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Case Report

Repeated coil embolization of traumatic basilar artery pseudoaneurysm accompanied by bilateral traumatic internal carotid artery stenosis following severe head injury in a pediatric patient: A case report and literature review

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ABSTRACT

Background: Few cases of pediatric traumatic intracranial aneurysms (pTICAs) in the posterior circulation involving the basilar artery (BA) following severe head trauma have been reported. Here, we describe a pediatric case of traumatic BA pseudoaneurysm accompanied by bilateral traumatic internal carotid artery (ICA) stenosis following blunt head trauma.

Case Description: A 16-year-old boy presented to our emergency department after being hit by a car. The patient was initially diagnosed with multiple skull base fractures underlying traumatic subarachnoid hemorrhage and left acute epidural hematoma. Seven days following emergency craniectomy, magnetic resonance imaging revealed bilateral ICA stenosis, BA stenosis, and BA pseudoaneurysm. We decided to perform coil embolization, resulting in body filling and a volume embolization ratio of 15.7%. Twenty-eight days after coil embolization, digital subtraction angiography revealed aneurysmal rupture. We performed repeated coil embolization, resulting in body filling and a volume embolization ratio of 20.9%.

Conclusion: We reported a pediatric case of traumatic BA pseudoaneurysm accompanied by bilateral traumatic ICA stenosis following a severe head injury treated with repeated coil embolization. Considering the risk of further brain injury due to high incidence of rupture, early vascular survey and appropriate treatment may be the most important prognostic factors in pTICAs.

Keywords: Basilar artery, Coil enbolization, Head injury, Neurosurgery, Pediatric, Pseudoaneurysm, Trauma, Traumatic intracranial aneurysm, Traumatic pseudoaneurysm

INTRODUCTION

Pediatric intracranial aneurysms are caused by infection, trauma, or congenital factors. Pediatric traumatic intracranial aneurysms (pTICAs) account for less than 5% of all intracranial aneurysms and can result from penetrating or severe head trauma.[3,5,9] pTICAs are most common in the anterior circulation and are histologically considered pseudoaneurysms, increasing their probability of rupture over that of other intracranial aneurysm types and may have an unfavorable

outcome.[1,5,23] pTICAs in posterior circulation involving the basilar artery (BA) following severe head trauma have been rarely reported.[4,6,8,13,16,19,20] Furthermore, none of these reported pTICAs involved the anterior circulation. In this report, we describe a pediatric case of traumatic BA pseudoaneurysm accompanied by bilateral traumatic internal carotid artery (ICA) stenosis following blunt head trauma. We also present a literature review of previous cases of this rare condition.

CASE PRESENTATION

A 16-year-old boy presented to our emergency department after being hit by a car coming from the left while riding a bicycle at an intersection and being thrown off the road by approximately 10 m. The patient presented with a Glasgow coma scale (GCS) score of 4 (E1V2M1) with anisocoria (3.5/diffuse), and both direct and indirect light reflexes absent. Head computed tomography (CT) revealed multiple skull base fractures underlying traumatic subarachnoid hemorrhage and left acute epidural hematoma [Figures 1a and b]. The skull fractures involved the right frontal bone, right pyramidal bone, clivus, left anterior clinoid process, and left mastoid process [Figures 1c and d]. Contrast-enhanced head CT was also performed, but no obvious aneurysm was found on the day of admission [Figures 1e and f].

Emergency craniotomy was performed to remove the hematoma, and craniectomy was added for decompression. Postoperative management included deep sedation, hyperventilation, and hyperosmolar therapy to control intracranial pressure. Deep sedation was terminated on day 5, but the patient's level of consciousness continued at a GCS score of 5T (E1VTM4).

