

# Delayed presentation of a carotid pseudoaneurysm following penetrating neck trauma

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## Abstract

**Objective:** Penetrating carotid trauma in a hemodynamically stable patient invariably presents with a pseudoaneurysm on initial imaging. Although extremely rare, delayed pseudoaneurysm formation has been reported. The purpose of this paper is to define this rare entity and propose a diagnostic and treatment plan.

**Methods:** We present a case of delayed presentation of carotid pseudoaneurysm following penetrating neck trauma. A systematic review of the literature was performed.

**Results:** A 21-year-old male presents to the trauma center after sustaining a gunshot wound to the left upper back resulting in a zone 2 hematoma and pneumothorax. Bullet fragment artifact interfered with computed tomography. Carotid angiogram was normal. The patient was discharged after 3 days. He returned to the Emergency Department 3 months later with a painful pulsatile hematoma. Computed tomography angiogram revealed a 6-cm pseudoaneurysm arising from the proximal left internal carotid artery (ICA). A left common carotid artery (CCA) to ICA bypass with reversed great saphenous vein was performed. The patient's post-operative course was uneventful, neurologic deficits improved, and he was discharged.

**Conclusion:** Delayed presentation of traumatic pseudoaneurysms has been reported, although usually these cases are iatrogenic access complications in extremities. While endovascular therapies are first line for zone 1 and 3 vascular injuries, management of zone 2 injuries is still controversial. This patient was treated with a bypass due to the need to evacuate the hematoma that was exerting a mass effect in the neck.

## Keywords

Carotid trauma, penetrating trauma, pseudoaneurysm, delayed presentation

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## Introduction

Penetrating carotid injuries represent 3% of all traumatic arterial injuries. These usually present with either “hard signs” of vascular injury or by identification of a pseudoaneurysm on imaging. Diagnosis and management are dictated by the hemodynamic and neurologic status of the patient, in addition to the presence of other concurrent traumatic injuries.<sup>1,2</sup> We present a case of a penetrating carotid injury, which presented in a delayed fashion as a pseudoaneurysm requiring urgent surgical attention.

## Case

The patient is a 21-year-old previously healthy male brought to the trauma bay after sustaining a gunshot wound to the left upper back scapular region. His primary survey

was remarkable for a zone 2 non-expanding hematoma of the left neck without a wound in the neck, requiring prophylactic intubation for airway protection. Chest X-ray demonstrated a hemopneumothorax, for which a chest tube was placed. Secondary survey was notable for the previously mentioned gunshot wound. Computed tomography (CT) angiogram of the neck and chest was then performed, showing the left neck hematoma mentioned previously

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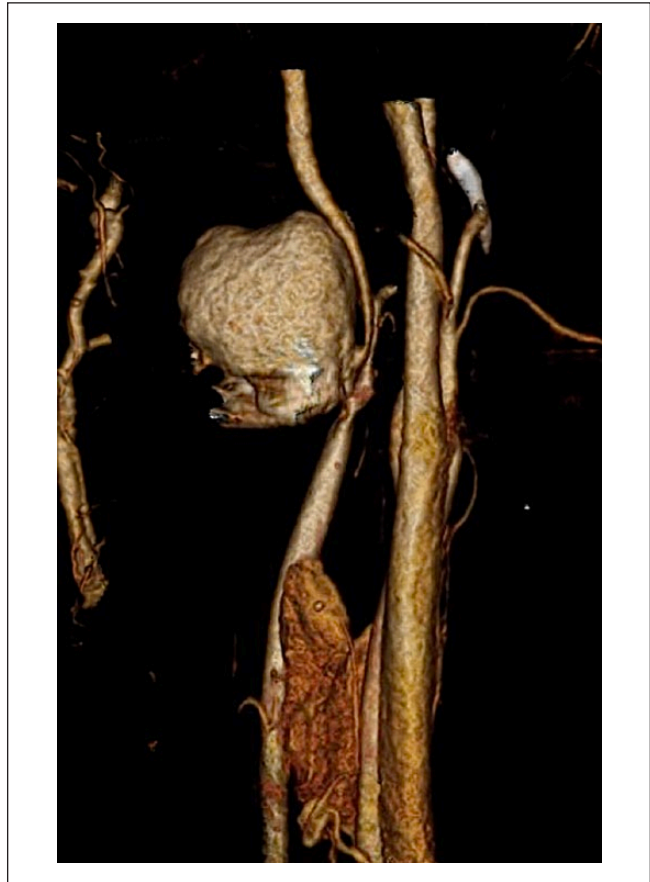




**Figure 1.** Axial CT angiogram image of the proximal carotid artery with bullet artifact interfering with image interpretation. CT: computed tomography.

