

The Management of Very Small/Blister Internal Carotid Artery Aneurysms

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Summary

Blood blister aneurysms are uncommon lesions that have a poor natural history. Because there is no clear aneurysmal sac to treat they remain challenging lesions to manage whether the approach is endovascular or surgical. Although the management of intracranial cerebral aneurysms has changed subsequent to the results published by the ISAT trial, there still exist groups of aneurysms which do not lend themselves to endovascular management. There are recent reports of successful endovascular management using flow diverting approaches but experience is limited and relying on flow change may be insufficient to prevent re-rupture. Surgery when possible offers the advantage of immediate vessel wall reconstruction.

Introduction

With the improvement in imaging techniques smaller aneurysms are better visualized. This, together with the knowledge that blister type carotid aneurysms cause subarachnoid haemorrhage and have an appearance that can change over days, should lead to easier diagnosis of this condition. Aneurysms, which are 2 mm or less in diameter and often have a more fusiform than saccular appearance, are referred to as blood blister-like aneurysms (BBA). They occur at non-branching sites of the supraclinoid internal carotid artery (ICA) although they may also be found at the anterior communicating artery². Although endovascular techniques have revolutionized the treatment of aneu-

rysms in general these blister-like aneurysms present a challenge because of their small size, wide necks and fragile nature. Treating these aneurysms surgically is also not without its problems and surgeons are often faced with a hole in the carotid when the aneurysm disintegrates during dissection. BBA are uncommon and their management is subsequently based on what little has been published³. Over a 31-month period we identified seven cases in our practice that were managed surgically.

Methods

Over a 31-month period we looked for patients who met "the criteria" for BA. A BA is diagnosed if the aneurysm is 2 mm or smaller and found at a non-branching point of the supraclinoid ICA however one of the aneurysms was on the proximal A1 which still fulfils the criteria of Vishteh and Spetzler². The patients were felt to meet the criteria if at surgery the aneurysm was found to match the results of the digital subtraction angiography (DSA) or computer tomographic angiography (CTA) depending on how the diagnosis was made. Our preference is to treat blister aneurysms surgically assuming that there is a region of the vessel wall that is deficient and that we can reconstruct this more immediately using clips. A supraorbital keyhole approach is routinely used. Endovascular coiling has less chance of protecting the thin or absent fundus characteristic of these aneurysms and flow diversion also presents the risk of navigating past a very weak vessel wall.

Results

Over the 31-month period we were able to identify seven patients who met the criteria for a BBA. The findings are shown in Table 1.

Patients' ages varied from 30 years to 57 years with a median of 43 ½ years. In our series all patients except one were females and one was pregnant at presentation. The World Federation of Neurosurgeons (WFNS) Grade varied with

Table 1

Age/ Sex of patient	WFNS on admission	Fisher Grade	Diagnosis on DSA	Diagnosis on CTA	Delay between DSA and CTA	Day post ictus of surgery	Site of BA
48/M	V	IV	seen			16	ICA
45/F	II	III	missed	seen	7 days	26	ICA
49/F	II	III	missed	seen	5 days	12	A1
57/F	II	IV	seen			9	ICA
30/F	I	III	seen			13	ICA
56/F	I	I	seen			6	ICA
52/F	II	III	seen			2	ICA

only one patient Grade I and one patient Grade IV the rest being Grade II. One patient improved to grade IV from Grade V and one patient deteriorated from Grade I to Grade II between admission and treatment.

The diagnosis was made using DSA in five patients and CTA in two. In the two patients in which the diagnosis was made using CTA in retrospect the abnormality could be seen on the DSA although at the time of the DSA the abnormality was not obvious and was overlooked.

The delay between ictus and surgical intervention varied from two to 26 days. Patients who had the diagnosis missed on initial DSA, were a low WFNS grade or who developed vasospasm tended to have a longer waiting period before being clipped. The site of the BBA was the supraclinoid ICA in all except on patient who had the BBA at the proximal A1.

The management and outcome of the patients is shown in Table 2.

In all patients the BBA was treated surgically

Table 2

Type of clip used	Vasospasm	Outcome/Modified Rankin scale
Sundt	Nil	0
Right-angle	Nil	0
Sundt	Nil	0
Small straight	Nil	1
Small straight	Present clinically	4
Right-angle	Nil	1
Small straight	Present clinically	6

although in one patient coiling of the BBA was attempted unsuccessfully. Our practice is to treat aneurysms as early as possible to avoid re-bleeds. However in this group there was delay in most cases because of missed diagnosis or initial poor grade. Most patients had a good outcome as shown by the modified Rankin scale but one patient died unexpectedly seven days post-clipping. Unfortunately we were unable to

obtain a post mortem to establish whether the cause of death was a rebleed.

Discussion

Blister aneurysms almost certainly result from a pathology different from saccular berry aneurysms. They are more fragile, often involve

an extended region of the vessel wall and can alter angiographic appearance over a period of days. They most likely result from a dissecting process.

Surgeons may be skeptical and want to continue to clip aneurysms, but sooner or later they will have to come around to the fact that they cannot match what ISAT has shown to be true⁴.

