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Case Report

Traumatic Pseudoaneurysms of the Head in War Time: Report of Two Unusual Cases

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ABSTRACT

Intracranial or extracranial pseudoaneurysms due to penetrating head injuries with gunshot are very rare entities. As the pseudoaneurysms of the superficial temporal artery usually present with a pulsating mass lesion beneath the scalp, intracranial pseudoaneurysms are manifested with symptoms including decreased conscious level, seizure, or focal neurological deficits. Here, two patients with combat-related pseudoaneurysms are reported. One was in the distal cortical branch of the anterior cerebral artery and one was in the superficial temporal artery. Both of the cases were victims of the Libyan war. One was admitted with a swelling in his scalp and a pseudoaneurysm on the parietal branch of the superficial temporal artery was diagnosed with computed tomography; and the other was incidentally diagnosed on the distal cortical branch of the anterior cerebral artery during an operation for removal of an intracranial bullet. Both of the aneurysms were treated with surgical excision without any complication.

KEYWORDS: Gunshot injury, Anterior cerebral artery, Penetrating head injury, Pseudoaneurysm, Superficial temporal artery, Traumatic aneurysm

INTRODUCTION

Pseudoaneurysms emerge with disruption of all three histological layers of the vessel and contain hematoma in a false lumen outside of the vessel and are also known as false aneurysms (20). They are presumably associated with penetrating injuries and in contrast to a true aneurysm do not have an aneurysmal neck. Pseudoaneurysms formed by military munitions used in conflicts of war are well known entities (12). Gunshot wound or blast injury to head may cause traumatic extra- (TECA) or intracranial pseudoaneurysm (TICA) (6). Combat-related traumatic aneurysms located on the distal middle cerebral artery (MCA) or on the superficial temporal artery (STA) are rarely seen (6,12,22). We found only eight cases of pseudoaneurysm located on the distal MCA (M4) and six cases of pseudoaneurysm located on the STA following a gunshot or blast injury in the literature (Table I).

Here, two head-wound patients with a pseudoaneurysm were presented. One of them presented with a palpable mass lesion beneath the skin of the right temporal region and the other with coma.

CASE REPORTS

Case 1

A 17-year-old boy, who was a victim of the Libyan civil war, was referred to the intensive care unit for coma 30 hours after sustaining a bullet injury to the right pterional area with an ambulance aircraft. His Glasgow Coma Scale score was 6 on admission. He had undergone debridement of the right pterional region at the local hospital. Computed tomography (CT) revealed an intracerebral hemorrhage with bone fragments from the right to the left hemisphere; the bullet had stopped

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Table I: Pseudoaneurysms Located on the Middle Cerebral Artery or Superficial Temporal Artery Due to Blast or Gunshot Injury Reported in the Literature

Author	Mechanism	Location	Entery site
Aarabi (1)	Shell fragment	MCA (M4)	Parietal
	Shell fragment	MCA	Temporoparietal
	Shell fragment	MCA (M4)	Temporoparietal
	Shell fragment	MCA (M4)	Temporoparietal
Acosta et al. (2)*	GSW	MCA	Eye
Amirjamshidi et al. (3)	PHI#	MCA	Pterional
	PHI#	MCA (M4)	Frontal
	PHI#	MCA	Frontal
	PHI#	MCA (M4)	Frontal
	PHI#	MCA (M4)	Parietal
	PHI#	MCA	Frontal
	PHI#	MCA	Frontal
	PHI#	MCA	Frontal
	PHI#	MCA	Frontal
	PHI#	MCA MCA	Temporoparietal
	PHI#	MCA	Frontotemporal
	PHI#	MCA MCA	Parietal
Amirjamshidi et al. (4)	Shell fragment	STA	Multiple site
	Shell fragment	STA	Multiple site
	Shell fragment	STA	Multiple site
Bell et al. (6)	PHI/Blast injury	STA	Frontal
	PHI/Blast injury	MCA	Pterional
	PHI/Blast injury	MCA	Frontal
	PHI/Blast injury	STA	Frontal
	PHI/Blast injury	MCA (M3)	Pterional
	PHI/Blast injury	MCA MCA (M4)	Frontal
	GSW	MCA (M4)	Frontal
Cox et al. (12)	PHI/Blast injury	STA	Not known
Ditmore et al. (13)*	GSW	MCA	Face
Haddad et al. (17)	GSW	MCA*	Not specified
	Shrapnel	MCA*	Not specified
	Shrapnel	MCA	Not specified
	Shrapnel	MCA	Not specified
	Shrapnel	MCA*	Not specified
	Shrapnel	MCA*	Not specified
	Shrapnel	MCA	Not specified
	Shrapnel	MCA MCA	Not specified
	Shrapnel	MCA* MCA	Not specified
	Shrapnel	MCA*	Not specified
	Shrapnel	MCA*	Not specified

Table I: Cont.

