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CASE REPORT

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An unsuspected extracranial internal carotid pseudoaneurysm following dog bites: a case report and review of literature

Ahmad Hosseinzadeh[1], Reza Shahriarirad[1,2], Farzad Dalfardi[1], Human Arianpour[1] and Fatemeh Zarimeidani[1,3*]

Abstract

Background Extracranial internal carotid artery (ICA) pseudoaneurysm is a rare condition that can be caused either by penetrating or blunt trauma, including dog bites, which is an uncommon occurrence. Together with the possibility of no symptoms or nonspecific ones such as cervical pain, hematoma, swelling, or mass, considering ICA pseudoaneurysm following a dog attack is of paramount importance to avoid life-threatening complications.

Case presentation We present a rare case of a 17-year-old male with a history of dog bites three months prior, who presented to the emergency department with left-sided neck pain, dizziness, and several episodes of blurred vision and diplopia. On physical examination, a palpable mass measuring approximately 20 × 30 millimeters was identified in the left neck region and multiple superficial lacerations were observed in this area. Laboratory tests yielded normal results. Doppler ultrasound revealed a pseudoaneurysm in the left internal carotid artery. Because the great saphenous veins were insufficient, the patient was successfully treated with synthetic graft patch arterioplasty, and no complications were seen in his one-year follow-up with computed tomography (CT) angiography.

Conclusions This report emphasizes the significance of thorough initial evaluation and imaging in cases of dog attacks, even without apparent significant trauma, to rule out hidden arterial injuries.

Keywords Animals, Bites, Carotid artery, False aneurysm, Vascular Surgical Procedure

Background

Extracranial internal carotid artery (ICA) pseudoaneurysm is a rare condition that may be asymptomatic or present with cervical pain, hematoma, swelling, or masses. Patients with ICA pseudoaneurysm are prone to complications such as ruptures, hemorrhages, thromboembolic events, ischemic stroke, and cranial nerve dysfunction that overall increase the risk of morbidity and mortality [1]. ICA pseudoaneurysms are typically caused either by blunt or penetrating trauma, however, the animal bite is an uncommon cause of pseudoaneurysm, mostly seen in the radial or ulnar artery [2–8]. Dogs, particularly domestic ones, have the highest incidence rate of animal bites in Iran, approximately 10.4 per 1000 Iranians [9]. Most dog bite injuries typically happen in the head and neck area or limbs, usually superficial and requiring minimum medical intervention. However, dog bite injuries can be life-threatening while causing substantial tissue loss or affecting the airway and major arteries including the carotid artery [10].

*Correspondence:
Fatemeh Zarimeidani
fatemeh.zarimeidani@yahoo.com
[1]Thoracic and Vascular Surgery Research Center, Shiraz University of Medical Science, Shiraz, Iran
[2]School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran
[3]Students Research Committee, Shahrekord University of Medical Sciences, Shahrekord, Iran

In the literature, there are limited articles on relevant carotid injury from dog bites [2, 11–15]. To the best of our knowledge, this is the second report of internal carotid pseudoaneurysm following a dog bite, which highlights the importance of careful assessment of this danger concealed behind the innocuous wounds adjacent to the large vessels.

Case presentation

A 17-year-old male was admitted to the emergency department with left-sided neck pain and pulsatile mass, dizziness, and several episodes of blurred vision and diplopia. The patient reported being attacked by a dog and receiving a dog bite on his neck three months ago. The patient's vital signs were stable upon arrival, and he was fully conscious. On examination, multiple bite-filled masses were observed on the patient's face in the mandibular, temporal, left neck, and arm regions. A palpable mass measuring approximately 20×30 millimeters was identified in the left neck region (Fig. 1).

Laboratory tests yielded normal results, showing no evidence of leukocytosis, coagulopathy, or platelet disorders. All other laboratory investigations were within normal limits. The patient underwent a color Doppler ultrasound, which patient revealed a pseudoaneurysm at the left ICA near the site of bifurcation of the left carotid artery. A computed tomography (CT) scan was performed which demonstrated a focal outpouching of the left internal carotid artery, consistent with a posttraumatic left carotid pseudoaneurysm (Fig. 2).

