Posttraumatic Damage To The Internal Carotid Artery: Pseudoaneurysm Presenting With Epistaxis And Direct Carotid Cavernous Fistula

İnternal Karotis Arter Yaralanması: Direkt Karotiko-Kavernöz Fistül Ve Epistaksis İle Kendini Gösteren Psödonaevrizma Oluşumu

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Abstract: Three cases of posttraumatic internal carotid artery pseudoaneurysms presenting with epistaxis and associated direct carotid cavernous fistulae in two of the patients are presented. The rare association of the two types of posttraumatic internal carotid artery damage as well as the method and outcome of endovascular therapy performed in these cases will be reported.

Key words: Pseudoaneurysm- epistaxis- direct carotid cavernous fistula

Özet: ***Amaç:*** Psödoanevrizma ve direkt karotikokavernöz fistül oluşumu internal karotis arter travması sonucu oluşan iki nadir yaralanma tipidir.
Olgu Sunumu: Bu çalışmada üç olguda epistaksis ile kendini gösteren internal karotis arter psödoanevrizması ve olgulardan ikisinde eşlik eden direkt karotikokavernöz fistül sunulmaktadır.
Sonuç: İnternal karotis arterde oluşan iki nadir yaralanma biçimi ve bu olgulardaki endovasküler tedavi yöntem ve sonuçları sunulmaktadır.

Anahtar Kelimeler: Psödoanevrizma, epistaksis, direk karotiko-kavernöz fistül

INTRODUCTION

Posttraumatic pseudoaneurysms of the internal carotid artery (ICA) presenting with epistaxis and high flow carotid cavernous fistulas (CCF) due to traumatic laceration in the cavernous segment of ICA are rare sequelae of head trauma. Rapid diagnosis and immediate endovascular or surgical treatment is very important in reducing morbidity and mortality in both entities (4,8,9). Three cases with traumatic pseudoaneurysms of ICA presenting with epitaxis, two of which were associated with direct CCF are presented. The rare association of the two types of injury, clinical course and outcome of endovascular therapy in these cases will be reported.

CASE REPORTS

Case 1

22-year-old male patient presented with progressive vision loss, chemosis and proptosis in the left eye. He had suffered a traffic accident six

months ago, when he was hospitalized for head trauma. There was total loss of vision in the right eye due to transection of the optic nerve and multiple fractures in the anterior and middle skull base. There was one episode of massive epistaxis one week after trauma, which had been controlled with posterior nasal packing.

Cranial CT scan performed on the present admission showed enlargement of the left cavernous sinus, exophthalmus of the left globe and fractures in the left orbit and sphenoid sinus walls. The sphenoid sinus was filled with dense material.

During cerebral angiography, a direct carotid cavernous fistula supplied by a large tear in the C3-C4 segments of the left ICA was detected. The left cavernous sinus was extremely distended because of the high flow fistula draining by way of the ipsilateral ophthalmic veins and contralateral cavernous sinus. Two pseudoaneurysmal sacs extending into the left sphenoid sinus at the site of

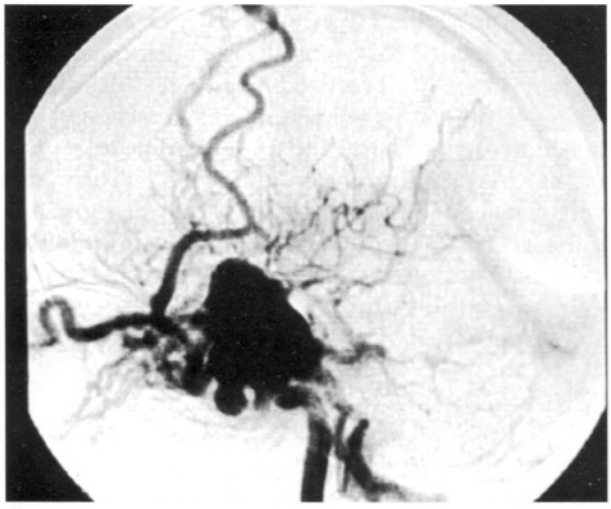


Figure 1a: Figure 1a (Case 1): Midarterial phase image of lateral left ICA injection in a young male with epistaxis and proptosis shows a direct carotid cavernous fistula and pseudoaneurysms extending into the sphenoid sinus.

