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Ruptured Blister-Like Aneurysm of Distal Internal Carotid Artery: A Distinct Entity

Distal İnternal Karotid Arterin Patlamış Blister Anevrizması: Farklı Bir Antite

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ABSTRACT

OBJECTIVE: Blister-like aneurysms are small hemispherical bulges that usually originate from the anteromedial wall of the distal internal carotid artery and cause significant subarachnoid hemorrhage. It is very important to recognize this novel lesion as a different type of aneurysm than ordinary berry aneurysms.

CASE DESCRIPTION: We report the case of a 43-year-old man who underwent a diagnostic procedure and was awaiting surgery elsewhere before being transferred to our institution. A right sided blister-like aneurysm was seen on angiograms. Although the aneurysm bled intraoperatively, 2 clips were placed with one slightly catching the medial artery wall. The outcome was excellent.

CONCLUSIONS: Since blister-like aneurysms are different than saccular aneurysms both morphologically and histologically, their treatment also differs making surgical exploration and standard clipping a more hazardous situation than usual. In fact, surgical decision for blister aneurysms should be individual with alternative plans in case the initial treatment strategy fails. Such a flexible strategy also necessitates preoperative cerebrovascular flow testing and a variety of additional hardware like encircling graft clips, microsutures or wrapping material ready in the operating room on top of traditional aneurysm clips.

KEY WORDS: Blood-blister like aneurysm, Clipping, Subarachnoid hemorrhage, Treatment

ÖZ

Blister anevrizmalar genelde internal karotid arterin anteromedial duvarından köken alan ve çok ciddi subaraknoid kanamaya neden olabilen vezikül ya da yarım daire şeklinde küçük kabartılardır. Bu özel anevrizma tipini tanımak ve sakküler anevrizmalardan farklı olduğunu bilmek önemlidir. Bu yazıda subaraknoid kanama akabinde başka bir merkezde etiyolojisi araştırılmış ve cerrahi tedavi beklerken hastanemize nakledilmiş 43 yaşında erkek hastanın tedavisi ile ilgili bilgi verilmektedir. Anjiyografilerde sağ internal karotid arter distalinde blister şeklinde görünen anevrizma, ameliyat sırasında kanadığı halde biri normal damar duvarını da tutan 2 adet klip ile başarılı bir şekilde tedavi edildi.

Blister anevrizmalar hem morfolojik, hem de histolojik olarak sakküler anevrizmalardan farklı olduklarından cerrahi eksplorasyon ve klipleme işlemi de daha risklidir. Aslında blister anevrizmalar için tedavi, olgu bazlı planlanmalı ve ana stratejinin başarısız olduğu durumlarda kullanılabilecek alternatif planlar da yapılmalıdır. Böyle esnek bir strateji hem karotis oklüzyonu durumunda beynin kollateral dolaşımı ve iskemi direncini gösteren preoperatif tetkiklerin yapılmasını, hem de ameliyathanede standart klip setleri içinde bulunmayabilecek greft klipler, anevrizmayı sarmak için kullanılabilecek malzeme ve mikrosütür gibi ek materyallerin bulunmasını gerektirmektedir.

ANAHTAR SÖZCÜKLER: Blister anevrizma, Klipleme, Internal karotid arter, Subaraknoid kanama

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INTRODUCTION

Rarely a very small hemispherical bulge occurs at the superior wall of the supraclinoid portion of the internal carotid artery (ICA) and this lesion resembles a tiny berry aneurysm but it is now considered a distinct entity with different features clinically, histopathologically and technically. Blister-like aneurysms (BA), as they are called, can cause much more serious subarachnoid hemorrhage (SAH) than a large berry aneurysm yet may even go undetected by angiography (5,7). In contrast to berry aneurysms, blister aneurysms are not located at arterial bifurcations and usually arise from the anteromedial surface of the supraclinoid ICA (C1>C2) (4). Exceptions to the rule exist: a single case of BA in the posterior circulation and few cases of BAs at the anterior communicating artery (ACoA) have been reported (2,25). BAs have very fragile walls and a poorly defined neck. In contrast to a berry aneurysm wall which consists largely of collagen within a thickened intima and adventitia, a blisterlike aneurysm basically consists of a thin adventitia that covers a focal intima and media defect (7,12). From the neurosurgical point of view, BAs are notorious for simply tearing away from the carotid wall while a traditional clip is closed. Intraoperative aneurysmal bleeding of BAs occurs in approximately 40-60% of patients and morbidity as well as mortality associated with this hemorrhage has been extremely high (17,22). Herein we report the case of a young man with a ruptured right ICA blister aneurysm who underwent surgery with an excellent outcome. As more neurosurgeons become aware of the clinical and surgical implications of this distinct entity, more cases will be encountered and safely treated.