Consequently, the patient was admitted for surgical intervention. During the procedure, exploration of the left carotid artery was performed and a shunt was inserted between the common carotid and internal carotid to save the blood flow. Because the great saphenous veins were insufficient in our exploration, carotid reconstruction was carried out using an expanded polytetrafluorethylene (ePTFE) patch angioplasty technique with prolene 7−0, followed by removal of shunt and hemostasis (Fig. 3).

Postoperatively, the patient was transferred to the ICU in a stable condition without complications. He remained conscious and able to communicate easily, with no hematoma observed at the surgical site. CT angiography was

Fig. 1 Before and after surgery. (**A**) 17-year-old male patient with a dog bite on the left side of the neck, with no evidence of swelling, infection, or hematoma on admission (**A**), and two weeks post-operation during the patient's follow-up clinic visit (**B**)

Fig. 2 Left carotid pseudoaneurysm. Contrast-enhanced CT of the patient shows a focal outpouching of the left internal carotid artery, consistent with a posttraumatic pseudoaneurysm in a patient with a history of a dog bite

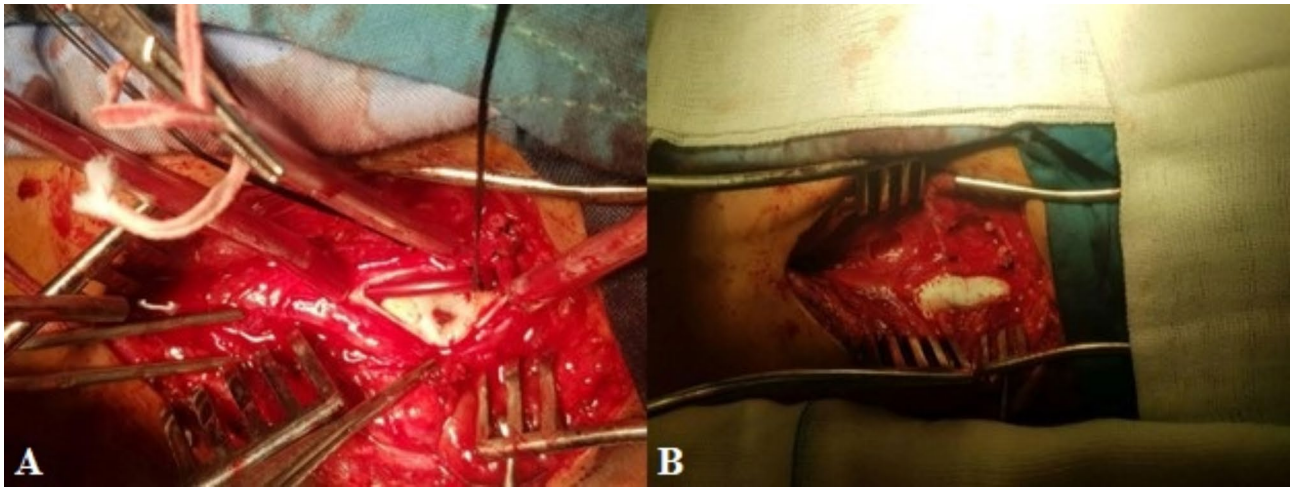

Fig. 3 Surgery procedure. After classic neck incision and exploration, showing the site of the pseudoaneurysm orifice and the carotid shunt placement (**A**). PTFE graft was placed over the repaired left carotid pseudoaneurysm site (**B**)

performed postoperatively and demonstrated normal findings with a proper blood supply to the repaired carotid artery. The patient had no complications during his one-year follow-up with CT angiography.

Discussion and conclusions

Extracranial ICA aneurysm is a potentially lethal condition with a rare entity, accounting for less than 1% of all arterial aneurysms. Pseudoaneurysms of the ICA are less prevalent than true aneurysms comprising 14% of all occurrences. The major cause of a pseudoaneurysm is either blunt or penetrating trauma. Traumatic causes of pseudoaneurysms vary from motor vehicle accidents, stab wounds, iatrogenic central venous cannulation or other cervical manipulations, sports accidents, and falls to animal bites [1]. A pseudoaneurysm after an animal bite is rare, with only 7 documented cases of this type of injury (Table 1) [2–8]. In the literature, animals responsible for pseudoaneurysms were snakes, cats, canines, and squirrels. Most of the pseudoaneurysms following animal bites occurred either in the radial or ulnar artery, while we report the second case of ICA pseudoaneurysm as a complication of a dog bite after the one by Miller et al. [2]. The reports of a pseudoaneurysm following animal bites were mostly from the USA, indicating that its true frequency may be considerably more than is currently recognized. This highlights the importance of widespread recognition and screening of this injury.