Head magnetic resonance imaging (MRI) was performed 7 days after surgery and revealed bilateral ICA stenosis, BA stenosis, and a pseudoaneurysm at the apical portion of the BA [Figures 2a and b]. Digital subtraction angiography (DSA) revealed bilateral ICS stenosis [Figures 3a and b] and an aneurysm protruding irregularly anteriorly from the distal portion of the BA, and the proximal portion of the BA was dissected [Figure 3c]. The maximum diameter of the pseudoaneurysm was 1.0 cm. After obtaining the guardian's consent, we decided to perform coil embolization. The aneurysm was gradually thrombosed, resulting in body filling and a volume embolization ratio of 15.7% [Figure 3d].

On day 35, that is, 28 days after coil embolization, head CT was performed for follow-up and revealed enlarged ventricles and intraventricular hemorrhage. A second coil embolization was performed following DSA, which revealed a rupture of the aneurysm, resulting in body filling and a volume embolization ratio of 20.9% [Figures 3e and f].

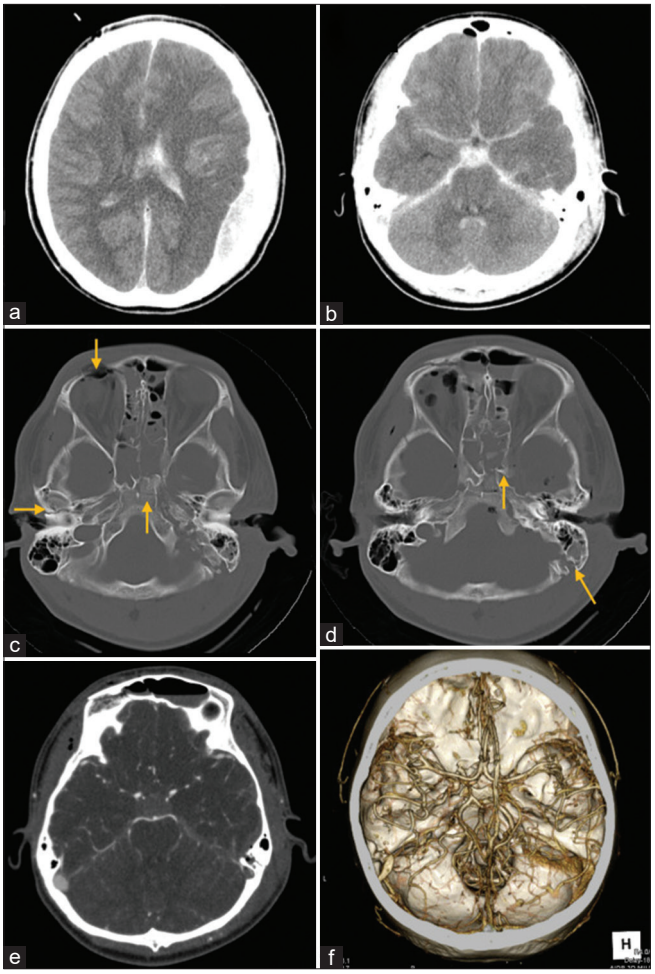

Figure 1: Head computed tomography (CT) shows multiple skull base fractures underlying traumatic subarachnoid hemorrhage and left acute epidural hematoma (a and b). The skull fractures involve the right frontal bone, right pyramidal bone, clivus, left anterior clinoid process, and left mastoid process (c and d; orange arrow). Contrast-enhanced CT of the head shows no obvious aneurysm (e and f).

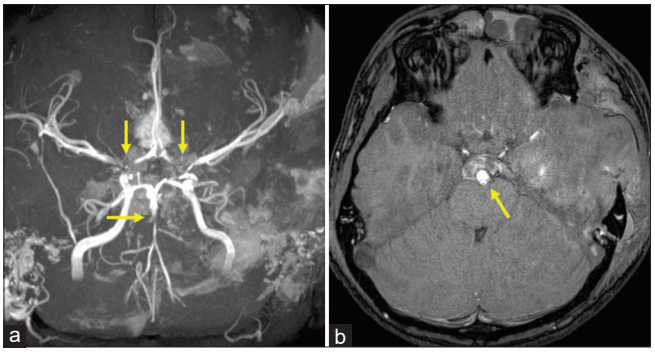

Figure 2: Head magnetic resonance imaging on day 7 revealed bilateral internal carotid artery (ICA) stenosis, basilar artery (BA) stenosis, and pseudoaneurysm at the apical portion of the BA (a and b; yellow arrow).

