

# Blister like aneurysm: a review about its surgical management

Aneurismas blister-like: uma revisão sobre seu manejo cirúrgico

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## Abstract

**Introduction:** Blister aneurysms are of uncertain pathogenesis and are a vascular lesion located in the brain. Overall, they represent 0.3% - 1.0% of all intracranial aneurysms and 0.9% - 6.5% of ruptured intracranial aneurysms. They are associated with high morbidity and mortality. Even with the first description being from 1969, there is still debate in the literature about which type of treatment is the best: surgical or endovascular. In this review, we focus on the surgical management. **Method:** The authors performed a review of available surgical techniques used for blood blister-like aneurysms treatment. Pubmed database was used as search source introducing blister-like aneurysm and blister aneurysms as keywords. The most relevant articles and those that focused on surgical treatment techniques were selected. **Discussion:** The most used surgical methods are clipping, trapping, wrapping and bypass. As main features of each technique, we can highlight clipping with good efficiency, when there is good neck exposure; trapping being employed in ruptured aneurysm; wrapping for avulsion and bypass that promotes vascularization to the distal territory of the aneurysm. **Conclusion:** The endovascular method has shown to be promising and efficient. However, different surgical techniques are still being employed based on their efficiency when facing certain surgical scenarios.

**Keywords:** Neurosurgery, Subarachnoid hemorrhage, Intracranial aneurysm, Endovascular procedures

## Resumo

**Introdução:** Aneurismas cerebrais blister-like são lesões vasculares de patogenia incerta. De modo geral, representam 0.3%-1.0% de todos aneurismas intracranianos e 0.9% - 6.5% dos aneurismas intracranianos que rompem. Estão associados a alta morbimortalidade. Mesmo com a primeira descrição sendo de 1969, ainda há debate na literatura sobre qual tipo de tratamento é o melhor: cirúrgico ou endovascular. Nessa revisão, focamos no tratamento cirúrgico. **Métodos:** Os autores realizaram uma revisão das técnicas cirúrgicas utilizadas para tratamento de aneurismas blister-like. A plataforma Pubmed foi utilizada para a pesquisa das palavras chaves "blister-like aneurysm" e "blister aneurysm". Os artigos de maior relevância e aqueles que enfatizam as técnicas cirúrgicas foram selecionados. **Discussão:** Os métodos cirúrgicos empregados são clipagem, trapping, wrapping e bypass. Quanto às características de cada método, podemos salientar a eficácia da clipagem, quanto melhor for a exposição do aneurisma; o uso do trapping em situações de rompimento do aneurisma; wrapping para casos em que houve avulsão do aneurisma e by-pass que promove a vascularização distal ao aneurisma. **Conclusão:** O método endovascular tem se mostrado promissor e efetivo. No entanto, as diferentes técnicas cirúrgicas ainda são empregadas e defendidas devido a sua eficiência frente certos cenários cirúrgicos.

**Descritores:** Neurocirurgia, Hemorragia subaracnóideia, Aneurisma intracraniano, Procedimentos endovasculares

## Introduction

Blister aneurysms are rare brain vascular lesions of uncertain pathogenesis<sup>(1)</sup>. Overall, they represent 0.3% - 1.0% of all intracranial aneurysms and 0.9% - 6.5% of all ruptured intracranial aneurysms<sup>(1-11)</sup>. They are associated with high morbidity and mortality<sup>(9,12,13)</sup>. If we compare them to the saccular aneurysm, it is noticed that they affect a younger population<sup>(1,3,13)</sup>. The first description was made by Sundt and Murphey in 1969, where they anatomically defined the aneurysm

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as a shallow and broad based or semi fusiform focal protrusion<sup>(1,3,4,6,11,14-16)</sup>. The most common location is the supraclinoid internal carotid artery (ICA)<sup>(1,3-5,7,10-11,13-15,17-18)</sup>. Now, it is possible to further classify blister aneurysms into four different groups: I – classic, lesions are small bulge on the parent artery with no neck. II – berry-like, lesions have a larger neck, but not larger than the carotid diameter. III – longitudinal, where it affects a longer portion of the carotid, even larger than the diameter. IV – circumferential, where the lesion has an extension around the carotid<sup>(1,9)</sup>. Although saccular aneurysms have an intimal relation with major arterial junctions, the same cannot be expected with blister aneurysms<sup>(1,5,8,11,15-16,18)</sup>. In this type of lesion, they can be found in 65% of cases arising from the anteromedial carotid wall<sup>(1,13)</sup>.

