

Penetrating neck trauma with common carotid artery injury caused by a percussive drill

A case report

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Abstract

Rationale: Penetrating neck traumas are dangerous and have a high mortality rate, particularly in patients with common carotid artery injuries. Advances in diagnostic imaging technology have shifted management of penetrating neck injuries from mandatory exploration to selective management. The question is now regarding optimal selection of auxiliary examinations to assess “stability” rapidly and guide clinics in managing such patients.

Patient concerns: A 56-year-old man suffered neck trauma with the right common carotid artery caused by a percussive drill. The carotid artery could not be clearly displayed in computed tomography (CT) angiography imaging.

Diagnoses: Penetrating neck trauma due to percussive drill bit with common carotid artery injury.

Interventions: X-ray and bedside duplex ultrasound with color Doppler flow imaging were used to assess the state of trauma and the foreign body was removed under general anesthesia.

Outcomes: The patient was discharged at postoperative day 10 with no complication. The patient had no sequelae from this injury at 6-month follow up.

Lessons: X-ray provides a comprehensive assessment of damage, and can efficiently detect foreign bodies in the skull and cervical vertebrae. Duplex ultrasound to be a viable method to exclude macrovascular injury in unstable patients who are not eligible for computed tomography angiography (CTA) or catheter angiography imaging. Widely available duplex ultrasound and x-ray should be considered in emergency situations.

Abbreviations: CDFI = color Doppler flow imaging, CT = computed tomography, CTA = computed tomography angiography.

Keywords: duplex ultrasound, foreign body, neck, penetrating trauma

1. Introduction

The neck is an extremely complex anatomical region that contains blood vessels, the aerodigestive tract, cervical vertebra, and the spinal cord. Penetration of this region by a foreign body can result in life-threatening injuries. The mortality rates for penetrating neck trauma are estimated to be 3% to 6%,^[1] with the most common

cause of death being massive hemorrhage from injury to vascular structures. The management of penetrating neck injuries has undergone a shift from mandatory exploration to one of selective management. Selective operative management of patients, based on careful physical examination and selective diagnostic tests, is currently the gold standard advocated by clinicians.^[2,3]

According to the anatomical level of the injury, penetrating injuries of the neck can be divided into 3 zones. Zone I extends from the clavicles and sternal notch to the level of the cricoid cartilage. Zone II is the region between the cricoid and the inferior border of the mandible. Zone III is the area between the angle of the mandible and the skull base.^[4] Zone II contains the highest density of vital structures and is where penetrating injuries occur most often.^[5] If patients present with signs of significant injury, including active hemorrhage or expanding hematoma and hemiparesis, then immediate operative management is warranted. Hemodynamic stability and the presence of intracranial injury remain crucial factors in evaluating the stability and prognosis of the patient. There is then the question of how to select the optimal auxiliary examination to evaluate stability.

Here, we present a case of penetrating neck trauma in a 56-year-old man, caused by a percussive drill. The drill had entered the anterior border of the right sternocleidomastoid muscle at the level of the hyoid bone, exiting from the right occipital bone. There was a rupture of the common carotid artery. The metallic foreign body was removed successfully with no complications.

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2. Case report

A 56-year-old man presented to our emergency department with a percussive drill bit penetrating the right side of his neck (Fig. 1). On admission, his vital signs were as follows: temperature 36.8°C; heart rate 78 beats per minute; blood pressure 95/60 mmHg; respiratory rate 20 breaths per minute; fingertip oxygen saturation, 100% with 2L/min oxygen given via nasal prongs. He was conscious and clinically stable, with normal limb movement and no obvious bleeding from the wound. There was no evidence of respiratory distress. Bleeding volume was approximately 500 mL according to paramedic records. Routine blood testing on admission showed a hemoglobin level of 109 g/L, red blood cell count of $3.63 \times 10^9/L$, and hematocrit of 31.6%. The main body of the percussion drill had been disconnected before examination, leaving the bit in the patient's neck.

X-ray examination of the skull and lateral part of the neck was performed immediately in the emergency department. Imaging showed a metallic foreign body in the right neck, directed towards the mastoid and exiting the occiput (Fig. 2). We confirmed that the foreign body had not entered the skull and that cervical vertebrae were not damaged. Emergency bedside duplex ultrasound and color Doppler flow imaging (CDFI) were performed by a sonographer, revealing entry of the foreign body into the common carotid artery. CT and three-dimensional reconstruction of neck images were performed, confirming no evidence of injury to the cervical vertebrae. Image artifacts secondary to the metallic foreign body, rendered the display of



Figure 1. Stab injury from a percussive drill to the right side of the patient's neck.

the carotid artery in computed tomography angiography (CTA) poor.