CASE HISTORY

A 43-year-old gentleman presented to a local hospital after sudden onset of headache and nausea. Computed tomography (CT) scan showed a Fisher Grade 3 SAH (Figure 1). He was then transferred to a university hospital where a cerebral angiogram was done to show a right-sided medially projecting aneurysm. For reasons unknown to us, the patient was kept in the ward for the next 6 days awaiting surgery and then a CT-angiogram was done. The family then transferred the patient to our hospital for treatment. CT scan on admission to our hospital showed that most of the SAH has resolved. The cerebral angiogram (Figure 3) as well as magnetic

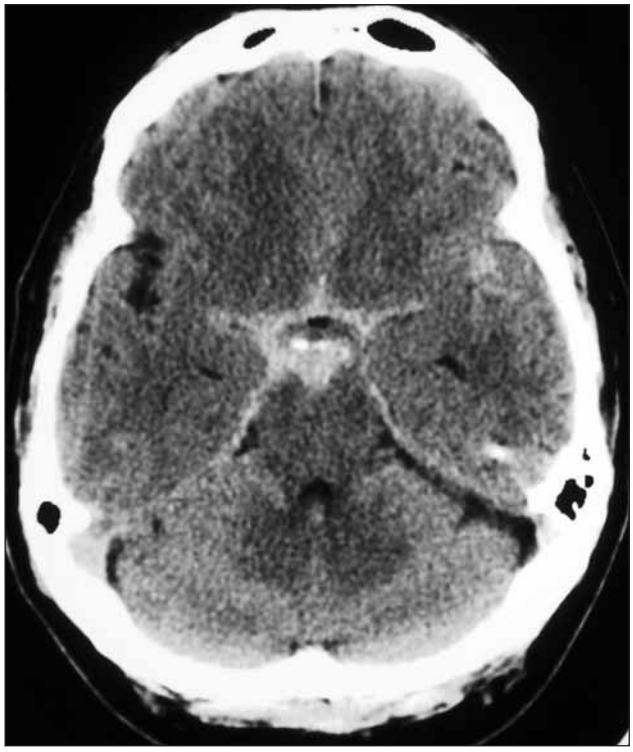
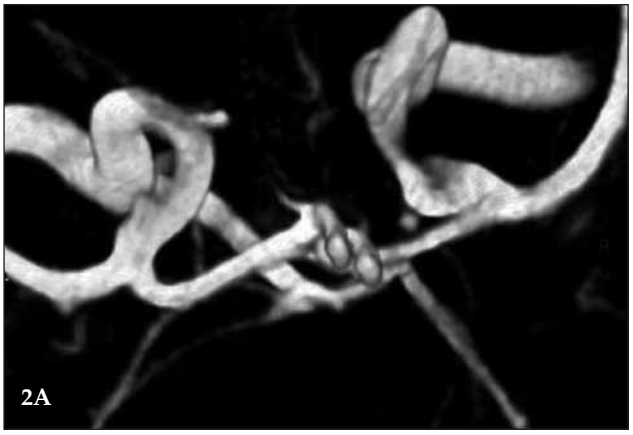


Figure 1: *Axial non-enhanced CT scan showing Fisher Grade 3 subarachnoid hemorrhage.*

resonance (MR) and MR-angiography (MRA) (Figure 2A,B) showed the same medially projecting aneurysm originating from the medial wall of the supraclinoid ICA. The right-sided posterior communicating artery was rudimentary and could not be visualized with the MRA. MRA also showed that a short (5-6 mm) segment of ICA before the origin of aneurysm was spastic and the aneurysm segment appeared to show post-stenotic dilation.

Considering the morbidity of a repeat angiography to check the patency of anterior communicating complex, a CT-angiography with manual compression over the right common carotid artery was done before surgery. 3D CT angiographic images showed a patent and efficient anterior communicating complex and that the left carotid flow could supply blood up to the middle cerebral artery (MCA) periphery (Figure 4). The patient was taken to the operation room (OR) at the 10th day post-bleeding. At surgery, the cervical ICA was exposed first for proximal control and umbilical tapes were passed around the ICA, external carotid (ECA) and common carotid arteries. A pterional craniotomy was done next and wide dissection of the right Sylvian was carried out. Lifting or