A consolidated treatment of blister aneurysms is the surgical approach. It can be further classified as clipping, trapping, wrapping and bypass. Besides the four surgical methods analysis, authors intend to verify blister aneurysm locations, surgical results and surgeon's reliabilities in regard to surgical methods. Furthermore, our literature review did not identify any similar published research in this topic.

## Method

Authors performed a review of available surgical techniques used for blood blister-like aneurysms treatments. Pubmed database was used as source

search introducing “blister-like aneurysm” and “blister aneurysms” as keywords.

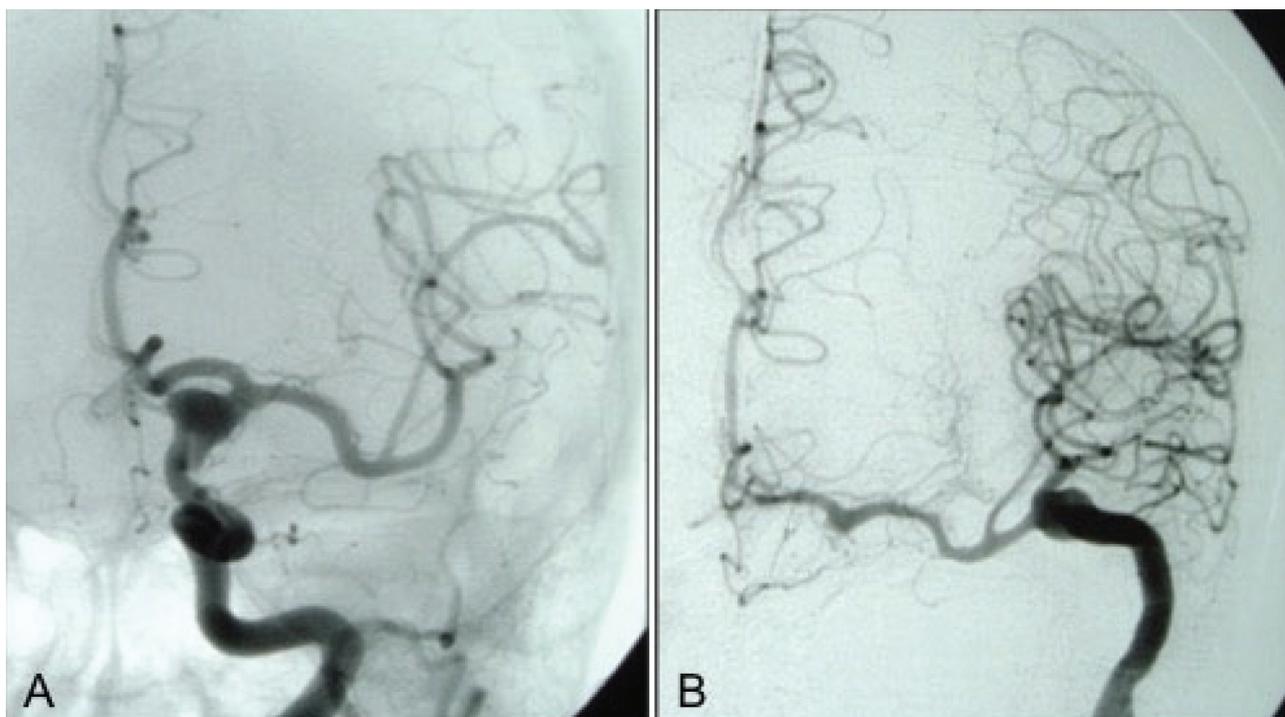
## Results

The most relevant English written articles about surgical treatment techniques were selected among 293 papers. We considered of high relevance the evaluation of 5 cases reports, 7 cases series, in which 2 specifically analyzed direct clipping and 3 bypass techniques, 3 retrospective studies, one of them comparing surgical versus endovascular treatment, 7 reviews and 2 meta-analysis.

## Discussion

BBA is more common in women, with a preponderance occurring in the right ICA<sup>(4)</sup> (FIGURE 1A). A high incidence of rerupture in the early period after the ictus is characteristic of intracranial arterial dissection. Likewise, the incidence of intraoperative or postoperative bleeding among patients with BBAs has been reported to be significantly higher than that among patients with saccular-type aneurysms.