The wound was actively bleeding following CT and CTA. Immediate mandatory exploration was performed under general anesthesia. The common carotid artery was dissected and temporarily clamped rapidly as CDFI had revealed injury. Approximately two-thirds of the distal wall of the right common carotid artery was ruptured. The foreign body was incarcerated in the vessel. The internal and external carotid arteries were dissected and temporarily clamped (Fig. 3). The vascular surgeon used a 5-0 prolene to suture the right artery. There were no signs of injury to the right internal jugular vein or the right accessory nerve (Fig. 4). The foreign body passed from the posterior border of the sternocleidomastoid muscle to the occipital surface. There were no other injuries to adjacent arteries or nerves. The foreign body was removed (Fig. 5). The wound was irrigated with hydrogen peroxide, iodine, and normal saline. A drainage tube was inserted and the wound edge was sutured. Prophylactic tracheotomy was performed. Postoperatively, patient presented with no neurological or motor deficit. The patient was given intramuscular tetanus antitoxin (1500 IU), and intravenous cefortiam (2.0 g, 12-hourly) to prevent infection within 1 week, and subcutaneously injected with low molecular weight heparin calcium (4000 IU) for 1 week. With no actively bleeding and the drainage of fluid with no purulent secretion, the drainage tube was extracted on the fourth postoperative day. The tracheostomy cannula was removed on postoperative day 7, and no dyspnea was apparent. The patient was discharged at postoperative day 10 with no complications. The patient had no sequelae from this injury at the 6-month follow up.

3. Discussion

The neck is a vulnerable area that contains a high density of vital structures. Recently, the management of penetrating neck trauma has shifted from mandatory neck exploration to selective

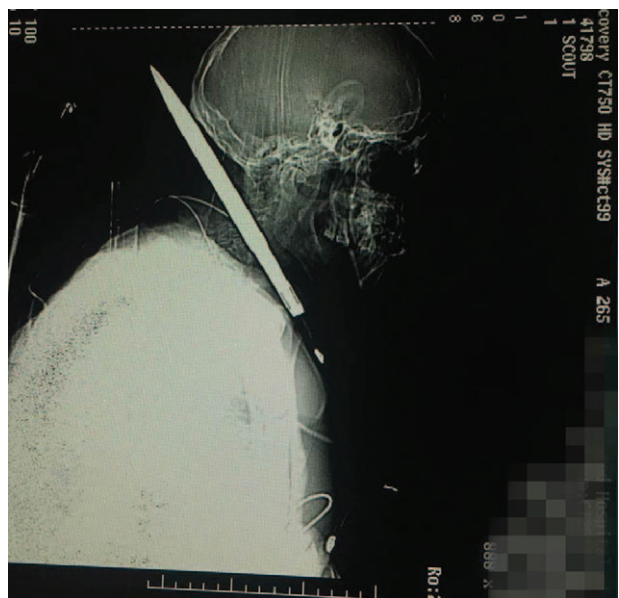


Figure 2. X-ray of the skull and neck. The foreign body extends from the mastoid to the occiput. There was no entry into the skull and no obvious damage to the cervical vertebrae.

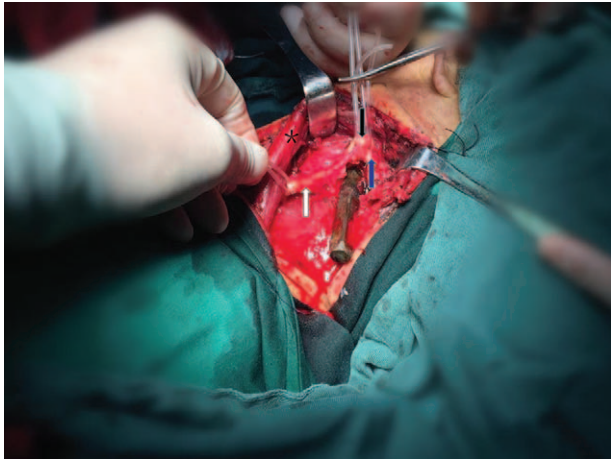


Figure 3. The right common carotid artery was ruptured and the foreign body was incarcerated. The common carotid artery, internal carotid artery, and external carotid artery were dissected and temporarily clamped (*: right sternocleidomastoid muscle, white arrow: right common carotid artery, blue arrow: external carotid artery, black arrow: internal carotid artery).

management. This is largely due to advancements in diagnostic imaging technology, as well as the consideration that neck exploration can result in unnecessary complications.^[6] Immediate neck exploration is typically performed when the patient demonstrates airway compromise, massive subcutaneous emphysema, air bubbling through a wound, profuse active bleeding, refractory shock, an evolving stroke, or a rapidly expanding hematoma. Injuries to the intracranial/cervical vertebrae and spinal cord are also important factors that affect the prognosis.