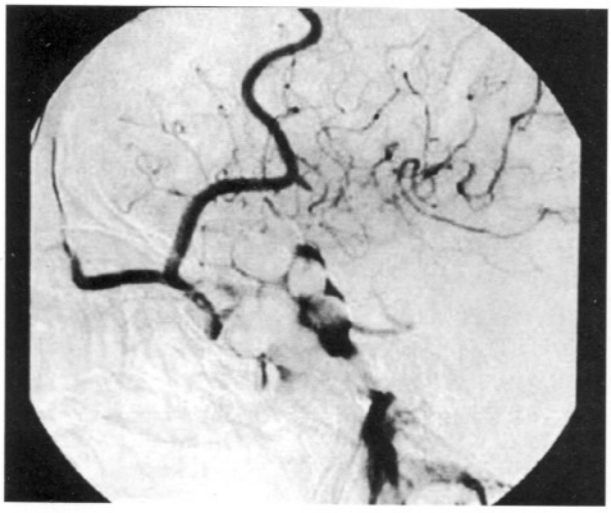


Figure 1b: After balloon embolization of the extremely distended cavernous sinus, fistulous flow and pseudoaneurysmal opacification are reduced with diminished steal in the intracranial flow.

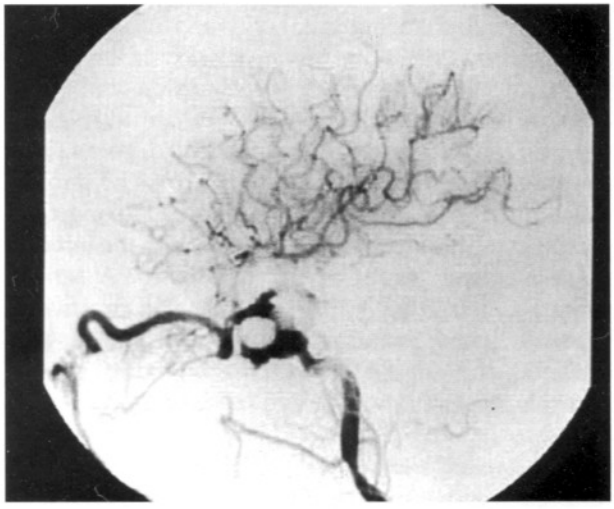


Figure 1c: One week later, although some of the balloons have deflated, the fistulous flow is diminished further; the pseudoaneurysms are no longer visualized.

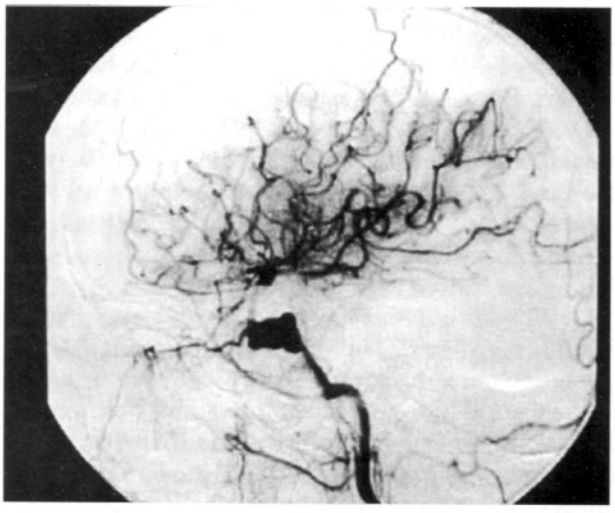


Figure 1d: Follow up cerebral angiogram performed one month later reveals total fistula thrombosis with some thinning in the supraophthalmic segment of ICA, and a pseudoaneurysm in the cavernous portion of the artery.