As mentioned before, pathogenesis is unclear. Nevertheless, one reasonable explanation would be a sclerotic arterial segment suffering from an increased hemodynamic stress. The histological result is debatable. Most think that it is a dissecting lesion, when some argue that it is in fact a false lesion. One



**Figure 1** - left carotid angiografia (frontal view) showing in: **A** – a blister aneurysm in the anterior wall of the ICA; **B** – after a EC-IC bypass as treated by the authors.

way or the other, it is a consensus that blister aneurysm has a focal vessel-wall defects, adventitial lining without collagen matrix, explaining its critical course and reserved prognosis<sup>(1,4,12-13,16-17)</sup>.

### Treatment of blister-like aneurysm

The ideal treatment of an intracranial aneurysm is to obliterate it, while flow in the vessels associated with the aneurysm is maintained. They can be occluded using surgical techniques such as direct clipping, trapping, wrapping and bypass<sup>(2,5-8,10,15-16)</sup>.

The BBAs are notoriously difficult to treat by any means, mainly by their small size, fragile walls, lack of an aneurysm neck and tendency to avulse with minimal manipulation<sup>(19-22)</sup>. The incidence of intra and postoperative bleeding is higher than in saccular aneurysms<sup>(19,23)</sup>.

There are some divergences between the surgical and the endovascular treatment, related with which has better outcome, safety, complete obliteration and complications as regrowth and rebleeding. Most authors debate about all these characteristics, without a clear homogeneous opinion. Shah et al, 2017<sup>(12)</sup> and Meling, 2017<sup>(13)</sup> performed meta-analysis, while Ren et al, 2018<sup>(2)</sup> performed a retrospective study, concluding that surgery has superior obliteration rates and similar neurological outcomes – comparing to the endovascular treatment - coming at the price of higher complication rate mostly because of higher rupture rate, vasospasm, hydrocephalus and infarction. Endovascular management offers superior safety, but higher retreatment rates and lower obliteration. Liu et al, 2017<sup>(3)</sup> compares his results with the literature and predicts that with endovascular technique improvement, the interventional therapy will be preferred. On the other hand, some authors emphasize the advantages of the surgical method, because of its convenience and good outcomes<sup>(5)</sup>. Meling TR et al, 2008<sup>(23)</sup> state that endovascular coiling of BBAs of the ICA cannot be recommended due to the high rates of procedural rupture (75%), aneurysm regrowth, and rebleeding. Cho et al, 2012<sup>(24)</sup> also debate about the aneurysm regrowth in a case report after coil embolization, saying that surgery is a useful treatment modality for fragile aneurysm. Furthermore, Peschillo et al, 2016<sup>(8)</sup> in a meta-analysis states that patients in Hunt and Hess (HH) > 3 had better outcomes when treated with surgery.

### Modalities of surgical treatment

#### Clipping

Simple surgical clipping refers to the practice of the exposure of the aneurysmal neck via craniotomy

and the exclusion of the entire abnormal vascular wall from the circulation using single or multiple clips. Two principles apply in surgical clipping: isolating the lesion from active circulation and maintaining the integrity and patency of the parent vessel<sup>(22)</sup>.

Using temporary clips and placing the permanent clip blades along normal arterial walls are key to successful clip reconstruction that avoids intraoperative aneurysm rupture, especially in BBA cases. The efficacy of this method relates to a good neck exposure.

Kalani MY et al, 2013<sup>(21)</sup> concludes that direct clipping brings good long-term outcomes with acceptable morbidity. Mooney et al, 2015<sup>(16)</sup> had no mortality rate and could conclude that surgery achieve complete obliteration and excellent long-term outcomes.

#### Trapping

The trapping technique consists into clipping arteries proximally and distally to the aneurysm, in order to isolate it from the cerebral circulation. This method can be used in case of ruptured aneurysms, with the idea to stop circulation to the lesion and, consequently, stop de bleeding. Ji et al<sup>(5)</sup> in their review discuss that balloon occlusion test for collateral flow must be performed prior to trapping. A good collateral flow is important to maintain cerebral perfusion, especially from the anterior communicating artery<sup>(13)</sup>. Insufficient cerebral flow in such cases may result in massive cerebral infarction, as described by Ogawa et al<sup>(19)</sup>.

