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Case report

Case report: Tree branch penetrating injury into zone III of the neck

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ABSTRACT

Introduction: Penetrating trauma to the neck can result in severe morbidity and mortality. Location of the injury dictates the appropriate clinical management. Challenging traumatic injuries require resourceful treatment options.

Case presentation: A complex traumatic case of a foreign body penetrating the neck, the parotid gland, disrupting the internal jugular vein, with the tip resting at the anterior aspect of the C1 ring is reported. In this case, the authors seek to describe the clinical management of a vascular injury that resulted from penetrating zone III of the neck.

Discussion: Due to the complex and dense presence of various structures in the neck, injuries can be difficult to manage. Thus, an algorithm identifies management strategies that are based on the location of the injury, signs of vascular injury, identified injured structures and the hemodynamic stability of the patient. Balloon tamponade has been described in other organs of the body and might be a therapeutic option in patients were venous injuries are difficult to access.

Conclusion: Penetrating neck injuries continue to result in significant morbidity and mortality. However, with appropriate and efficient evaluation and management, better outcomes are expected as demonstrated in this case.

1. Introduction

Penetrating trauma to the neck is uncommon but often results in severe morbidity and mortality [1] with arterial and venous injuries being the most common cause of death [2]. As such, CT angiography is routinely performed to identify or rule out vascular injuries in neck penetrating trauma that violates the platysma, especially in patients who are hemodynamically unstable or show 'hard signs' of vascular injury, such as active bleeding, airway compromise, and expanding/pulsatile hematoma [3]. Location of the injury largely dictates the appropriate clinical management given the close proximity of critical structures in the neck including, nerves, vasculature, nodes, trachea, and esophagus [4]. Therefore, precise determination of foreign body location and tract is essential and may require interdisciplinary management.

The patient presented to an American College of Surgeons (ACS) community Level II trauma center located 15 miles from the Texas-Mexico border in Hidalgo County. Here, we discuss a case of a zone III neck penetrating trauma with disruption of the internal jugular vein at the base of the skull. Given the difficult access to this vascular injury, a creative solution was devised.

2. Case presentation

This is a 50-year-old male who presented after a fall. The patient was cutting tree branches, when a cut branch forced him to fall out of his boom lift and a branch impaled his face just inferior to his right tragus (Fig. 1). The patient was first taken to a freestanding ER, where CTA of the neck was performed which revealed the foreign body traversing the right parotid gland with the tip at the anterior aspect of the right side of the C1 ring. Additionally, significant focal irregularity/disruption involving the right internal jugular vein at the level of the C1 ring was observed, as well as mild narrowing of the proximal right external carotid artery (Fig. 2). The patient was transferred to an ACS verified Level II trauma center for higher level of care with the foreign body still in place.

On exam, the patient was hemodynamically stable, neurologically intact, GCS15, awake, alert, answering all questions appropriately, in no

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Fig. 1. Upon arrival, patient noted to have a penetrating foreign body just anterior to the right ear.

acute distress and without respiratory concerns. His only observed injury was the penetrating foreign body. Patient denied loss of consciousness, numbness/tingling, or pain in any other region of his body.

Given the patient's hemodynamic stability and intact neurological exam, immediate consults of ENT and vascular services for pre-operative planning were obtained. The decision was made to achieve proximal and distal control of the right internal jugular vein before any attempt to remove the foreign body. The patient was taken to the operating room by ENT and trauma surgeon. ENT began by obliterating and compressing the sigmoid sinus to obtain proximal control of the right internal jugular vein. This was accomplished by carrying out a postauricular incision on the sulcus. A flap was elevated anteriorly, identifying the temporal line. An incision along the temporal line was made as well as a vertical incision around the ear canal. The periosteum was elevated with a flap and the mastoid was noted. A microscope was utilized to aid in performing the mastoidectomy using a 4.0 mm fluted bur, which successfully eliminated most of the mastoid cells that surrounded and covered the sigmoid sinus. Dissection was then continued using a diamond bur. A 1.0 cm window was then made into the now paper-thin bone that was the wall of the sinus. The sigmoid sinus was then packed with bone putty to the point of compressing the sinus with the purpose of obliterating and ablating the sinus to stop the blood flow to the jugular vein.

