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Case Report

Forty hours with a traumatic carotid transection: A diagnostic caveat and review of the contemporary management of penetrating neck trauma

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ABSTRACT

Although penetrating neck trauma (PNT) is uncommon, it is associated with the significant morbidity and mortality. The management of PNT has changed significantly over the past 50 years. A radiological assessment now is a vital part of the management with a traditional surgical exploration. A 22 years old male was assaulted by a screwdriver and sustained multiple penetrating neck injuries. A contrast CT scan revealed a focal pseudoaneurysm in the left common carotid artery bulb. There was no active bleeding or any other vascular injuries and the patient remained haemodynamically stable. In view of these findings, he was initially managed conservatively without an open surgical exploration. However, the patient was noted to have an acute drop in his hemoglobin count overnight post injury and the catheter directed angiography showed active bleeding from the pseudoaneurysm. Surgical exploration 40 hours following the initial injury revealed a penetrating injury through both arterial walls of the left carotid bulb which was repaired with a great saphenous vein patch. A percutaneous drain was inserted in the carotid triangle and a course of intravenous antibiotics for five days was commenced. The patient recovered well with no complications and remained asymptomatic at five months followup.

Introduction

Penetrating neck trauma (PNT) is uncommon, which represents approximately 1% of all traumas in the United States.[1] However a mortality rate of PNT is accounted between 3% and 6%. The most common mechanism of PNT is stab wounds.[2] Given the anatomical intricacy of this region and the vicinity of major arterial vessels to the aerodigestive tract, a multidisciplinary approach is often needed to manage these injuries.

Case report

A 22 years old male was assaulted by a slotted screwdriver and suffered multiple facial and neck penetrating injuries. On arrival to our tertiary trauma center, the patient was noted to have suffered multiple penetrating injuries to his neck, involving zone Ion the right side and zone III on the left side as well as a right sided infraorbital facial laceration (Fig. 1). The patient had an intact airway with no respiratory compromise and remained haemodynamically stable without ongoing bleeding. No neurological deficit was noted. There were no documented soft or hard signs of vascular injury.

Contrast CT scan showed extensive surgical emphysema and a poorly defined hematoma involving the left carotid and parapharyngeal space which raised concern for a concomitant pharyngoesophageal injury. A small focal pseudoaneurysm of the carotid bulb was also noted (Fig. 2). Based on these findings, a plan made by a tertiary care which combines the otolaryngology surgical team and the vascular surgical team was implemented. In view of the patient's stable clinical condition, hemodynamic stability and absence of any soft and hard signs of vascular injury, he was managed non-operatively with a view for catheter directed angiographic imaging the next day. However the patient was noted to have an acute drop in hemoglobin count overnight post injury. Via the right femoral artery access, the emergent catheter-directed digital subtraction angiography (DSA) of the carotid elucidated the active contrast blushing arising from the pseudoaneurysm at the carotid bulb, which would raise concerns about the imminent rupture (Fig. 3).

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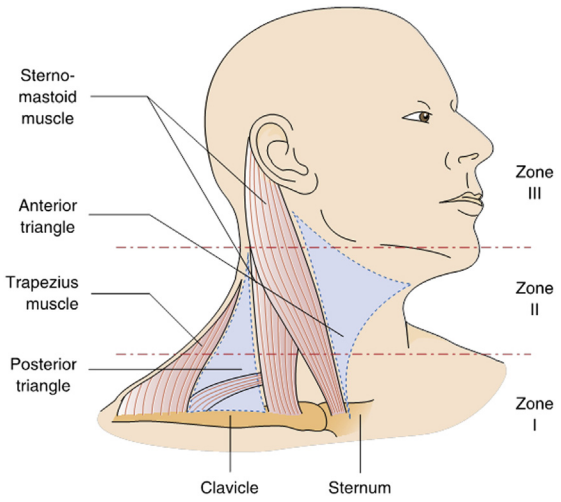

Fig. 1. Anatomical description of the location of penetrating neck injuries. Source: Van Waeset al.[11].

Fig. 2. Computer tomography angiography of the neck demonstrates a left common carotid artery pseudoaneurysm.