Author	Mechanism	Location	Entery site
Jinkins et al. (18)*	GSW	MCA	Not specified
Lee et al. (21)*	GSW (pellet)	STA	Multiple site
Rahimizadeh et al. (23)	Shell fragment	MCA	Left side of cranium
	Shell fragment	MCA	Zygoma
Sadar et al. (24)*	GSW	MCA	Left side of cranium
Santos et al. (25)*	GSW	MCA	Submandibular region
Schmidt-Vanderheyden and Backmun (26)*	GSW	MCA	Temporal
Spetzler and Owen (27)*	GSW	MCA	Face
Present study	GSW	MCA (M4)	Parietal
	GSW	STA	Temporal

***GSW:** Gunshot wound, **MCA:** Middle cerebral artery, **PHI:** Penetrating head injury, **PHI#:** Not specified, due to gunshot or blast injury during wartime, **STA:** Superficial temporal artery, ***:** Civilian gunshot injury.*

at frontal cortex under the skull after traveling through all the right and left frontal lobes (Figure 1A). The patient improved over a 2-month period of intensive care. Seizure attacks that were difficult to control began in the patient although he was under appropriate antiepileptic treatment. A late control CT showed the resolution of hematoma with the bullet in the same location (Figure 1B, C). It was decided to remove the bullet. When the dura was opened and the underlying frontal cortex exposed, the bullet was found to be accompanied by a round hemorrhagic structure presumed to be a pseudoaneurysm (Figure 2A). The bullet and the aneurysmal structure were removed with microsurgical techniques; the aneurysm wall had a close relationship to a small bone fragment that had come there with the bullet (Figure 2B). The histological examination of the aneurysm showed no vessel wall layer and it was diagnosed as a pseudoaneurysm (Figure 2C). The pseudoaneurysmal dilatation was full of hemorrhage with peripheral organized tissue.

Case 2

A 24-year-old man, who was a victim of the Libyan civil war, was admitted with a slow-growing swelling in his right temporal area. He was wounded from his chin and head during a conflict 45 days ago. He was neurologically intact; a round and pulsating mass measuring 2x1.5 cm beneath scar tissue in his right temporal region was detected on physical examination. A CT-angiogram investigation showed a lesion with contrast enhancement on the parietal branch of the STA, supporting our presumed diagnosis of pseudoaneurysm (Figures 3A-C; 4A, B). The lesion was explored and removed by excision under local anesthesia. The histological examination of the aneurysm showed no vessel wall layer and it was diagnosed as a pseudoaneurysm (Figure 3A-C).

■ DISCUSSION

The true incidence of conflict-related TICAs or TECAs is still uncertain (6). Ferry and Kempe (15) found only two pseudoaneurysm cases among 2,187 casualties in the Vietnam War, and Chadduck (10) found none among 879 cases of craniocerebral injury in the Korean Conflict. Rahimi-Movaghar et al.(22) collected 177 cases of traumatic aneurysm due to gunshot injury in their review of the literature in 2013. After that report, we found one TICA (9) and one TECA on STA (21); and a series of 11 patients with 13 TECAs reported by Cox et al.(12) which was dismissed in that study. Although the patients presented in this report were victims of the Libyan civil war, we did not have any data regarding the number of patients with penetrating head injuries and any other possible traumatic aneurysms during that war.

Penetrating vascular injuries can behave differently even in the same patient regarding their occurrence, evaluation or regression (21). It was found that the incidence of TICA formation was significantly higher when the site of entrance was the orbitobasal and frontal regions (3), and in presence of accompanying intracranial hematomas (7) in penetrating head injuries. Bodanapally et al.(8) found a statistically significant correlation between bi-hemispheric injury and occurrence of traumatic aneurysms. Intracranial aneurysm formation was not always associated with a penetrating injury and bone fragment entry site (3,6). The aneurysm of the first case reported here was located opposite to the bullet entrance site.