along with bullet fragment artifact that interfered with image interpretation at the level of the left distal common carotid (CCA) and proximal internal carotid arteries (ICA) (Figure 1). No pseudoaneurysm was observed. The contralateral cervical vessels and intra-thoracic vasculature were intact. Vascular surgery was consulted to evaluate this lesion. At that point, the patient was following commands and moving all four extremities; however, he was intubated and a comprehensive assessment of his cranial nerve function was not feasible. A carotid angiogram was performed. This did not reveal any traumatic injury to the cervical or intra-thoracic vasculature, namely the absence of pseudoaneurysm, dissection, thrombosis, or fistula. The patient was then managed conservatively post-procedure. He was initially in the intensive care unit (ICU) for neurovascular checks until he was extubated. His chest tube was subsequently removed, and he was discharged home without any antiplatelet or anticoagulants.

A total of 3 months later, the patient presented to the Emergency Department with an enlarging pulsatile mass on his left neck. He was doing well until 3 days prior, when he developed pain and dysphagia. On evaluation, he was also found to have hoarseness, and tongue deviation to the left. The patient admitted to these symptoms being present over the past months but had worsened over the past 3 days. He was hemodynamically stable and underwent repeat CT angiogram of the neck (see Figure 2). This showed a 6-cm pseudoaneurysm arising from the proximal left internal carotid artery (ICA). Secondary to the proposed mass effect by the hematoma/pseudoaneurysm complex on the neighboring nerves and hypopharynx, decision was made to manage this with an open procedure to evacuate the hematoma (Figure 3). The patient underwent an end-to-end left

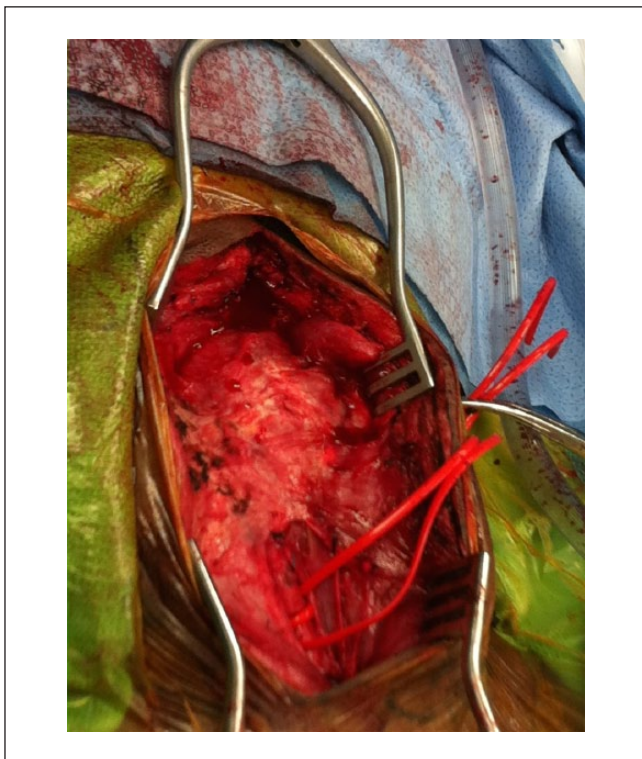


**Figure 2.** 3D reconstruction of CT angiogram of the neck showing a 6-cm proximal internal carotid pseudoaneurysm. 3D: three-dimensional; CT: computed tomography.

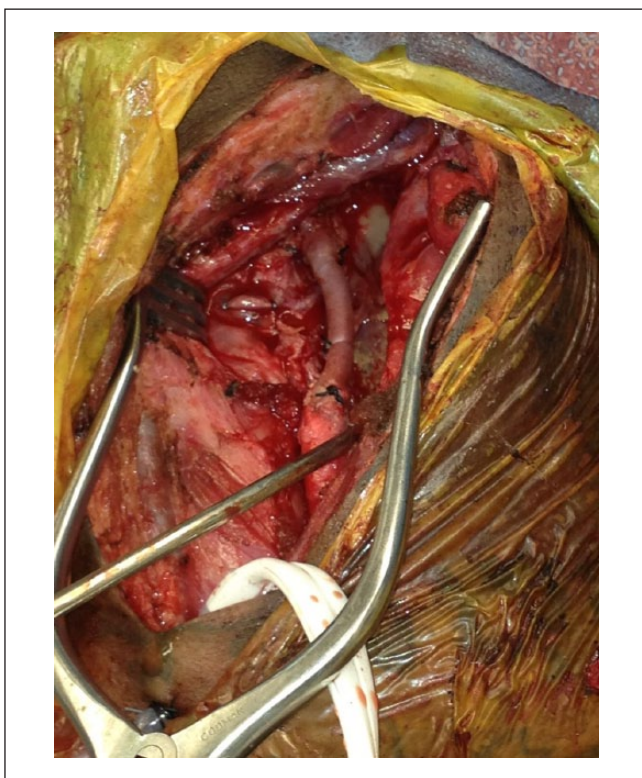
CCA to left ICA bypass with reversed great saphenous vein, and ligation of the left external carotid artery (Figure 4). No shunts were used. The patient was hemodynamically normal throughout the case, and there were no concerning electroencephalography (EEG) changes during carotid clamping. He was extubated immediately post-operatively. No new neurological deficits were noted. He was discharged home 3 days later and seen in clinic 2 weeks afterwards with improved hoarseness and left tongue deviation, an intact surgical incision, and no clinical evidence of a recurrent pseudoaneurysm or hematoma.