A decision was made to proceed with an exploration and repair of the carotid injury together with an exploration of the neck for pharyngoesophageal injury. Surgical exploration demonstrated a transection of the carotid bulb, which was repaired with a great saphenous vein patch (Fig. 4). The common carotid, internal carotid and external carotid were slung via an incision anterior to the sternocleidomastoid muscle. The anterolateral penetration of the distal common carotid was opened medially to connect with the posteromedial injury. The saphenous vein was anastomosed in a continuous fashion with 6-0 polypropylene starting at the posterior wall and continued around the medial wall to the anterior aspect of the common carotid artery. Surgical drains were left in the carotid triangle adjacent to the retropharyngeal space. In addition to this, saline lavage of the aerodigestivetract was performed by the otolaryngology team which demonstrated the absence of any

Fig. 3. A 3-D reconstruction of catheter based carotid angiography reveals focal pseudoaneurysm of the carotid bulb (white arrow).

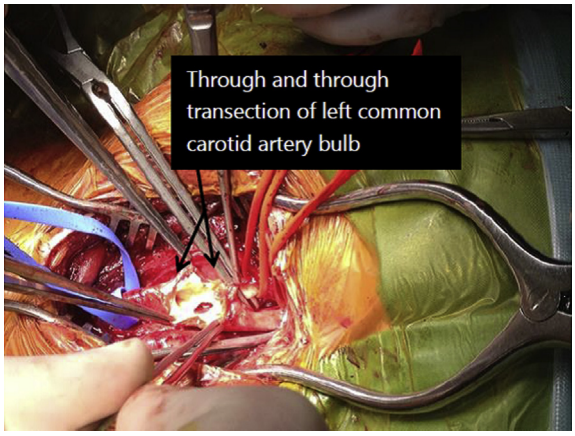

Fig. 4. Intraoperative photo depicts carotid transection in the left common carotid artery bulb (black arrows).

pharyngoesophageal injury. A barium swallow was also performed postoperatively which confirmed the absence of any aerodigestive tract injury and excluded the need for any further endoscopic assessment. The patient remained on piperacillin and tazobactam for five days and he was discharged seven days later on oral amoxicillin with clavulanate acid. Six weeks postoperatively, CT angiography (CTA) showed a patent carotid artery and the annual carotid ultrasound surveillance was planned. Five months after injury, the patient remained asymptomatic.

Discussion

The management of PNT has evolved over time. Over the following three decades, there has been a gradual shift to selective exploration or selective non-operative management secondary to high rates of negative explorations and iatrogenic injuries.[3]Current recommendation of the necessary of the mandatory exploration is controversial, which is based on anatomical location of injury.

PNT is typically classified according to the anatomical zone of the injury (Fig. 1). Zone I injuries occur between the clavicle and

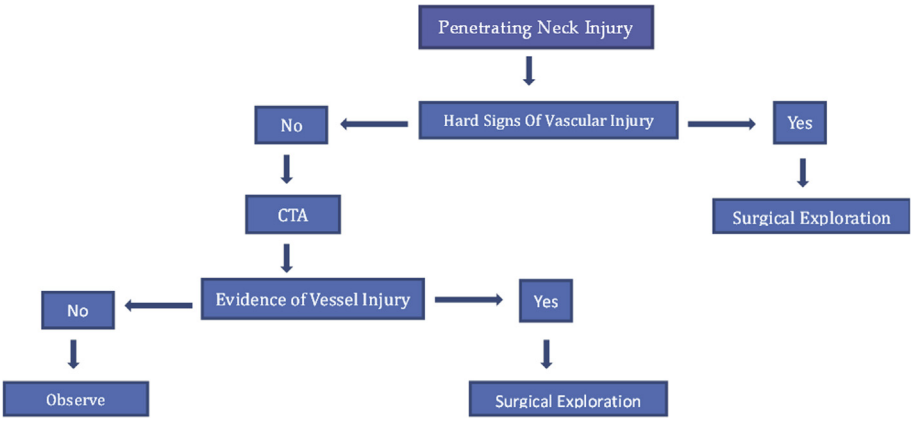

Fig. 5. Management algorithm of PNT following primary survey.

the cricoid cartilage. Zone II injuries occur between the cricoid cartilage and the angle of the mandible, while zone III injuries occur from the angle of the mandible to the base of skull. Selective exploration characteristically only occurs in zone I and III locations with adjuncts such as digital subtraction angiography and aero-digestive endoscopy, but in zone II penetrating platysma required the immediate exploration. Over time, many studies have debunked the idea that zone II injuries required the exploration and highlighted the significant burden on resources and limited diagnostic yield of investigating zone I and III injuries. CT has resulted in a shift in management to a "no zones" approach to the assessment of haemodynamically stable PNT patients.[1] Using this approach, patients are categorized as unstable or stable, rather than according to the anatomical zone of neck injury. The unstable patients could undergo an immediate exploration in the operating room. Patients who are stable but with symptomatic undergo multidetector computed tomography angiography (MDCT-A), the results of which, in combination with examination findings, help to determine whether further diagnostic tests are performed or surgical intervention is needed.