An acutely decreased conscious level, seizure, or focal neurological deficits are the most common symptoms of clinical presentation of TICAs (20). As TICAs usually cause immediate or delayed intracranial bleeding, pseudoaneurysms on STA often present with pulsatile mass lesions that progressively grow in size (19,28). As pointed above, the cases reported in this study presented with seizure attacks and a pulsatile growing mass lesion for the TICA and STA aneurysm respectively.

In particular cases of penetrating head injuries, angiography was recommended to rule out the delayed formation of traumatic intracranial aneurysm (20). In case of acute head injury, CT is the procedure of choice, so early diagnosis of pseudoaneurysm may be ignored (16); for this reason any patient who has a penetrating head injury through frontobasal or pterional window (6), or when the missile passes from one hemisphere to the other (3), is advised to undergo diagnostic angiography. However, in the acute stage, even digital subtraction angiography (DSA) may not show any aneurysm formation due to presence of associated hemorrhage lesions and/or aneurysm formation could take time (25). The limitation of the first case reported here was not to use CT-angiography or DSA for detecting any possible vascular injury. Doppler ultrasonography (DU) and/or CT-angiography may be sufficient for detecting STA aneurysm (19,22). In the second case, CT-angiography definitely revealed a pseudoaneurysm of the STA. There is no study reporting routine use of magnetic resonance imaging (MRI) for the diagnosis of pseudoaneurysm. MRI/MR-angiography is advised for the patients with recurrent epistaxis and progressive cranial nerve palsy following a head injury, followed by DSA if a suspicious lesion is found (20). Bhaisora et al. (5) reported that MR-angiography with time of flight (TOF) sequence can be used in traumatic aneurysms of the intracranial vessels with nearly 90% accuracy. A pseudoaneurysm may show contrast enhancement in T1-weighted images, and hyperintense core and hypointense rim representing hemosiderin on T2-weighted images (11,14).

Aggressive surgical management of the TICAs was advised as the most appropriate treatment (20). The surgical treatment of TICAs includes clip application (6), resection (3), trapping (20) and endovascular treatment (6) - coil embolization (9,16), glue embolization or stent (8,21). Pseudoaneurysms are usually not suitable for clipping because they not have a true neck formation (3). In the present report, the pseudoaneurysm located on