Computed tomography (CT) and three-dimensional reconstruction revealed the metal foreign body and excluded injuries to the vertebral bodies and spinal cord. However, the drawback of these methods is that they cannot be performed at the bedside and require specific patient posturing. Given that the neck wound was

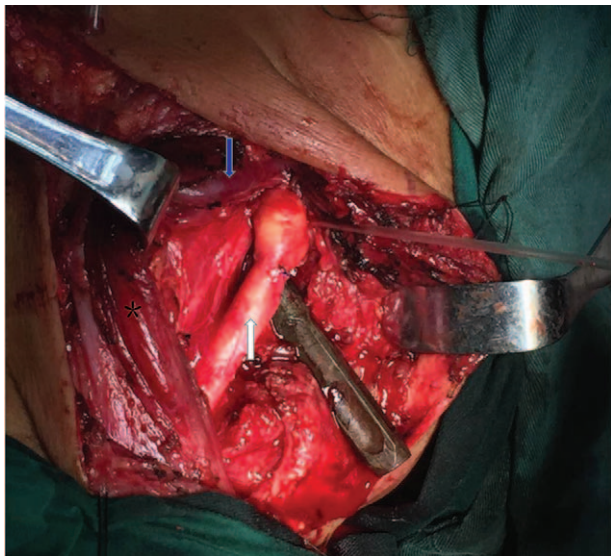


Figure 4. The right common carotid artery was sutured. The right internal jugular vein remained within normal limits (*: right sternocleidomastoid muscle, white arrow: right common carotid artery, blue arrow: right internal jugular vein).



Figure 5. The foreign body removed.

bleeding after CT and CTA, we considered the possibility that the foreign body had moved while the patient was repositioned for CT imaging. X-ray is a viable alternative as it can provide evidence of skull and vertebral injury; major advantages of this imaging modality include its availability, non-invasiveness, and ability to be used at the bedside. X-rays taken in the emergency room for this patient showed no injuries to the skull or cervical vertebrae.

The rate of major vascular injuries due to penetrating neck trauma can reach up to 50% in Zone II. In particular, injury to the carotid sheath can result in fatal hemorrhage.^[7] In this case, the foreign body entered the right neck in zone II. Angiography is considered the gold-standard method for examining suspected vascular injury.^[8] Shortcomings include potential complications such as transient ischemic attack or stroke, the lack of access at rural hospitals, and the length of time needed to perform the procedure. Given these limitations, CTA has been investigated as a possible alternative.^[2,3] However, the interpretation of CTA images may be limited by metallic fragments retained in the neck.^[9,10] In our case, CTA imaging could not completely rule out vascular injury due to an artifact caused by the metallic foreign body. CDFI has been advocated as a noninvasive alternative to conventional arteriography. Advantages include convenience and its ability to be used intraoperatively. It also provides high sensitivity (91%) and specificity (99%) for detecting vascular injuries.^[11] In our case, bedside duplex ultrasound was performed immediately and showed a rupture of the common carotid artery. These findings were in keeping with intraoperative findings. As such, duplex ultrasound can preliminarily exclude the presence of macrovascular injury and help guide mandatory neck exploration in emergency cases.

Injury of internal carotid artery or common carotid artery had high mortality rate and central neurologic deficit,^[1,12] with development of modern surgical techniques, when technically feasible, carotid artery repaired became the accepted method of treatment.^[13–16] Reva et al^[15] analyzed 46 patients with common and internal carotid artery injury, poor outcomes of carotid artery ligation and carotid artery repair were performed in 100% and 30%, respectively, and recommended that repair is the primary method of choice in carotid artery injury. du Toit et al^[16] considered that carotid artery should be repaired rather than ligated when technically possible, subsequent ischemic, or hemorrhagic cerebral

infarction is unpredictable, but overall outcome is superior to that with ligation of the injured artery. In this case, the patient's vital signs were stable and without central neurologic deficit after temporary carotid artery clamped and repaired. CTA or color Doppler ultrasound can be used as the examination method during postoperative follow-up. In this case, color Doppler ultrasound showed normal blood flow during postoperative follow-up.

4. Conclusions

Given the high morbidity and mortality of penetrating neck trauma in unstable patients, it is necessary to master the anatomy of this region and use appropriate auxiliary techniques to evaluate patients. Radiography provides a comprehensive assessment of damage, and can efficiently detect foreign bodies in the skull and cervical vertebrae. Bedside duplex ultrasound, particularly CDFI, can also provide useful information regarding injuries to macrovascular structures. We consider duplex ultrasound to be a viable method to exclude macrovascular injury in unstable patients who are not eligible for CTA or catheter angiography imaging. Widely available duplex ultrasound and x-ray should be considered in emergency situations.

Author contributions

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Supervision: Yi Zhao, Ping Fang, Yehai Liu.

Writing – original draft: Dong Wang.

Writing – review & editing: Yi Zhao, Ping Fang, Yehai Liu.

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