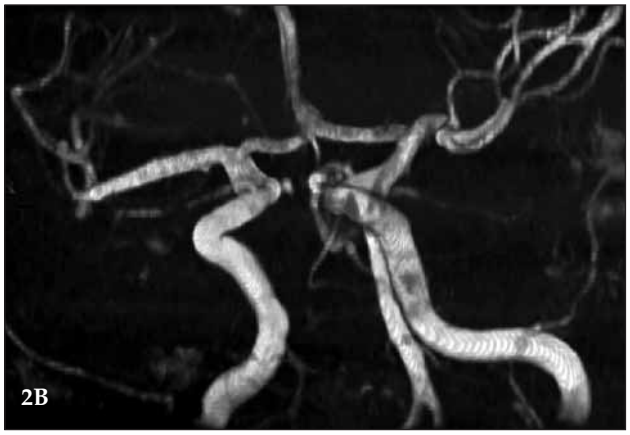


Figure 2: A. *3D MRA in the operative position (right pterional with head turned to left), and* ***B*** *in AP position both clearly show the aneurysm.*

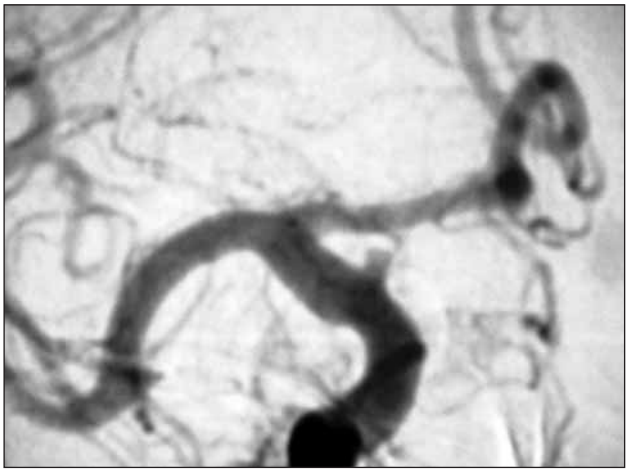


Figure 3: *Cerebral angiography in off-lateral AP position shows a right ICA aneurysm that projects medially and has no relationship with a bifurcation or a branch.*

manipulation of the frontal lobe was avoided. Deep down in the carotid cistern, a medially projecting ICA aneurysm that looked like a dome was seen (Figure 5). Hemosiderin-colored fibrin was seen circumferentially around the base. There was no

Figure 4: *3 D CT angiography with right common carotid and bifurcation compression shows a fully functioning anterior communicating complex.*

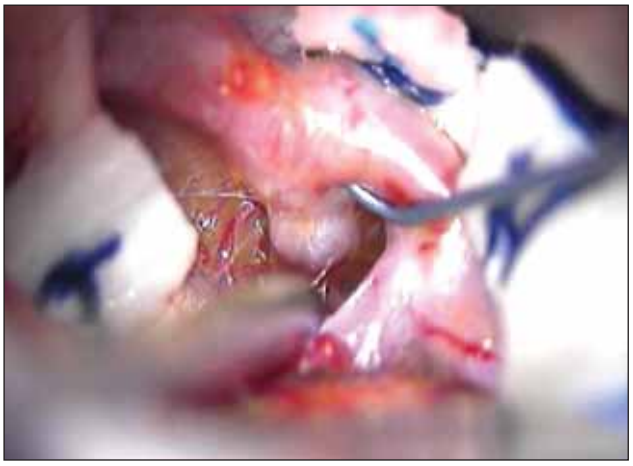


Figure 5: *Operative microphotograph showing the small bulge on a tortuous supraclinoid ICA. Note the transparency of the aneurysm wall and hemosiderin belt around its base.*

neck. The blood turbulence inside the aneurysm could be seen. A Sugita microclip was initially used to clip the base of the aneurysm. Massive bleeding from the base occurred upon an attempt to reposition this clip. Temporary clips were then placed over the ICA proximal to the aneurysm and a second Sugita clip was applied to the artery side of the first clip to include a thin section of the normal appearing medial artery wall so that the tear in the base of the aneurysm was trapped between two clips.

The postoperative period was uneventful except for a temporary neurogenic pulmonary edema which resolved in 24 hours with re-intubation and mechanical ventilation. A control angiogram done on the postoperative 6th day revealed no remnant or vasospasm (Figure 6). The patient was discharged the next day with a Karnofsky performance scale score of 100/100.