#### Wrapping

Wrapping has been used when a traditional clip can not be properly applied due to either the morphology of the aneurysm itself or the underlying sclerotic changes of the carotid artery. This technique entails encasing the entire diseased segment with an appropriately sized thin sheet of – usually – cotton. Mechanical reinforcement of the carotid artery provides protection from a potential immediate re-rupture while, in the long term, induced inflammatory changes lead to connective tissue formation and remodeling of the arterial wall<sup>(1)</sup>. However, Balik et al, 2017<sup>(25)</sup> point out that wrapping does not prevent rebleeding, as Bojanowski et al<sup>(9)</sup>, and is associated with a high incidence of postoperative SAH and death, similar to Nagasaki et al<sup>(17)</sup> who state that this method alone is associated with poor outcomes. Bad outcomes should be explained by the complexity of the cases that underwent to wrapping.

Another surgical situation where wrapping can be used, is named clipping on wrapping. It is a technique applied to ruptured aneurysms where the lesion

is wrapped with autogenous tissue or absorbable material to reconstruct the integrity of the vessel wall before clipping. This technique could be used for dealing with aneurysmal neck avulsions. However, this method is not suitable for complete neck avulsion due to the deficit of aneurysmal neck<sup>(22)</sup>.

Park et al, 2017<sup>(14)</sup> state that wrapping alone may not prevent rebleeding or regrowth of BBA, but wrapping with suturing or clipping can be useful choice for reinforcement of BBA. Ogawa et al, 2000<sup>(19)</sup> and Ji et al, 2017<sup>(5)</sup> think that clipping on wrapping material is one with the best results to treat blister-type aneurysms. Based on Meling's<sup>(13)</sup> experience, it is adopted the clip-enforced Gore-Tex wrapping as the first-line surgical modality. Lee JW et al, 2009<sup>(26)</sup> discuss that wrapping with cellulose fabric and holding clipping technique could be chosen as the optimal surgical modality for prevention of rebleeding from dissection of blister aneurysms.

Kubo et al, 2015<sup>(27)</sup> discuss that Wrap-clipping may be advantageous in terms of preserving anterograde flow, when it is safely and completely applicable. It may be suitable for BBAs that are located far from the anterior clinoid process that project anteriorly or anteromedially and are located at the communicating segment of the ICA.

### Bypass

Bypass is a surgical intervention that revascularizes territories distal to the aneurysm, excluding the artery containing the aneurysm, without risk of ischemic complications. Types of anastomoses can be end-to-side, side-to-side, or end-to-end<sup>(28)</sup>. One of the main bypass techniques consists of the extracranial-intracranial (EC-IC) bypass (FIGURE 1B). With an extracranial arterial graft, as superficial temporal artery (STA), the neurosurgeon performs the revascularization of the cerebral arteries, as the middle cerebral artery (MCA). Another option, for giant aneurysms and also BBAs, is the intracranial-intracranial (IC-IC) bypass<sup>(29)</sup>. So, a BBA can be excluded with its parent vessel, while the distal circulation should be maintained by de bypass.

A retrospective review conducted by Kazumata et al, 2014<sup>(20)</sup> describe a technique that involves anastomose of the radial artery with the M2 segment of the MCA. They believe that despite the complex and time-consuming approach, radial artery graft bypass with parent artery sacrifice can achieve a favorable outcome in patients with BBAs. Furthermore, they believe STA-MCA bypass occasionally fails to carry a sufficient amount of blood flow, whereas a high-flow bypass such as external carotid artery (ECA)-radial artery (RA)-MCA bypass provides cerebral perfusion comparable to that provided by the ICA.

### Conclusion

Blister-like aneurysms still challenge neurosurgeons into different aspects, such as, the pathogenesis, the diagnosis, the best treatment option for each patient and the intraoperative and post-operative complications. Most authors' debate which type of management is best including clipping, trapping, wrapping, bypass, or endovascular methods. From our perspective and based on the literature data, the surgical method, as reviewed in this article, is still being employed by vascular neurosurgeons, given its proven efficacy and different techniques that can be used in different situations. Nevertheless, the endovascular treatment has a promising role in the management of blister-like aneurysm, where some authors already stand for this method as the best option. However, there is still no consensus in adopting it as a first option approach.

### Disclosure

The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article.

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