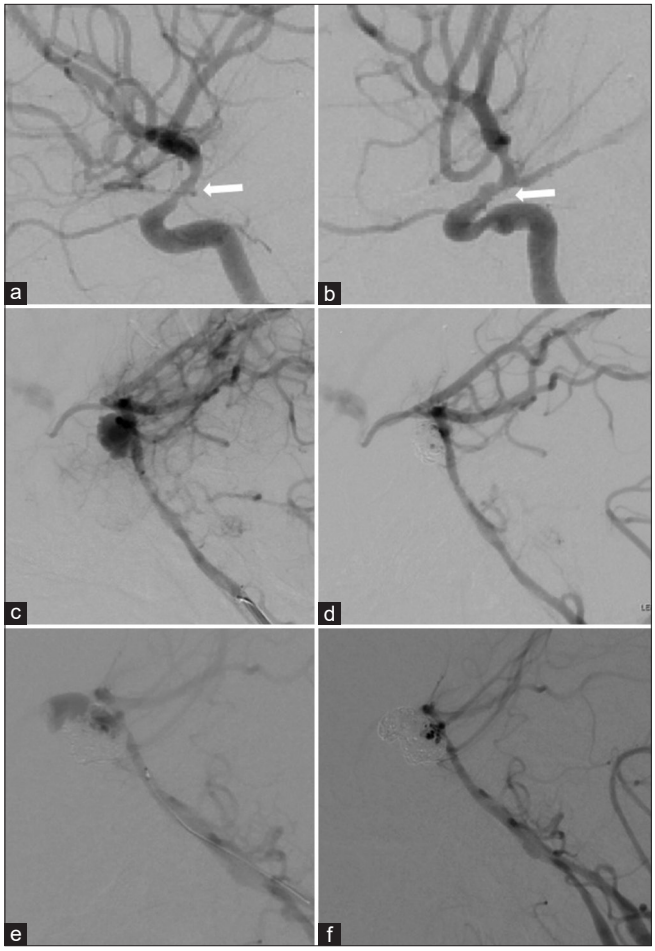

Figure 3: Digital subtraction angiography (DSA) revealed bilateral internal carotid artery stenosis (a and b; white arrow) and the aneurysm protruding irregularly anteriorly from the distal portion of basilar artery (BA) and proximal portion of the BA was dissected (c). The aneurysm gradually thrombosed, resulting in body filling and a volume embolization ratio of 15.7% (d). Second coil embolization was performed following DSA that revealed re-rupture of the aneurysm, resulting in body filling and a volume embolization ratio of 20.9% (e and f).

Head MRI on day 42, 1 week after retreatment, showed no obvious blood flow in the aneurysm, and the BA and bilateral ICA stenoses had improved [Figures 4a and b]. DSA also showed improved bilateral ICA stenosis [Figures 4c and d]. At the 6-month follow-up, the patient had a GCS of 8T (E4VTM4) and a modified Rankin Scale (mRS) score of 4.