The trauma surgery team then took over to obtain distal control of the right internal jugular vein. A longitudinal incision was made along the anterior border of the sternocleidomastoid muscle. Dissection was carried down until the muscle was identified and retracted laterally. The internal jugular vein was found and isolated. Internal jugular vein ligation was performed with a #0 silk suture to obtain distal vessel control. The tree branch was slowly retracted and venous bleeding from the tract was encountered. Given the quality, quantity, and location of the bleeding, being deep into a tract and close to several small vessels and nerves, the decision was made to tamponade the tract. A tamponade device that was fashioned using an 18F red rubber catheter and penrose

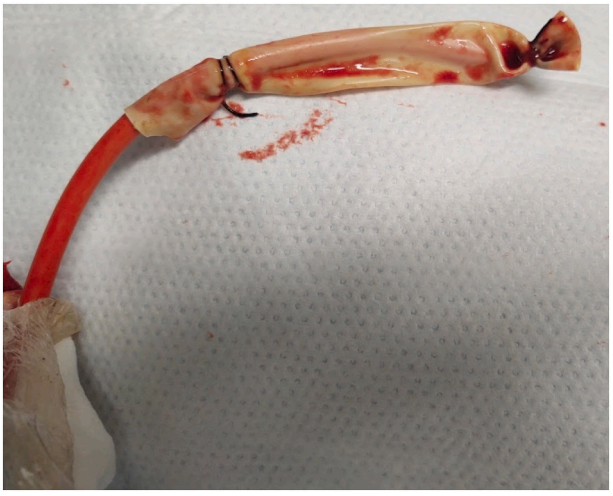

Fig. 3. Tamponade device constructed of 18F red rubber catheter and penrose drain ligated proximally and distally.

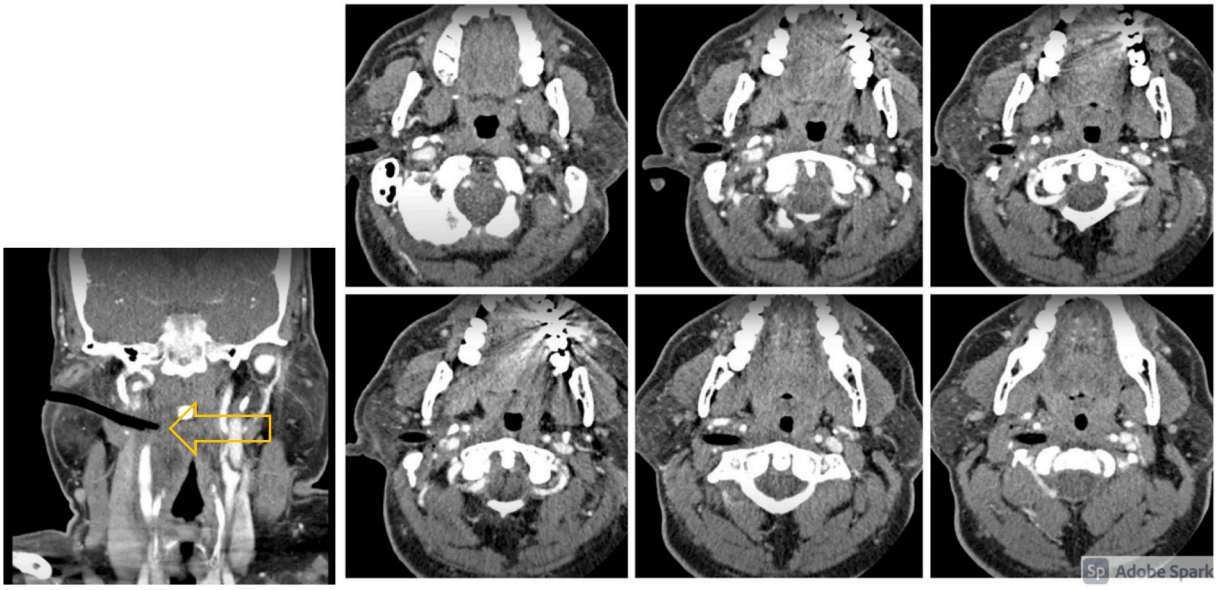

Fig. 2. Neck CTA revealing the penetrating foreign body traversing through the parotid gland with disruption of the internal jugular vein.