Carotid injury is an uncommon finding in case of a dog attack, with 6 reported cases, including carotid laceration, occlusion, dissection, and pseudoaneurysm formation (Table 2). Dog's lick, scratch, or bite may also be infected with *Pasteurella multocida*, resulting in mycotic aneurysm [6]. Serious dog bite injuries not only lead to lacerations on the skin but also can cause considerable damage to soft tissue by crushing, grinding, and avulsion [2]. Damage to the arterial wall, resulting in local hematoma. Maintained turbulent blood flow between the arterial laceration and the hematoma results in pseudoaneurysm development [16, 17].

Up to 60% of extracranial ICA pseudoaneurysm cases may be asymptomatic, similar to our patient at his first admission. As in our case, the enlarging pseudoaneurysm may present with pain and a pulsating neck mass. Other presentations include a medial bulge in the pharyngeal wall, or as carotid thrill or bruit, cranial nerve palsies, and ruptures with hemorrhage. Pseudoaneurysm can also be accompanied by thrombosis, leading to a cerebral infarction [1, 2]. Similar to our patient, the ophthalmological symptoms have been reported in some cases of ICA pseudoaneurysm, including amaurosis or low visual acuity and blurred vision. These symptoms usually occur unilaterally and may be related to the impairment of the blood supply. Bilateral involvement can also be seen regarding the anatomical anastomosis of cavernous sinuses [16].

The proper management of dog bite wounds involves thorough cleaning of the wound with debridement, primary repair, antibiotic therapy, and rabies vaccination if necessary. When assessing a dog attack, even without major penetrating trauma as in our case, additional assessment should also be done to prompt rule out hidden arterial injury such as pseudoaneurysm affected by the blunt force of the attack, which could otherwise be delayed and lead to morbidity and mortality [18].

A pseudoaneurysm can be presented either in an acute or delayed fashion. The time to diagnosis of a pseudoaneurysm was different in the cases of animal bites, ranging from a few hours to three weeks (Table 1). In contrast to Miller et al.'s study, our patient was diagnosed with carotid pseudoaneurysm three months after the dog attack with color Doppler sonography. At the

Table 1 Pseudoaneurysm following animal bite

Author	Year	Country	Gender/Age	Animal	PA location and Size	Latency Time/signs and symptoms	Surgical Intervention	Outcome
Miller et al. [2]	1993	USA	M/50	Dog (Rottweiler)	Right ICA/NA	Immediately/Positive Babinski's reflex on the left side, flaccid paralysis of the left arm and leg, and left facial droop	None	Partially regained left arm and leg function at a 1-year follow-up
Pin et al. [5]	2017	China	M/61	Snake	Ulnar artery/1 cm	Eight hours/Local tense swelling, erythema, paresthesia and pain	Clamping both ends of the aneurysmal bulges, and removing 5-centimeter- long piece of the artery	Full recovery
Winter et al. [8]	2023	USA	F/74	Squirrel	Radial artery/5 mm	Immediately/Pain and laceration with surrounding ecchymosis	None	Clinical improvement in pain/No follow up required
Senthilkumaran et al. [7]	2022	India	Case 1: F/50 Case 2: F/45	Snake	Ulnar artery/NA	Case 1: One hour/Pulsatile tender mass Case 2: 5 days/Swelling, pain, and numbness in hand and tingling sensation in fingers	None	Full recovery
Jeng et al. [6]	2020	USA	M/61	Canine	Descending thoracic aorta/NA	Three weeks/Generalized malaise	Thoracotomy and femoral–femoral cardiopulmonary bypass for complete PA resection and aortic replacement with a 24-mm Gelweave graft	Full recovery
Dryton et al. [4]	2015	USA	F/56	Cat	Radial artery	Three weeks/Intermittent pain and discoloration of thumb and index finger	Excision	Resolution of ischemic digits
Levis et al. [3]	2008	USA	F/68	Cat	Radial artery	Several hours/Mild swelling with surrounding ecchymosis	Excision	N/A