the fracture were also detected (Figure 1a). Significant diminution of intracranial flow was observed due to the steal of the high flow fistula with collateral flow from the contralateral ICA and leptomeningeal vessels. Endovascular balloon occlusion of the fistula was planned in order to restore intracranial flow in the left cerebral hemisphere and to preserve vision in the left eye by reversing orbital venous hypertension. Arrest of flow in the pseudoaneurysms was another goal of therapy taking into consideration the episode of massive epistaxis.

Multiple detachable balloons were dislodged in the cavernous sinus on the venous side of the fistula using transarterial access. Upon detection of increase in the intracranial flow and some diminution of venous reflux into the ophthalmic veins, the procedure was terminated (Figure 1b). The patient was followed closely for one week. During that period, exophthalmus and congestion in the left eye regressed and visual acuity improved. A repeat cerebral angiography at the end of the first week showed that some of the balloons had deflated; however, the fistula flow was significantly slower and pseudoaneurysms were not visualized (Figure 1c). No further endovascular therapy was undertaken upon interpretation of the findings as progressive fistula thrombosis.

A control angiogram performed one month later showed some displacement and irregularity in the cavernous segment of the left internal carotid artery resulting from the enlarged and thrombosed cavernous sinus. There was total restoration of intracranial flow in the ipsilateral hemisphere and the fistula and pseudoaneurysms were obliterated (Figure 1d). During the last follow up visit in the fifth year of endovascular therapy, the ophthalmic findings had totally resolved. There were no new neurologic deficits or new episodes of epistaxis.

Case 2:

27 year-old-male patient was admitted with massive epistaxis, which was controlled with posterior nasal packing. History revealed a motor vehicle accident one year before admission, which had resulted in multiple fractures in the right temporal skull and lateral wall of the left sphenoid sinus (2a). He had been neurologically stable at the time but suffered an episode of moderate epistaxis one week after trauma, which had spontaneously resolved. The last bout of epistaxis one day before referral to our institution was pulsatile and severe causing a drop of 3 gr. in haemoglobin level. The patient was referred to our institution for angiography and endovascular therapy of epistaxis.

During cerebral angiography, a large pseudoaneurysm originating from the C1-2 segments of the cavernous portion of left ICA and extending caudally into the left sphenoid sinus was detected (2b and c). Due to the relatively wide neck and presumably weak walls of the sac, no attempt was made to occlude the pseudoaneurysm. Balloon occlusion of the left ICA was performed. A detachable balloon was inflated in the cavernous segment adjacent to the neck of the aneurysm occluding the left ICA. Nonfilling of the fistula was angiographically observed. After a test occlusion lasting 45 minutes, the balloon was detached upon detection of full clinical and angiographic tolerance for left ICA occlusion (Figure 2d). Two safety balloons were detached in the petrous and cervical segments of the left ICA. There were no complications in the immediate postoperative period. In the sixth-month-follow up, the patient appeared well with no neurologic deficit or history of recurrent epistaxis.

Case 3:

28 year-old male patient was admitted with progressive proptosis and congestion in the left eye, which had started two months ago. He also complained of blurred vision. On examination, a bruit was audible over the left globe. He had suffered trauma by falling from a height one year ago when he was hospitalized with no major neurologic deficit