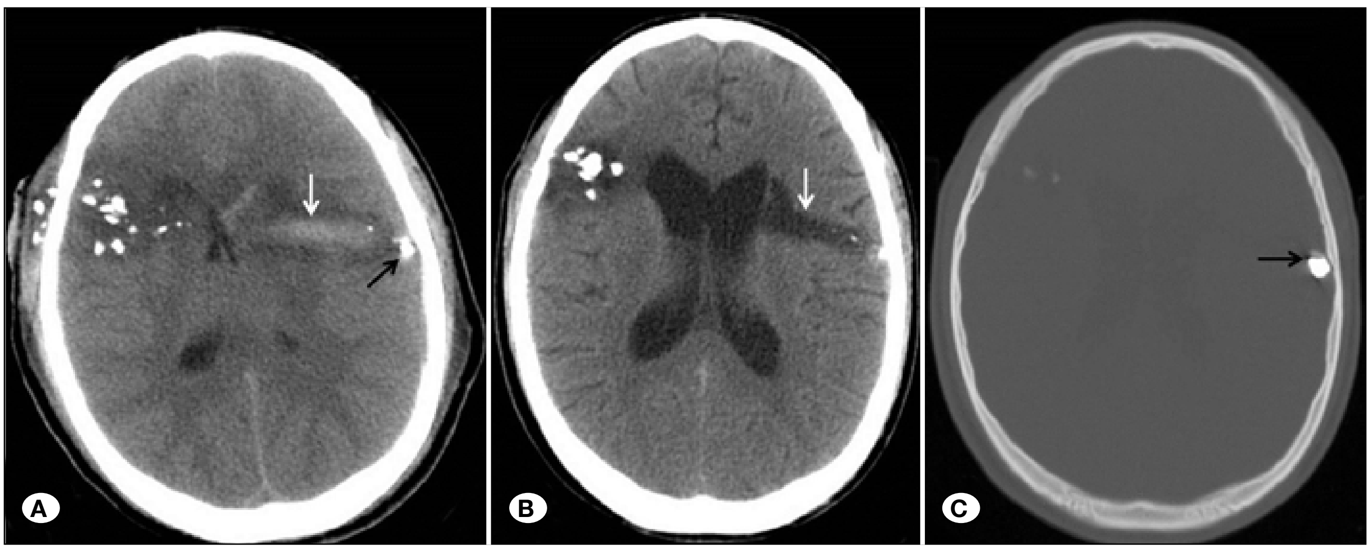

Figure 1: A) Multiple bone fragments in the right frontal lobe, collapsed lateral ventricles, intracerebral hemorrhagic contusion in the left frontal lobe (white arrow) and bullet and accompanying bone fragment in the left frontal cortex (black arrow) on initial CT scan of the patient, **B)** Multiple bone fragments in the right frontal lobe and slightly enlarged lateral ventricles, hypodense area due to the resorption of the hemorrhagic contusion in the left frontal lobe (white arrow) in the follow-up CT scan after 2 months, **C)** Bullet and accompanying bone fragment (black arrow) in bone-window CT scan.

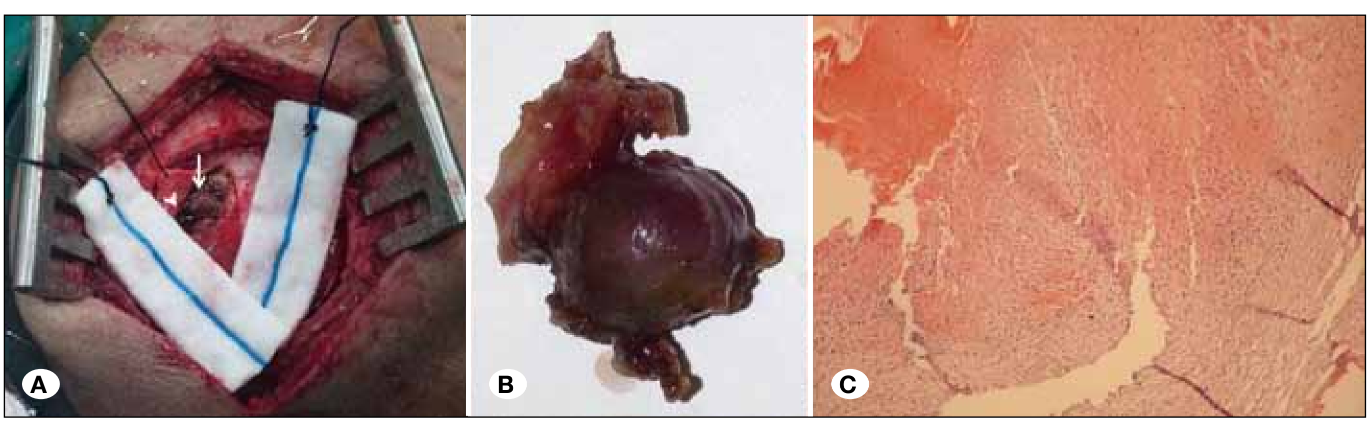

Figure 2: A) Bullet (arrow head) and aneurysm (arrow) in operation field, **B)** Pseudoaneurysm and accompanying bone fragment after resection, **C)** Hemorrhagic area in the pseudoaneurysmal dilatation with peripheral organized tissue (H&E, x200).

the cortical artery that was diagnosed during removal of a bullet was excised without any complication. Dissection and excision of the aneurysm is also recommended for treatment of STA aneurysms (28). Endovascular embolization (12,21) and digital compression that cause thrombosis of the aneurysm (19) are the other treatment modalities.

■ CONCLUSION

Although they are rare entities, intracranial or extracranial pseudoaneurysms should be considered in patients with penetrating head injuries by military munitions. A CT-angiogram or DSA for intra- and/or extracranial and DU for extracranial penetrating traumas can be used for diagnosis. The pseudoaneurysm can be definitely and safely treated with surgical excision.