F: female; M: male; PA: pseudoaneurysm; N/A: not available

Table 2 Carotid artery injury cases following a dog attack

Author	Year	Country	Gender/Age	Carotid injury	Symptoms	Complications
Miller et al. [2]	1993	USA	M/50	Occlusion of the right MCA, pseudoaneurysm in the right ICA	Flaccid paralysis of the left arm and leg, and left facial droop	Partially regained left arm and leg function at a 1-year follow-up
Itoyama et al. [11]	1994	Japan	M/10	Occlusion of the cervical right ICA	Delayed onset of left hemiparesis, impaired right-side visual acuity	Remained impaired right-side visual acuity
Meuli et al. [12]	1994	Switzerland	M/7	Localized wall irregularity in the left ICA adjacent to the common carotid bifurcation, and a subtotal occlusion of the left MCA	Delayed cerebral infarction with right hemiplegia, left facial nerve palsy, and aphasia	Mild spastic hemiplegia
Endean et al. [13]	1995	USA	N/A	Occlusion of the CCA	Asymptomatic	Full recovery
Varela et al. [14]	2000	USA	N/A	Combined carotid artery injury and laryngeal fracture	N/A	N/A
Chen et al. [15]	2020	China	F/68	Bilateral carotid artery dissection	Headache, weakness in both upper limbs	N/A

CAD, carotid artery dissection; CCA: common carotid artery; F: female; ICA, internal carotid artery; M: male; MCA, middle cerebral artery; N/A: not available

initial evaluation of our case, no signs or symptoms were detected supportive of pseudoaneurysm, which highlights the importance of imaging modalities. Considering to be the first-line imaging modality, sonography is an accessible and cost-effective method to prompt the diagnosis of trauma-induced pseudoaneurysms of the extracranial carotid artery, even in the case of a delayed diagnosis similar to our patient. However, CT angiography can be a better choice for distal carotid artery pseudoaneurysm [19, 20]. Contrast-enhanced CT and magnetic resonance imaging can also assist in diagnosing pseudoaneurysm [1].

Surgical procedures, endovascular or open repair, may vary depending on the specific characteristics of each severe bite lesion. The gold standard of treatment is complete excision of the pseudoaneurysm while intersecting the gap with synthetic or saphenous vein grafts or end-to-end anastomosis [1]. Regarding its high long-term potency, the open repair technique has been suggested in young cases of extracranial carotid pseudoaneurysms with accessible lesions and low surgical risk [20]. In this accordance, we performed a patch angioplasty of the carotid with an ePTFE graft. It should be noted that long-term surveillance imaging with a vascular surgeon will be required in repairs involving the implantation of stent/graft devices [17]. Based on our one-year follow-up with CT angiography, ePTFE grafts can be effective for the treatment of ICA pseudoaneurysms.

In conclusion, pseudoaneurysm of ICA as a complication of a dog bite has not been reported in the literature over the past twenty years. Regarding the rarity of involved deep neck structures as a result of animal bites and also the possible latency of symptoms, it seems important for clinicians to consider evaluation of these injuries at initial care and warn patients of such life-threatening complications to reach for early medical care in case of any signs or symptoms.

Abbreviations

ICA	Internal carotid artery
CT	Computed tomography
ePTFE	Expanded polytetrafluorethylene

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None to declare.

Author contributions

AH designed the study. FD and HA collected the data and performed a review of the literature. FZ drafted the manuscript and RS critically revised the manuscript. All authors proofread and accepted the final version of the manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Written informed consent was obtained from the patient in our study. The purpose of this research was completely explained to the patient and was assured that their information will be kept confidential by the researcher. The present study was approved by the Medical Ethics Committee of the Shiraz University of Medical Sciences and performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Consent for publication
Consent was obtained from the patient regarding the publication of this case report.

Competing interests
The authors declare no competing interests.

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