skull base. From: Bagheri SC, Khan HA, Bell RB. Penetrating Neck Injuries. Oral Maxillofac Surg Clin North Am. 2008 Aug;20(3):393-414

## **DIAGNOSIS**

After initial evaluation of patients victim of cervical trauma proposed by the Advanced Trauma Life Support (ATLS), the clinical evaluation should focus on signs and symptoms of lesions of large vessels, digestive tract, spinal cord, and cranial nerves. It is necessary to look for signs of entry and exit wounds and classify them according to the degree of injury. Based on the anatomical location of the suspected path of the penetrating object, physical signs and symptoms, attention is directed to a particular organ system or structure.

The only physical examination proved to be a reliable and meaningful clinical indicator of vascular injury, presenting hematoma as the most common sign, followed by shock and external bleeding<sup>1</sup>. Other important signs include absence of carotid pulse, carotid bruit, unresponsive shock to volume replacement and decreased radial pulse.

Signs and symptoms of digestive tract lesions include dysphagia, hoarseness, subcutaneous emphysema, dyspnea and bubbling from the cervical wound. Focal neurological deficits, local motor deficit, or defects peripheral sensorimotor, indicating brachial plexus injury, are common. Lack of these signs or symptoms, however, does not mean the absence of injury. Zone II injuries are the most common, about 50-80% of lesions<sup>1,8</sup>, and easily identified on physical examination and radiography, since the structures in this area are anatomically anterior, with significant manifestations in cases of injury. They are easy for surgical exploration, because they are in a zone larger than the others. Although quick and easy to approach and repair the zone II neck injuries, the philosophy of mandatory surgical exploration of all lesions in this region, regardless of clinical presentation, resulted in high rates of negative unnecessary and ineffective neck explorations, occurring around 50% - 60% of the operated cases<sup>3,9</sup>.

In contrast, lesions involving zones I and III are a real dilemma, because the surgical exposure of these regions is technically difficult (sometimes impossible) and may involve the thoracic or cranial cavity. In stable patients the lesions in zone I or III are conservatively and selectively evaluated<sup>3</sup>.

The emergencial surgical exploration is necessary in cases of vascular injury with signs of severity. Patients who are hemodynamically stable and without respiratory impairment should undergo complete diagnostic assessments. The selective approach allows to decide the need for surgery by physical examination and diagnostic tests - radiography, conventional angiography, esophagography, endoscopy, ultrasonography, magnetic resonance imaging and angiotomography<sup>3</sup>.

Computed tomography (CT) is an excellent tool for evaluation of soft tissue, trachea and larynx, being more sensitive than physical examination. However, it does not increase the sensitivity of the physical examination to assess airway lesions with significant surgical probability<sup>10</sup>. Angiography is considered the gold standard test for the detection of vascular lesions. Its use varies depending on the anatomic location of the lesion<sup>11</sup>. Currently, it is not mandatory to use angiography in the lesion zone I and III<sup>3,4</sup>.

Mazolewski et al. observed that the use of CT to significant neck injury in zone II has a sensitivity of 100% and a specificity of 91%. Therefore, with a high sensitivity and specificity, CT and CT angiography can be used to screen patients with cervical lesion. Nevertheless, the cost, time and risk are high<sup>12</sup>. Accordingly, Innaba et al. proposed that the

screening was based on the initial physical examination associated with CT of the neck, a posteriori, to eliminate any doubts. In trauma and cervical aerodigestive vessels, Innaba et. al. used CT angiography and found similar results, with sensitivity and specificity of 100% and 97.5%, respectively<sup>13</sup>. Color Doppler and magnetic resonance angiography have been proposed as non-invasive tests for the diagnosis of traumatic vascular lesions. The disadvantage of MRA is its limited ability to detect cervical spine fractures, besides being a lengthy examination, which limits its use in practice<sup>14</sup>. It was evident that in the absence of physical signs associated with penetrating injuries in zone II we can manage only with physical examination<sup>1</sup>.

## **TREATMENT**

Initial treatment of CPIs should proceed according to the ATLS, where the establishment of an adequate airway is the first priority<sup>1</sup>.

The indications for mandatory exploration for any penetrating injury, regardless of the affected cervical region, include hemodynamic instability, active external hemorrhage, hemoptysis, stridor, crackles, pulsatile or expanding hematoma, severe respiratory distress, wound bubbling or severe subcutaneous emphysema (if pneumothorax is excluded or drained)<sup>1-3</sup>.

Treatment of injuries in zone II has generated controversy in the literature over the past decades. Traditionally, symptomatic lesion in zone II would be mandatory immediate surgical exploration due to the favorable anatomy and high mortality of injuries. However, today the debate on the use of compulsory surgical exploration versus selective nonoperative treatment in asymptomatic and hemodynamically stable<sup>1</sup>.

Small laryngeal lesions can sometimes be managed conservatively, but all lesions of the larynx and trachea should be surgically repaired<sup>4</sup>.

## **CONCLUSION**

Penetrating neck trauma is a condition with high morbidity and mortality and accounts for 10% of admissions for trauma in the emergency and urgent care services. Because of this, it is important to know the anatomy of the cervical region to perform the initial physical examination, diagnostic methods and the available therapeutic approaches. Despite the debate regarding the optimal treatment of PNIs, there is consensus regarding the mandatory surgical exploration regardless the affected cervical region in cases severe signs/symptoms and hemodynamic instability.

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