DISCUSSION

The incidence of TICAs is lower than that of other aneurysms,[5] and pTICAs reportedly comprise fewer than 5% of all intracranial aneurysms.[9,11] pTICAs may be associated with non-penetrating trauma and motor vehicle accidents (MVA), usually accompanied by skull

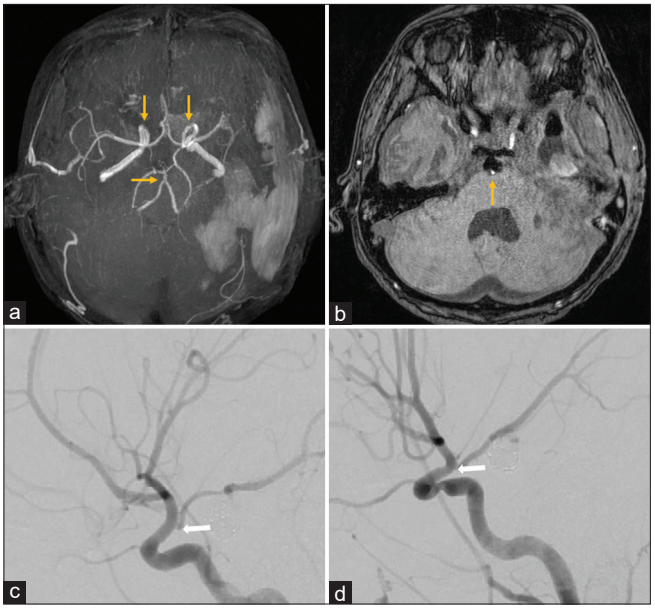

Figure 4: Head magnetic resonance imaging on day 42 showed no obvious blood flow in the aneurysm and the basilar artery stenosis and bilateral internal carotid artery stenosis had improved (a and b; orange arrow). Digital subtraction angiography also revealed improved bilateral internal carotid artery stenosis (c and d; white arrow).

fractures.[12,18] There are various hypotheses regarding the mechanism of TICA formation, including direct injury to the vessels due to dissection associated with extension and torsion and compressive effects on the vessels by surrounding anatomical structures (dura, bony prominences) and free bone fragments.[2,6] In the present case, the patient had a clival fracture, suggesting that the cause of the pTICA was direct injury to the vessels due to direct external forces. ICA stenosis may have been caused by compressive effects or acute dissection resulting from fracture of the carotid canal.

A pTICA in the posterior circulation secondary to blunt trauma is very rare, as the damaging artery is located deep in the brain and is expected to be caused by a large upright external force, with only few cases having been reported. To the best of our knowledge, ten cases of pTICAs in the posterior circulation have been reported after blunt head trauma [Table 1].[4,6-8,13,15-17,19,20] The patients in total, including our present case, were 11 (eight boys and three girls), with an average age of 8.09 years. The most common traumatic cause reported concerns about MVAs (63.6%), whereas accidental falls comprised up to 36.4%. Patients at the time of the first neurologic evaluation most frequently had a severe neurological status, with three patients in a coma (27.3%) and in 63.6% of cases, the GCS score was lower than 9. However, we found several varieties of presentation in the initial symptoms, with two

Table 1: Literature review of pediatric traumatic intracranial aneurysms in the posterior circulation.