drain that was cut to the approximate length of the tract and ligated proximally and distally with #0 silk, (Fig. 3) was then inserted into the cavity and instilled with 20 cc of sterile water. The catheter was clamped, producing adequate tamponade effect. The neck incision was closed and the patient was taken to the ICU intubated and sedated but and stable condition.

On post-operative day (POD) 1, the patient remained intubated as there was no cuff leak present, presumably due to compressive effect of the tamponade device (Fig. 4). The patient underwent a repeat CT of the neck, which did not reveal significant stenosis of the carotid artery or vertebral artery (Fig. 5). On POD 2, the patient was successfully extubated to nasal cannula with supplemental oxygen. The tamponade device was drained in the operating room, in the event that emergent operative intervention would have been required, but remained prophylactically in place, in the event of later bleeding. The patient also underwent an upper GI study that ruled out esophageal injury. On POD 4, the tamponade device was removed as there was no bleeding from the wound. The patient was noted to have facial asymmetry and a facial nerve injury was suspected. On POD 9, he was taken back to the operating room for a facial nerve exploration. However, upon evaluation, the nerve was noted to be intact. The patient's facial asymmetry slowly improved and he was discharged soon after.

3. Discussion

Trauma to the neck is a relatively rare occurrence and approximately 5–10 % involves penetrating injuries with mortality as high as 11% [5]. Due to the complex and dense presence of various structures in the neck, injuries can be difficult to manage. Thus, an algorithm identifies management strategies that are based on the location of the injury, signs of vascular injury, identified injured structures and the hemodynamic stability of the patient [6]. Patients exhibiting hemodynamic instability or hard signs of vascular injury, such as airway compromise or expanding/pulsatile hematoma are immediately taken to the operating room. Injured patients who are hemodynamically stable and without hard signs of vascular injury undergo CT angiography [7]. In this particular case, the patient was hemodynamically stable and without hard signs of vascular injury. Therefore, radiological work up as well as immediate consults to the ENT and vascular services for pre-operative planning were obtained. If the CT angiogram reveals a vascular injury, the patient is taken to the operating room or interventional radiology suite. If there is any suspicion for tracheoesophageal injury, which is reported to occur in approximately 7 % of penetrating neck injuries, the patient may need a bronchoscopy and/or esophagogastroduodenoscopy or swallow study. Given the location of the tip of the branch in this case, there was concern for an esophageal injury. However, there was little clinical suspicion to suggest the presence of a tracheoesophageal injury.