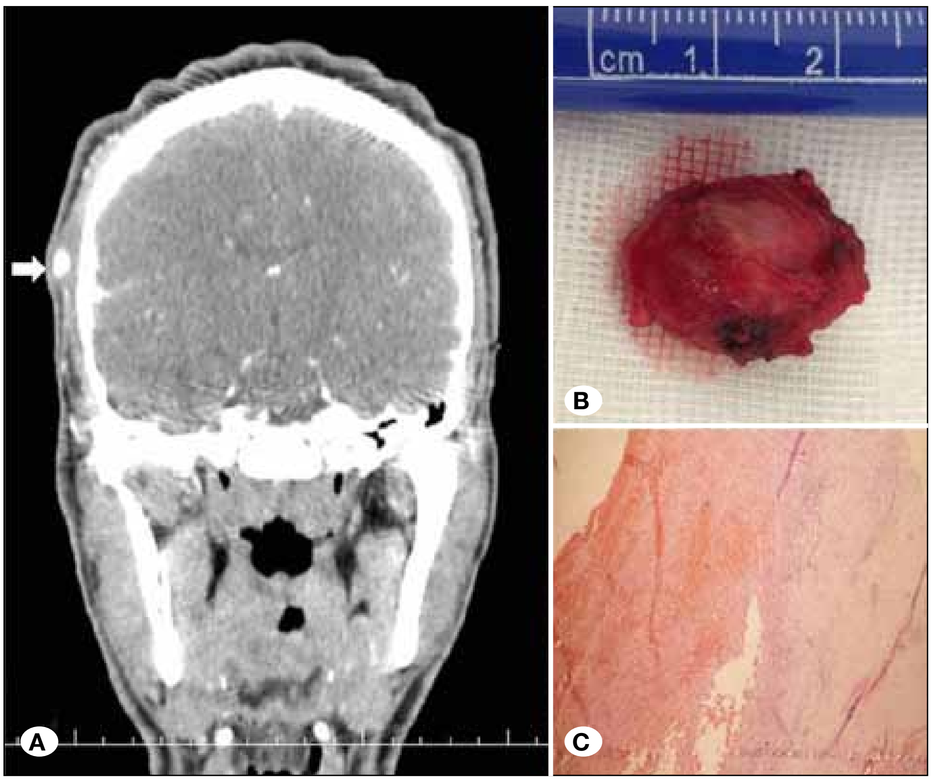

Figure 3: A) Coronal CT-angiogram of the pseudoaneurysm of the parietal branch of the right superficial temporal artery**, B)** Photograph of the pseudoaneurysm just after the resection, **C)** Organized hematoma composing the pseudoaneurysm (H&E, x200).

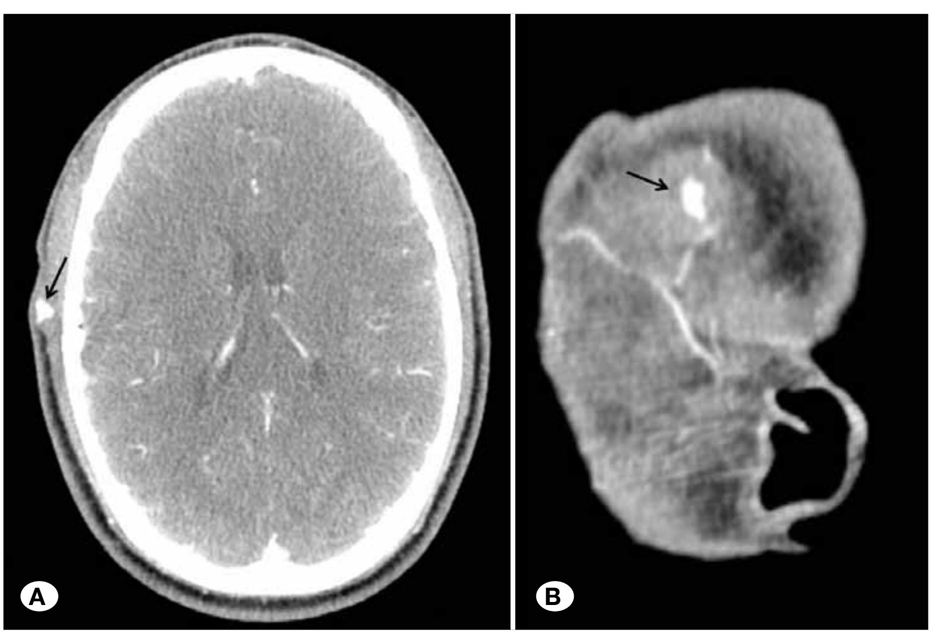

Figure 4: A) The CT-angiogram of the pseudoaneurysm in the right temporal extracranial area on axial image (black arrow). **B)** The CT-angiogram of the pseudoaneurysm located on the parietal brunch of the right superficial temporal artery on sagittal image (black arrow).

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