The correct treatment of BBAs is contentious and surgeons have been reluctant to surgically explore these fragile walled aneurysms^{3,5,6}. Surgical methods included various strategies from clip placement, wrapping, clip placement over a wrapped aneurysm to external carotid to internal carotid (EC-IC) bypass with trapping of the aneurysm or even sacrifice of the vessel if tolerable. It seemed that whatever surgical approach was used the risks were high intraoperatively (premature rupture and ICA laceration) and postoperatively (regrowth and rebleeding)⁷. It is not surprising then that endovascular techniques have recently been used.

In 2007 Park et al. reported on their experience with seven patients who fulfilled the criteria for having blood blister-like aneurysms which they elected to treat endovascularly⁸. Twelve endovascular procedures were undertaken including seven endovascular coiling (four conventional, two stent-assisted and one balloon-assisted) and five trappings. In two patients the endovascular treatment was done for failed surgical treatment. Four of the coiled patients showed aneurysmal regrowth and two rebled. In the remaining five patients the ICA was trapped at the involved segment using coils and balloons. Their conclusion is that endovascular coiling is not appropriate but vessel occlusion is. However they concede that if a balloon occlusion test is not tolerated then surgery should be considered and they share the concern that vessel occlusion in the face of potential vasospasm associated with a subarachnoid haemorrhage could have disastrous consequences.

Lee et al. published their results of treating nine patients who fulfilled the criteria for BBA⁹. Their management included stent assisted coiling and then in three patients a second stent (the so-called "stent within a stent" system) and a covered stent in a further three patients. In this series one patient died while a covered stent was being placed. The use of stents in the treatment of acutely ruptured aneurysms is not without other problems including increased thrombo-embolic events and dif-

ficulty in maneuvering a stent into position in the face of a friable vessel.

In our series, two of the BAs were picked up on CTA having been missed on the earlier DSA. In retrospect the abnormalities were visible on the DSA but were very subtle. It is likely that the aneurysms were picked up on later CTA because these are dynamic and progression may have occurred between investigations. This has certainly been our experience with serial DSA on other patients with blister aneurysms.

Although in one patient coiling was unsuccessfully attempted all our patients were operated on. The delay between ictus and treatment was either related to referral delay or poor clinical condition on admission. Once the diagnosis was made no patient waited longer than three days to have his/her aneurysm clipped. The aneurysms were clipped through a trans-ciliary/transbrow incision and craniotomy. In order to obtain good brain relaxation we routinely use lumbar drains immediately pre-operatively and split the Sylvian fissure as one of the initial maneuvers. Where possible we try not to use retraction but this was only achievable in two cases. In all cases the presence of cortex xanthochromia or perilesional clot confirmed the site of the haemorrhage. Mostly a small straight or right-angled clip could be used but in two cases a Sundt clip was used. In all cases we achieved proximal control prior to attempting aneurysm dissection. In two cases where the BBA was proximal this required a separate cervical incision to control the internal carotid artery. There was one intraoperative rupture which necessitated the use of one of the Sundt clips. Two patients developed vasospasm clinically and one patient developed a permanent deficit of dysphasia and hemiplegia related to this.

Clinical outcome was assessed at discharge then at a two-week follow-up with the best Rankin score being utilized. There was no radiological follow-up. Most patients had a good outcome as shown by the modified Rankin score.

It has not been our finding that the whole vessel wall is involved in each case. In five of the cases an ordinary clip could be applied to the aneurysmal bleb and in two a Sundt clip was required because of whole vessel wall involvement. Whether this illustrates that there may be more than one possible explanation of the cause or just worsening severity of the disease is not clear. Although some advocate the use of trapping with EC-IC bypasses, or trapping alone if tolerated, we are cautious of ICA

sacrifice when vasospasm may occur. Baskaya et al. treated four patients with BBAs and advocate definitive treatment as being EC-IC bypasses with surgical or endovascular trapping¹⁰. Shigeta et al., Abe et al. and Charbel et al. reported multiple patients in their small series with intra-operative avulsion during parallel clip application and this encouraged Sekulan et al to advocate the encircling clip graft or Sundt clip as the clip of choice^{3,11,12,13}.

With the advent of flow-diverters or using the so-called stent-in-stent flow diversion there has been renewed interest in treating these BBA. Gaughen et al. described six patients who presented with SAH from a BBA¹⁴. Using a staged procedure they placed a stent within a stent and then followed the patients with DSAs to establish whether the patient needed further management or coiling of the BBA. In three of the six coiling was required and ultimately they had a stable result in five of the six. In one patient

they had a rebleed that they ascribe to the second stent not being deployed ideally. They feel that their results are as good as those of Parks et al. without having to sacrifice the vessel⁷. Taking it a step further, Rasskazoff et al. presented their BBA which they also treated with a stent within a stent procedure but in their case they used flow-diverters (Silk stents) with a good result in the patient they treated¹⁵. As stated above, the use of stents is not without problems especially when a patient with an acute SAH needs to be put on double anti-platelet treatment before the stents are placed. This can cause problems should the patient then require a surgical procedure such as the placement of an external ventricular drain. Whatever the treatment approach, blister aneurysms remain difficult lesions to manage. There is currently no best approach and an awareness of the lesions nature and treating doctor's experience offers the best hope for patients.

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