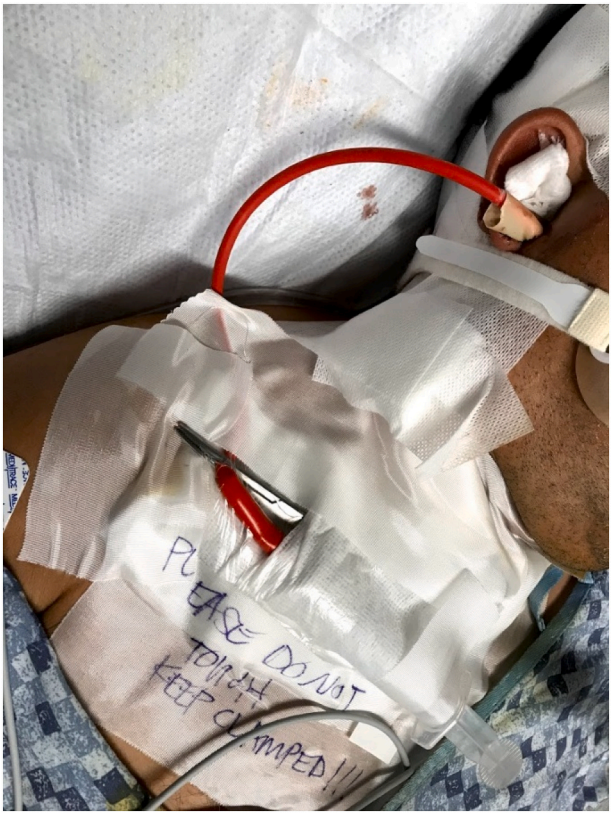

Fig. 4. Tamponade device in the tract formed by the foreign body.

The zones of the neck are commonly described as a means of managing injuries [8]. Zone I spans from the clavicles/sternum to the cricoid. Injuries in this region may affect mediastinal structures, thoracic duct, proximal carotid artery, vertebral artery, subclavian artery, trachea, lung, and esophagus. Thus, zone I injuries pose many life-threatening scenarios. Zone II includes structures from the cricoid to the angle of the mandible and is the most injured zone. Injuries in zone II may affect the carotid artery, vertebral artery, larynx, trachea, esophagus, jugular veins, vagus nerve, and recurrent laryngeal nerve. Zone III includes structures between the angle of the mandible to the base of the skull. Injuries may affect the carotid artery, vertebral artery, jugular vein, salivary gland, parotid gland and cranial nerves. This case entailed a zone III injury, which affected the internal jugular vein without injury to the internal carotid artery. The injury was anterior to the vertebral body but did not affect the spinal cord.

As with any trauma, penetrating neck injuries are evaluated with appropriate primary survey, with airway management as the first step. Key actions then include hemorrhage control, further analysis of injury, and possible operative/procedural intervention [9]. Decision of whether or not to operate on a patient with a penetrating neck injury can, at times, be controversial. However, 'hard signs' indicate a definitive need for operative intervention. Such signs may include active bleeding, shock, airway compromise, neurological deficit, hematemesis, or expanding/pulsatile hematoma [10]. In the absence of hard signs and therefore no need for immediate transfer to the operating room, workup, evaluation, and management of penetrating neck trauma can be complex and require interdisciplinary involvement.

With the introduction of newer imaging modalities, such as multidetector computed tomographic angiography (MDCTA), which is a highly sensitive and specific screening method for evaluation of vasculature and tracheoesophageal structures in the neck, management is shifting away from mandated exploration and low yield imaging [11] resulting in lower morbidity, radiation burden, and utilization of healthcare resources.

While zone II injuries allow for easier neck explorations, injuries to zone I and zone III involve vasculature high in the neck or low in the thoracic inlet, leading to more complicated exposures. Additionally, many injuries may be deceiving in that the external wound may not always correlate with internal projection and path of injury. Zone III injuries that disrupt the carotid artery may require mandible subluxation or mandibulotomy [12]. While, this case did not require mandibular displacement, this injury necessitated a complicated and multidisciplinary operative plan given the need to proximally ligate the internal jugular vein via the sigmoid sinus. Venous drainage for the mesiotemporal region occurs through the basal vein of Rosenthal and internal cerebral veins into the unpaired vein of Galen and the straight sinus into the transverse sinus and finally into the sigmoid sinus where it finally enters the internal jugular vein [13].

Given the difficulty accessing this injury and despite the internal jugular ligation, significant venous bleeding was encountered upon removal of tree branch, which necessitated the use of a tamponade device. The use of tamponade devices in surgery varies from hepatic to