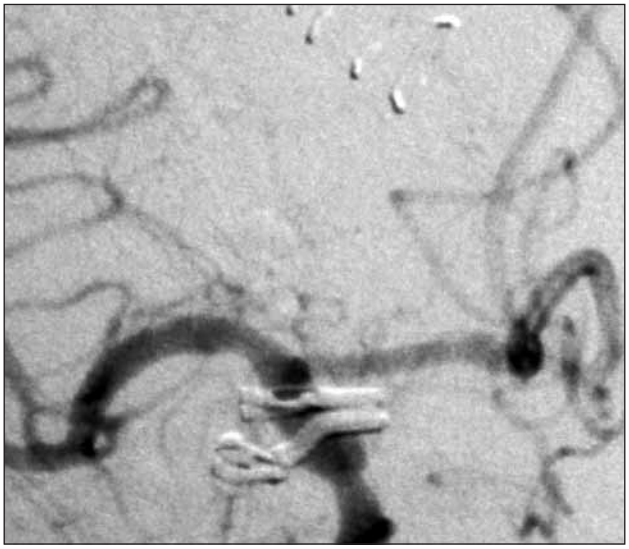


Figure 6: *Postoperative cerebral angiography shows complete obliteration of the sac.*

DISCUSSION

Aneurysms originating from the anterior wall of the ICA are rare, comprising 0.3-1% of all intracranial and 0.9-6.6% of all ICA aneurysms (9,15). The fact that Yasargil noted only 2 patients with distal medial wall aneurysms among a series of 941 patients who presented with SAH (0.2%) and among 319 cases with ICA aneurysm (0.6%) clearly shows how rare these lesions are. Of Yasargil's two cases, one had a saccular aneurysm that was clipped and the other had what we now know as blisterlike aneurysm. Yasargil described the latter (the earliest case of a blister-like aneurysm) as "... the aneurysm was extremely thin walled and ruptured at the base during dissection". At surgery on August 23, 1972, he applied temporary clips to ICA proximal and distal to aneurysm and managed direct repair of the ICA wall with interrupted microsutures again the first report of such treatment (28). In the late 80's and early 90's, Japanese authors like Nakagawa et al and Shigeta et al continued to describe these lesions as "ICA dorsal wall aneurysms" while few other Japanese neurosurgeons preferred the term "IC anterior wall aneurysms" or "IC superior wall aneurysms" (16,21). In 1988, Takahashi et al. coined the term "blister-like" (chimame) in the Japanese literature and this term became more popular after Abe et al. in a series of six patients used the term "blood blisterlike aneurysms of the ICA" to describe this subset of aneurysms in the English literature (1, 23). A recent landmark review emphasizing the occurrence of both saccular and blisterlike aneurysms over the distal anteromedial ICA wall, showed that blisterlike aneurysms were 5 times much common than the saccular aneurysms at this location (17).

Patients with BAs usually present with abundant SAH. Usually female patients and the right ICA are effected (1,15,17). Abundant SAH from rupture of such a small lesion is probably due to the fact that instant vasospastic reaction of the parent artery does not work as efficiently as in berry aneurysms so a significant amount of blood runs into the subarachnoid space during the initial rupture. On the other hand, BAs may not readily appear on initial angiograms due to their small size and unusual location. The medial wall of C1 and C2 sections of ICA should be thoroughly evaluated in the second or even third angiograms especially with rotational angiography if available (4,22). A configuration change into saccular type and growth in size in 7-12 days as documented indicates extreme weakness of the aneurysmal wall and brings about an inherent risk while awaiting the second angiogram (1,5,12,21).

The pathogenesis of BAs is uncertain but atherosclerotic weakening leading to wall changes with possible dissection have been suggested as a possible cause. Hemodynamic stresses at a tight arterial curve and/or hypertension may also play a role. The evolution or progression of a BA into a saccular looking aneurysm on a subsequent angiogram is only an illusion since the new saccular looking lesion also does not have a thick wall as in a true berry aneurysm. This pseudo-progression is probably related to lysis of the intraaneurysmal clot (7,12). Ogawa et al. compared a group of blisterlike and saccular aneurysms of the ICA trunk and concluded that these two types were not consecutive lesions (17).

Since BAs are different than saccular aneurysms both morphologically and histologically, their treatment is also different making surgical exploration and standard clipping a more hazardous procedure than usual. A literature review demonstrated that numerous therapeutic strategies have been used to treat BAs including direct clipping, clipping plus wrapping, wrapping alone, clipping with Sundt encircling graft clips, encircling silicone clip (VASCWRAP) application, primary suturing of ICA alone, vascular staple clip closure of

ICA, arterial suturing with encircling clip reinforcement, trapping with or without extracranial-intracranial (EC-IC) bypass, EC-IC bypass followed by endovascular ICA occlusion, endovascular ICA occlusion plus late surgical trapping, endovascular trapping, and endovascular coiling (1,5,6,9,10,13,14,16,17,18,19,20,21,22,24,26,27, 29).