## Discussion

Penetrating neck trauma is managed on the basis of the location of the injury, hemodynamic status, and the presence of hard signs of vascular injury. With the advent of the availability of accurate imaging modalities, hemodynamically stable patients without hard signs of vascular injury should undergo further imaging to delineate their injuries. This is a progressive move from the previous era where all zone 2 injuries that penetrated the platysma were explored, yielding an 80% negative exploration rate. CT angiogram is the



**Figure 3.** Intra-operative picture of the pseudoaneurysm with proximal control of the common carotid artery.



**Figure 4.** Intra-operative picture of common carotid artery to internal carotid artery bypass with reversed great saphenous vein.

first line modality with 90% sensitivity and 100% specificity for vascular injury. Accuracy is limited with metallic bullet fragments or shrapnel causing artifact; arteriography should be used in that situation as a confirmatory study. Unlike blunt cerebrovascular injuries where progression from dissection or intramural hematoma to pseudoaneurysm can occur with time, penetrating carotid injuries most commonly present with pseudoaneurysm on imaging at initial presentation and non-operative management is not usually an option. Zone 1 and 3 injuries are ideally managed with endovascular techniques due to difficult exposure (zone 3 distal control) or maximal invasiveness potentially requiring a sternotomy with or without a trap door incision (zone 1 proximal control). Management of zone 2 injuries still remains controversial since we have either open or endovascular options available, although certain authorities recommend a first line endovascular approach if anatomically favorable lesion and reserving the open approach as a second line option.<sup>1-3</sup>

Our patient did not sustain a direct penetrating injury to the neck, but instead had a left upper back low velocity gunshot wound with bullet fragments deflected into the neck manifesting as a zone 2 non-expanding hematoma. Initial imaging with a CT angiogram was unrevealing secondary to metallic artifact from the bullet, and a carotid angiogram was normal.<sup>4</sup> The patient was then re-admitted 3 months later with a symptomatic pseudoaneurysm.

Delayed presentation pseudoaneurysm has been reported after penetrating trauma of the arteries of the upper and lower extremities, and the carotid arteries. These presentations can be delayed up to 10 years according to one report. The incidence is rare and pathophysiology of this delayed presentation is unknown; however, the consequences are clearly potentially fatal.<sup>5-8</sup>

Although endovascular options are increasingly utilized in vascular trauma,<sup>9</sup> both the size of the pseudoaneurysm and its associated clinical symptoms (dysphagia, hoarseness, tongue deviation) make an open surgical procedure a more attractive option. Although the technical difficulties due to dense inflammatory reaction, which increases the likelihood of injury to surrounding structures, should not be understated.<sup>10</sup> This patient successfully underwent a left CCA to left ICA bypass with reversed greater saphenous vein.

Regardless of the treatment method used, restoration of vascular continuity is far superior to ligation or endovascular occlusion, with the incidence of neurological sequela 8% versus 50% in revascularized versus ligated carotids, respectively.<sup>11,12</sup> Untreated lesions, even those with initially adequate flow, may progress to occlusion or have other embolic phenomena.<sup>13</sup> Unlike blunt carotid injuries, no consensus has been reached regarding conservative therapy with anti-thrombotic or anti-coagulant agents, and concerns remain for worsening of these lesions and other concurrent traumatic injuries with such therapies, despite some studies suggesting otherwise.<sup>14,15</sup>

## Conclusion

A high index of suspicion must be maintained for carotid injuries in penetrating neck injuries. While liberal use of imaging may prevent negative neck explorations, delayed presentations from unidentified injuries are possible. Although rare in incidence, pseudoaneurysms are the most commonly sequela following penetrating neck injury, and presentation may be delayed up to 3 years. Regardless of the treatment modality, whether open or endovascular, the main objective should be to prevent the morbidity and mortality arising from associated neurologic insult.

## Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Ethics approval

Our institution does not require ethical approval for reporting individual cases or case series.

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## Informed consent

Written informed consent was obtained from the patient for their anonymized information to be published in this article.

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