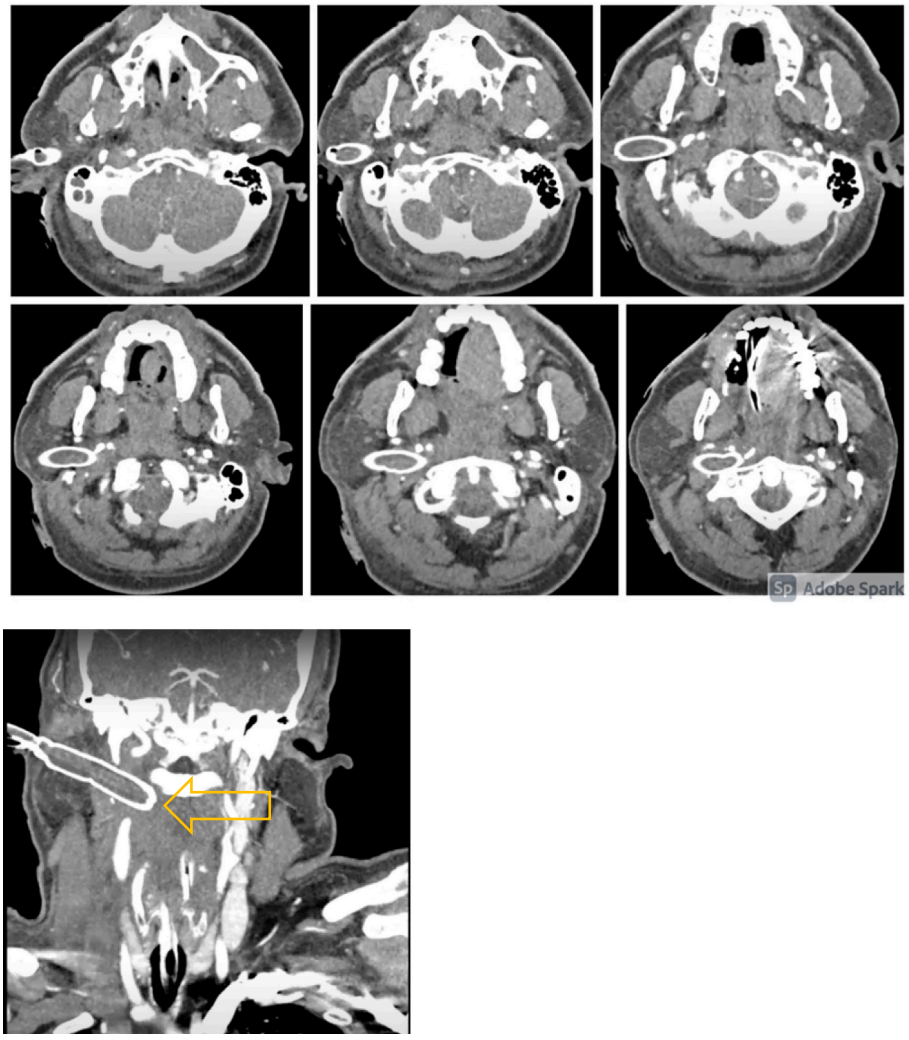

Fig. 5. Neck CTA post operatively revealing tamponade of tract.

uterine to cardiac surgeries. A foley balloon is commonly the tamponade device of choice, even in penetrating neck injuries [14]. Here, however, a unique tamponade device fitted to the exact tract of injury was devised. The decision to retrofit a new kind of device rather than use the foley catheter balloon stemmed from the need to tamponade a longer but narrower tract, which would not have otherwise been possible with the round shape of an inflated foley catheter balloon.

4. Conclusion

Penetrating neck injuries continue to result in significant morbidity and mortality. However, with appropriate and efficient evaluation and management, better outcomes can be expected as demonstrated in this case.

Ethics approval and consent to participate

We obtained IRB approval from Western (WCG) IRB study #.

Consent for publication

Waiver of consent was obtained via Western (WCG) IRB.

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Author contribution

Randa Barsoon completed data collection. Randa Barsoon, Jesus Rendon and David Bar-Or wrote the manuscript. Carlos H. Palacio was senior mentor for this paper. All author(s) read and approved the final manuscript.

Guarantor

Mariselda Salazar RN

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Declaration of competing interest

We know of no conflicts of interests associated with this report and there was no financial support that could have influenced its outcome.

Data availability

The data generated during the current study are not publicly available, as they were compiled from our own patient records, but are available from the corresponding author on reasonable request.

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