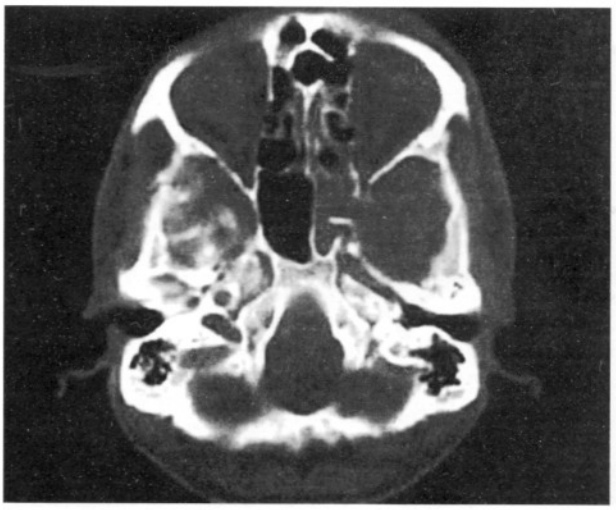
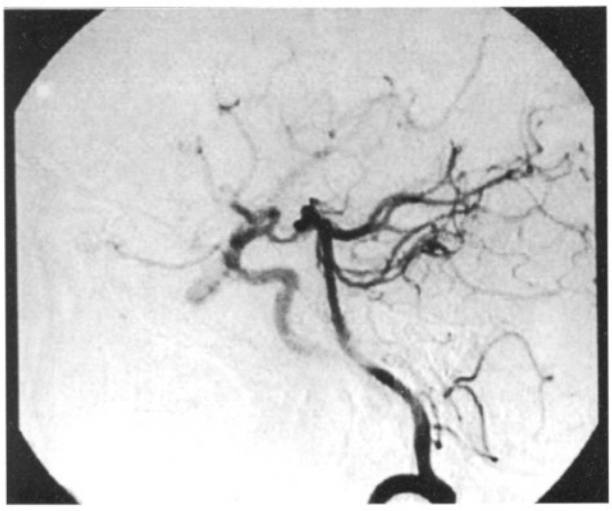


Figure 2a (Case 2): CT in bone algorithm shows fractures in the right side of the skull base (not shown) and left sphenoid sinus in a young male patient admitted with massive epistaxis.



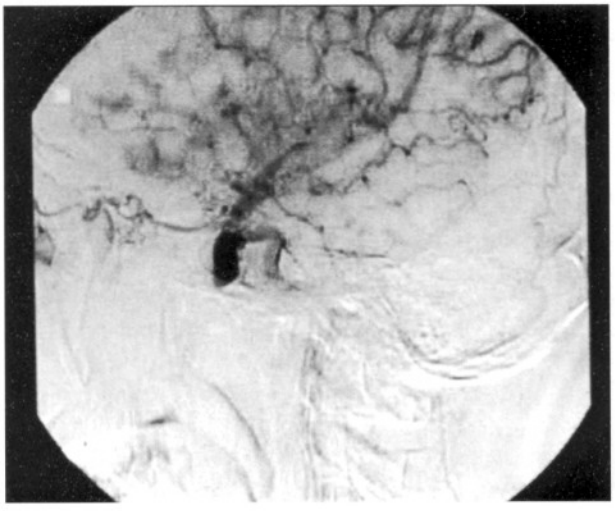


Figure 2b and c: Lateral left vertebral artery injection with simultaneous compression of the ipsilateral common carotid artery demonstrates a pseudoaneurysm originating from the distal cavernous segment of the ICA and extending into the sphenoid sinus (b). There is contrast stagnation in the aneurysmal sac (c).

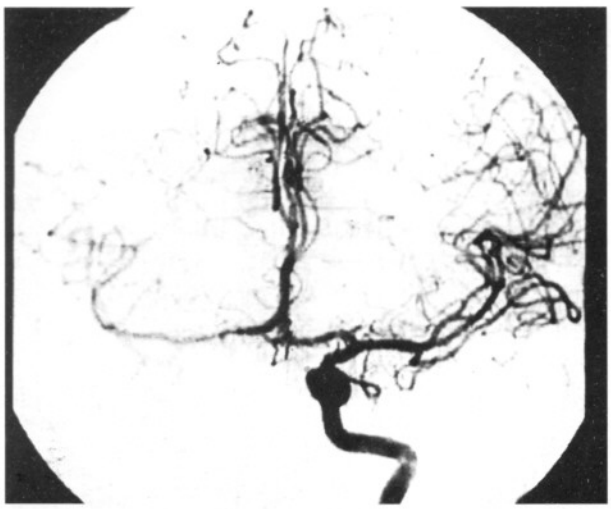


Figure 2d: After balloon occlusion of the left ICA at the point of the tear, right ICA injection in the anteroposterior projection shows total obliteration of the pseudoaneurysm with symmetric angiographic perfusion in both hemispheres.