Reference	Age (years)	Sex	Trauma modality	Initial GCS	Skull base fracture	Surgery in the acute period	First CTA/MRI	First DSA	First diagnosis	Localization	Size	Treatment	Recurrence	F/U period	Final mRS
Loevner *et al.*, 1998[13]	7	M	Fall	15	No	No	N/A	36 months	9 months	Distal BA	N/A	Conservative	No	72 months	1
Teitelbaum *et al.*, 1998[20]	8	M	MVA	3	No	No	N/A	2 months	2 months	Distal BA	2 cm	Staged colling	Yes	4 months	1
Connor *et al.*, 2001[4]	12	F	MVA	4	No	No	N/A	3 weeks	20 days	Distal BA	2.3 cm	Coiling	No	2.5 months	3
Morón *et al.*, 2005[15]	6	M	Fall	14	No	No	N/A	2 days	15 days	Left PCA	N/A	Conservative	No	5 years	1
Kneyber *et al.*, 2005[8]	5	F	Fall	3	No	No	N/A	1 week	3 weeks	Proximal BA	N/A	Conservative	No	6 months	4
Ong *et al.*, 2010[17]	3	M	Fall	N/A	No	No	N/A	15 days	15 days	Left SCA	N/A	Coiling	No	3 days	6
Griauzde *et al.*, 2014[6]	7	F	MVA	3	No	Yes	20 weeks	20 weeks	20 weeks	Distal BA	1.2 cm	Stent coiling	No	3 months	3
Huh *et al.*, 2015[7]	9	M	MVA	9	Yes	Yes	15 days	15 days	15 days	Right VA	1.5 cm	Coiling	No	52 days	6
Nimjee *et al.*, 2015[16]	2	M	MVA	8	Yes	No	4 weeks	32 weeks	4 weeks	Distal BA	2.1 cm	Clipping	No	12 months	2
Sujijantarat *et al.*, 2017[19]	14	M	MVA	6	Yes	Yes	1 day	3 days	1 days	Distal BA	1 cm	Staged trapping	Yes	24 months	3
Present case	16	M	MVA	4	Yes	Yes	1 day	7 days	7 days	Distal BA	1 cm	Repeat coiling	Yes	4 months	4

BA: Basilar artery, CTA: Computed tomography angiography, DSA: Digital subtraction angiography, F: Female, GCS: Glasgow coma scale, MRI: Magnetic resonance imaging, M: Male, mRS: modified Rankin Scale, MVA: Motor vehicle accident, PCA: Posterior cerebral artery, SCA: Superior cerebellar artery, VA: Vertebral artery, F/U: Follow up, N/A: Not applicable

patients diagnosed incidentally or after complaining of mild headaches.[13,19] Interestingly, the aneurysm was not detected on the first CT examination in any case. Of the listed cases, no patient underwent DSA on admission to the emergency department. Diagnostic DSA was performed in all patients between 24 h and 5 months after the traumatic event. Notably, pseudoaneurysm formation was present at the time of first DSA examination in only five patients in our review.[6,7,17,20] Once a pTICA in posterior circulation with repeat DSA was identified, the most common location was the BA in eight patients (72.7%), followed by the posterior cerebral artery, superior cerebellar artery, and vertebral artery. The treatment choice was also highly variable, with six patients treated through the endovascular route (54.5%) and two treated surgically (18.2%). In three patients (27.3%), conservative treatment was reported for clinical severity or spontaneous and complete thrombosis. Despite their rarity, according to the literature, pTICAs are associated with marked morbidity and mortality rates, as high as 40–60%.[22] In our review, two patients died despite surgical treatment.[7,17]

Three recurrences were observed during angiographic follow-up of the eight treated aneurysms, with a recurrence rate of 37.5%. There were one and two recurrences in the microsurgery and endovascular treatment groups, respectively.[19,20] The recurrence rate for pTICA is unknown; however, considering a previous investigation of 15 patients with pTICA where only one patient had recurrence after treatment, it is possible that pTICAs in the posterior circulation may have a higher recurrence rate.[14]

Of all, 7 patients (63.6%) had a poor mRS score (≥3), denoting severe morbidity and mortality.[14] Unfortunately, in these 11 cases, no significant correlation was found between the location of the aneurysm, type of treatment, and final outcome. However, considering the risk of further brain injury from the high incidence of rupture,[10,21] early vascular surveys and appropriate treatment of pseudoaneurysms may be the most important prognostic factors for this rare condition. In addition, due to the small number of reported cases, further accumulation of cases and more detailed statistical evaluations is required in the future.

CONCLUSION

We reported a pediatric case of traumatic BA pseudoaneurysm accompanied by bilateral traumatic ICA stenosis following severe head injury treated with repeated coil embolization. Past literature has indicated that pTICA has a high recurrence rate and may present severe morbidity and mortality. Early diagnosis, treatment, and detection of recurrence will require close follow-up after treatment and early consideration of DSA.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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