Although there is no optimal treatment per se, surgery appears to be more creative or curative than endovascular surgery. Given the fact that the lesion to treat is a hemispheric dome with a wide base and a very weak wall, endovascular coil embolization theoretically does not appear to be a safe and sound method. So far, endovascular techniques have been useful only as a complementary or a stabilizing treatment method rather than a definitive treatment (3, 18). Islam et al. used coil placement as the initial method to fill a BA yet the BA regrew in 3 months and endovascular proximal occlusion after EC-IC bypass surgery had to be undertaken for definitive treatment (8). Few BA cases that were cured with coil embolization alone exist in the literature but all these cases were treated in the chronic period when the walls of aneurysms were probably not as fragile as they were in the early post-SAH period (6,14,24). Endovascular techniques like stent placement or coil placement with balloon remodeling were also used without success (3). Endovascular balloon occlusion of the ICA often resulted in new collaterals and refilling of the BAs from the contralateral ICA or the posterior circulation which necessitated later surgical trapping (19).

The decision should be individual with alternative plans in case the initial treatment strategy fails. A flexible surgical strategy necessitates a variety of additional hardware in the OR on top of traditional aneurysm clips. A broader selection of fenestrated clips, different sizes of Sundt clip-grafts or other encircling clips, microsutures, wrapping material such as silicone sheet or muslin must be made ready before contemplating surgery (22). Since ICA occlusion may become necessary at a very awkward moment such as during neck avulsion and abundant bleeding, a preoperative balloon occlusion test to assess cerebral blood flow studies using an angiogram, SPECT or xenon CT should be done to determine the risk of immediate ischemic complications (8,22). This evaluation may not be possible or reliable in the acute stage, especially if the clinical condition of the patient is poor and it may therefore be delayed until the acute process of SAH subsides and/or the patient recovers a bit. When it becomes evident that an extracranial-intracranial bypass may become necessary, the preoperative consideration should also include what kind of a bypass can be done. In addition to the well-known superficial temporal artery to middle cerebral artery (STA-MCA) anastomosis, radial artery or saphenous vein grafts between the cervical ECA and the larger of the M2 segments of the MCA have also been used safely to create high flow extracranial-intracranial bypass in patients with BAs (3,8,11).

At surgery, exposure of cervical ICA and the carotid bifurcation is a must and this exposure would be useful both for proximal control and for possible bypass (1,9,13,19,21). Anterior clinoidectomy may be complimentary to widen the deep operative field but does not preclude cervical exposure. During craniotomy, every effort should be made to preserve the superficial temporal artery. Lumbar cerebrospinal fluid (CSF) drainage before or during craniotomy creates a theoretical risk of rupture for cases with an aneurysm adherent to the frontal or temporal lobe. Therefore, any intracranial volume or pressure change should not be triggered before the dura is opened. Similarly, the possibility of massive bleeding exists immediately after opening the dura, again due to the reduction of the aneurysmal transmural pressure gradient. Once the dura is open, retraction to the frontal or temporal lobes should be avoided and this can be done safely with wide dissection of the Sylvian fissure and suction of sufficient CSF (22). In addition to these precautions, gentle subpial dissection of the brain may be a secure method in cases with adherent BAs to the frontal or temporal lobe (13). The surgical literature on BAs emphasizes that the clip should catch both the neck and the wall of the ICA. The clip should be applied while the pressure within the artery is low to let the clip catch the normal wall. Clip application parallel to the axis of ICA to prevent both kinking and pressure of the settling brain on the clip has been uniformly suggested (1, 5, 7, 16, 17, 21). However, parallel clip application in a deep and fragile operative field is not easy and not only poses a high risk of neck avulsion or clip slippage but also lumen narrowing once the blades are released. Removal and reclipping then become very risky.

Multi-angle clip appliers should be ready in the tray for cases of a tortuous supraclinoid ICA. At times it may be wiser to settle with an obliquely placed clip than to risk a tear at the base of the aneurysm while trying to insert the clip parallel to the ICA (8,21,27). A Sugita-like clip makes it possible to catch the parent arterial wall from the aneurysm side without causing substantial stenosis as it has a strong spring and narrow blades (16). Wrapping alone will not be sufficient since it may not prevent regrowth or rebleeding but wrapping after microsuturing; wrapping after hemoclip stapling or even wrapping after clipping can be done for the peace of mind (9). As for the treatment of postoperative complications like vasospasm, triple H and nimodipine plus angioplasty are used as usual. In case of vasospasm after ICA occlusion or ICA trapping, angioplasty through the ipsilateral ICA will obviously become impossible, leaving only a contralateral endovascular approach across the ACoA as a possible but difficult technique (18)

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