except for a temporary left sixth cranial nerve palsy. Imaging performed at the time is inaccessible, however, basilar skull fractures have been reported. Medical history also revealed two episodes of massive epistaxis four and six weeks after trauma, which were controlled with posterior packing.

Cerebral angiography revealed a direct carotid cavernous fistula supplied by a tear in the distal cavernous segment of the left ICA. A pseudoaneurysm with a relatively narrow neck extending into the left sphenoid sinus was also present (Figure 3a). A detachable balloon was placed on the venous side of the fistula via transarterial approach, inflated and detached with total occlusion of the fistula as well as the pseudoaneurysm (Figure 3b). Repeat cerebral angiography was performed the next day because of recurrent eye findings associated with the fistula. On angiography, it was observed that the balloon had deflated and the fistula has recurred. A total of five appropriate size electrically detachable microcoils and a detachable balloon were then placed in the cavernous sinus on the venous side of the fistula. Upon detection of residual fistulous flow in the control ICA injections, balloon occlusion of the left ICA was performed with a detachable balloon placed inside the parent artery at the point of the tear (Figure 3c and d). The patient was discharged a few days later with no neurologic deficit. During the first and sixth month follow up, the eye signs had totally resolved and there were no new episodes of epistaxis or neurological problems.

DISCUSSION

Rupture of aneurysms in the cavernous segment of the internal carotid artery may result in life threatening epistaxis. Aneurysms may be traumatic pseudoaneurysms, or real saccular aneurysms; however, there are also reports of tuberculosis infection, transsphenoidal surgery and radiotherapy resulting in pesudoaneurysm formation in the ICA

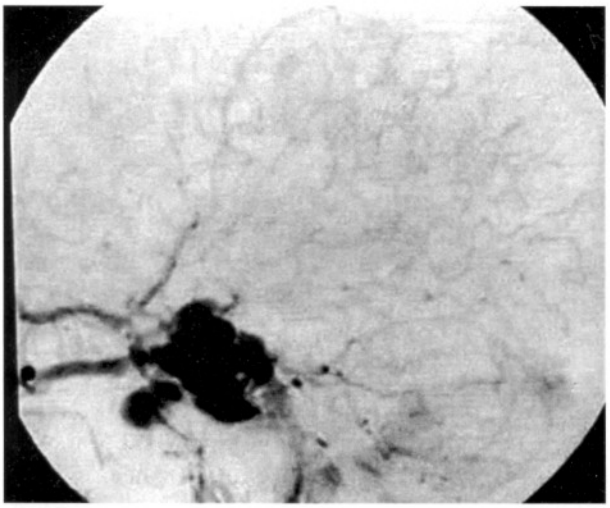


Figure 3a: Figure 3a (Case 3): Left lateral ICA injection of a young male with similar symptoms with the first case shows a direct carotid cavernous fistula and pseudoaneurysm extending into the sphenoid sinus.