Carotid injuries typically involve the common carotid artery and can present with hard signs. However, in patients with PNT, the incidence of vascular injury is relatively lower than expected.[4]

The initial management of all trauma patients should follow ATLS principles. Specific to PNT, a definitive airway is advocated in the event of hard signs of major vascular injury. Major hemorrhage should also activate concurrent resuscitation of red blood cells, platelets and coagulation factors as appropriate. Urgent surgery is necessary in such patients. Otherwise, patients with a satisfactory primary survey assessment without active bleeding require a high definition fine cut CT angiogram. Unlike catheter angiography, CTA is minimally invasive and increasing more accessible. Moreover, CTA can also provide information about non-vascular injuries. CTA has shown high sensitivity and specificity for detecting all significant vascular and aerodigestive injuries.[5,6] One study from a Level 1 trauma center in Miami, Florida showed a sensitivity of 100% and specificity of 94% for the significant vascular and aerodigestive injuries.[5] These findings also correlated well with a Columbian study involving 175 patients with suspected penetrating neck injuries, reporting a sensitivity of 100% and specificity of 99%.[6] In a comparison study between CTA and conventional catheter directed angiography involving 60 patients with penetrating neck injuries, CTA was shown to be comparable in detecting arterial injuries. Of the 10 injuries identified on catheter angiography, nine were identified adequately on CTA, with only one carotid injury involving a small pseudoaneurysm of the origin of the common carotid artery not demonstrated as a result of inadequate field of imaging.[7] Thus we recommend that in patients without hard signs of major vessel injury CTA should be performed in conjunction with early referral to a vascular surgeon. If there is no evidence of vascular injury on CTA, neck exploration is not indicated to examine for vascular injury. If there is an evidence of vascular injury or any development of symptom or clinical sign of deterioration, patients require urgent review by a vascular surgeon and an immediate operative intervention.

Aerodigestive injuries are rare in PNT. Thoma et al[4] showed in his study of 203 patients presenting to a tertiary urban trauma center with penetrating neck injuries on account of stab or gunshot wounds,pharyngo-esophageal injury was identified in 18 (8.9%) and an upper airway injury was identified in eight (3.9%) patients. Only 25 patients (12.3%) required the surgical intervention. The remaining 158 (77.8%) patients were managed conservatively with no complications.[4] Investigation and management of these injuries is also contentious.[2,8] Contrast swallow investigations can be useful in determining the size and extent of an aerodigestive leak. However the diagnostic sensitivity for detection of leak approximates 50%.[9] Oesophagoscopy, either rigid or flexible, is highly sensitive for detecting penetrating pharyngo-oesophageal injuries.[10]

Management of aerodigestive injuries should initially follow the primary survey algorithm as mentioned previously. Any patient with a suspected aerodigestive injury should have no oral intake. Intravenous antibiotics with coverage for both aerobic and anaerobic organisms should be initiated. This case highlights the fact that benign appearing PNTmay mask a significant and potential life threatening pathology that focal pseudoaneurysms of the carotid can deteriorate quickly, even when initially stable. Therefore, we suggest that all penetrating trauma involving the neck should necessitate a multidisciplinary review using the management algorithm in Fig. 5. Following this algorithm, patients should have CT or catheter directed angiography if immediate surgery is not required. No matter how minor injury is, early involvement of a suitable tertiary referral vascular surgical center is essential for patients with any evidence of vascular injury. The authors are aware that the algorithm for managing PNT is also influenced by individual hospital factors. In a peripheral center where PNT is an unusual and often uncommon injury, our suggestion is that all such patients should be managed as per the suggested algorithm. Selective imaging should be preferably left to the dedicated trauma centers which manage PNT frequently.

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