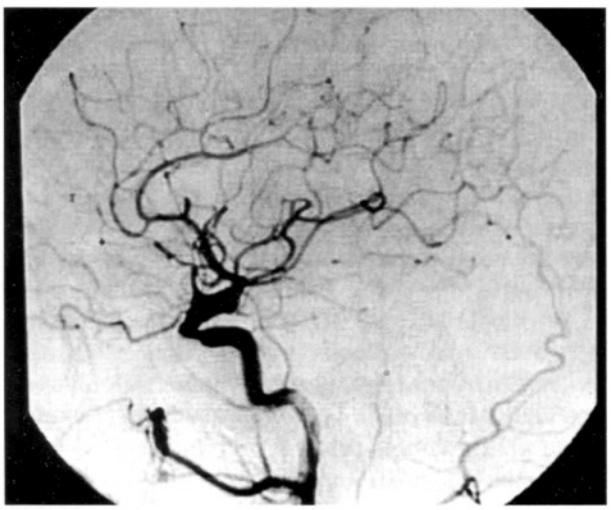


Figure 3b: The fistula and pseudoaneurysm have been totally occluded with a detachable balloon dislodged on the venous side via transarterial approach. There is a slight impression of the balloon in the anterior wall of the distal cavernous ICA segment.

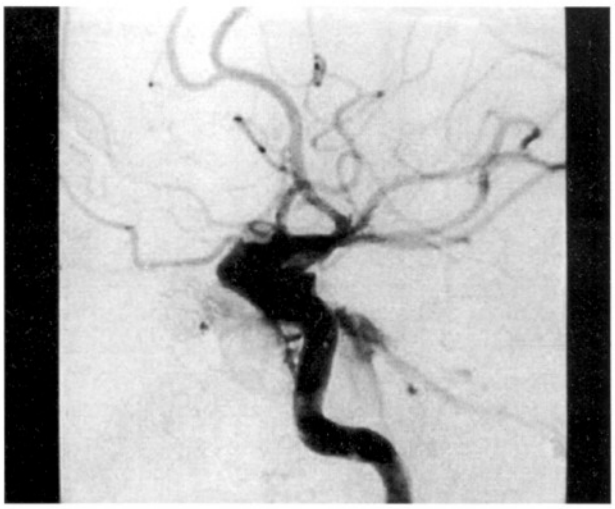


Figure 3c: The fistula has relapsed due to balloon migration in the control angiogram performed on the next day upon recurrence of symptoms.

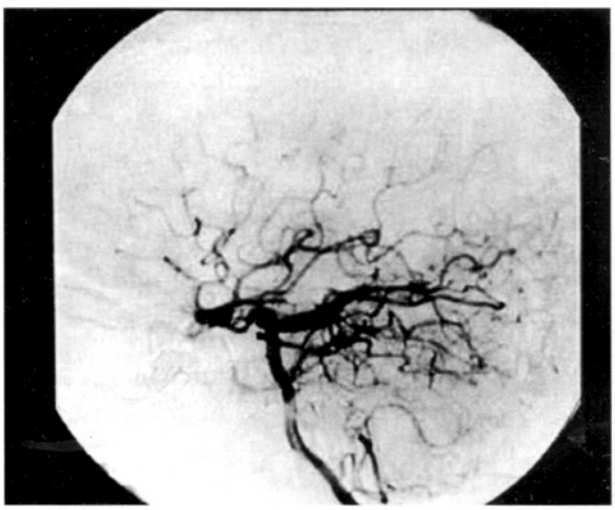


Figure 3d: Left vertebral artery injection after parent artery occlusion with detachable balloons and electrically detachable coils shows total fistula occlusion and hemispheric perfusion from the posterior communicating artery.

leading to massive epistaxis (3,6,10,15). In this small series of patients, all aneurysms were traumatic pseudoaneurysms and first episode of epistaxis occurred one to four weeks after trauma. The latency period of epistaxis in patients with ICA pseudoaneurysm following traumatic insult is variable and mortality has been shown to be as high as 30 % (4). No mortality related to epistaxis or endovascular therapy has been encountered in this study.

The typical clinical presentation in patients with traumatic pseudoaneurysm of the internal carotid artery is history of head injury, monocular blindness and life threatening epistaxis, also referred to as *Mauer's triad* (9). History of head injury and epistaxis

of varying severity was present in all of our three patients and monocular blindness was present in one (Case 1) due to transection of the optic nerve during craniofacial injury.

In two of the patients (Cases 1 and 3) signs and symptoms of carotid cavernous fistula, another rare but potentially devastating sequel of head trauma with skull base fractures, dominated the clinical picture. Classically, a direct carotid cavernous fistula can be defined as a high flow communication between the cavernous internal carotid artery and the cavernous sinus and may most commonly be the result of traumatic laceration of the artery or the rupture of a saccular aneurysm into the cavernous sinus. The signs and symptoms, which may also be delayed similar to the rupture of traumatic ICA pseudoaneurysm, are headache, orbital pain, diplopia, exophthalmus, pulsatile bruit and visual loss. Transvenous or transarterial embolization of the fistula and endovascular balloon occlusion of the ICA are the possible endovascular treatment modalities (5,14).

The association of traumatic pseudonaeurysm of the internal carotid artery and direct carotid cavernous fistula is rare. Millman and Giddings reported one case presenting with major epistaxis related to ICA pseudoaneurysm and signs and symptoms of carotid cavernous fistula on examination. The management of the lesions is not discussed in their report (12). In their series of five patients with traumatic intracavernous aneurysms presenting with massive epistaxis, Liu and colleagues reported one case with accompanying direct carotid cavernous fistula. The patient was managed surgically with trapping of the internal carotid artery and muscle embolization of the fistula with favorable postoperative course (11). One earlier report of the association of epistaxis and carotid cavernous fistula came from Wilson et al, in 1966 (16).

Rapid diagnosis and immediate management of epistaxis related to traumatic ICA pseudoaneurysms are crucial in reducing the high mortality. Diagnosis may be delayed due to other problems resulting from head injury and the equivocal nature of the epistaxis, which is commonly delayed and rarely severe during the initial attacks. Surgical repair of the aneurysm and trapping or ligation of the ICA as well as endovascular occlusion of the ICA and selective obliteration of the fistula via transarterial or transvenous route (without parent artery sacrifice) has been successfully performed in the management of traumatic pseudoaneurysms of the internal carotid artery (4, 7, 10, 11). In our patients endovascular treatment has succeeded in the definitive treatment of epistaxis and the symptom has not recurred during a follow up period of six months to five years. Endovascular occlusion of the pseudoaneurysm has not been an attractive option due to the danger of rupture or uncontrollable bleeding resulting from damage to the weak fibrous walls of the aneurysm.

In this series, one patient with traumatic aneurysm and carotid cavernous fistula (Case 1) has been managed with transarterial balloon embolization of the fistula, which also resulted in occlusion of the pseudoaneurysm. The other patient with the same angiographic findings (Case 3) has been managed with balloon occlusion of the internal carotid artery with successful closure of the fistula and the pseudoaneurysm. The indication of endovascular therapy in both cases was prevention of stroke and recurrent bouts of epistaxis as well as restoration and salvage of vision endangered by orbital venous congestion inflicted by the high flow fistula. Successful treatment of posttraumatic pseudoaneurysms of the carotid artery with endoluminal stenting and transstent coiling has been reported in recent literature (1, 2, 13).

In this small series of patients with traumatic pseudoaneurysm of the ICA and direct carotid cavernous fistulas, catheter angiography and endovascular therapy has succeeded in definitive diagnosis and treatment. Our results together with others' from literature strongly suggest that endovascular therapy should be the treatment of choice in both lesions.

CONCLUSION

This study reports three cases of traumatic pseudoaneurysms of the internal carotid artery accompanied by direct carotid cavernous fistula in two patients. Massive epistaxis and the mainly ophthalmic signs and symptoms of the high flow fistula should prompt immediate angiographic evaluation. Although rare as sequelae of head trauma and even rarer when in association, the authors suggest that the results of this study and data from literature imply that endovascular embolization is the treatment of choice in these potentially devastating entities.

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