European Journal of Radiology xxx (2013) xxx–xxx

Contents lists available at ScienceDirect

European Journal of Radiology

journal homepage: www.elsevier.com/locate/ejrad

Blood blister-like aneurysms: Single center experience and systematic literature review☆

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ARTICLE INFO

Article history:
Received 23 April 2013
Received in revised form
19 September 2013
Accepted 22 September 2013

Keywords:
Intracranial aneurysm
Blister-like
Endovascular treatment
Intracranial stent
Clipping

ABSTRACT

Blood blister-like aneurysms (BBAs) are a controversial entity. They arise from non-branching sites on the supraclinoid internal carotid artery (ICA) and are suspected to originate from a dissection. Our aim is to describe the BBA cases seen in our center and to present a systematic review of the literature on BBAs.

We analyzed the eleven cases of BBA admitted to our center from 2003 to 2012. We assessed the medical history, treatment modality (endovascular and/or surgery), complications and clinical outcome.

The cohort included 8 women and 4 men with a mean age of 53.16 years. Treatment of the BBA consisted of stenting and coiling in 5 patients, stenting only in 4 patients, coiling and clipping in 1 patient, clipping only in 1 patient, and conservative treatment in 1 patient. A good outcome was found in 10 patients, as defined by a modified Rankin Scale (mRS) less than or equal to two at three months. A systematic review of the literature was performed, and 314 reported patients were found: 221 patients were treated with a primarily surgical approach, and 87 patients were treated with a primarily endovascular approach. A rescue or second treatment was required in 46 patients (21%). The overall estimated treatment morbidity rate was 17%, and the mortality rate was 15%.

BBAs exhibit more aggressive behavior compared to saccular aneurysms, and more intra-operative complications occur with BBAs, independent of the treatment type offered. They are also significantly more likely to relapse and rebleed after treatment. Endovascular treatment offers a lower morbidity–mortality compared with surgical approaches. Multilayer flow-diverting stents appear to be a promising strategy.

1. Introduction

Blood blister-like aneurysms (BBAs) include arterial lesions from non-branching sites (dorsal or anterior wall) on the internal carotid artery (ICA) [1–4]. Although there have been descriptions of BBAs located at other sites within the intracranial circulation [5–7], the initial and most classic definition of a BBA is restricted to the ICA. They are particularly rare, representing approximately 0.9–6.5% of all ICA aneurysms [1,8], 1% of all intracranial aneurysms [9], and 0.5–2% of all ruptured aneurysms [10,11]. These lesions were first described in the late 1970s [3], but the term "blister" was introduced in 1988 by Takashi [4]. Patients typically present with acute subarachnoid hemorrhage (SAH), and the affected population is younger than patients with saccular aneurysms [12]. Some authors have reported a female predominance, a right-sided ICA predominance [12,13] and an association with hypertension [12,13]. The classical morphology is small, hemispherical-shaped and bulging from non-branching sites on the ICA [1,2]. They are typically diagnosed after a bleed because their small size allows them to be frequently missed on the first computed tomography angiogram (CTA) or even on the first digital subtraction angiogram (DSA). Special attention must be paid to the radiological evolution of a BBA after rupture because its progression to a saccular shape can be seen up to several days after the bleed [14].

Abbreviations: BBA, blood blister-like aneurysms; CT, computed tomography; CTA, computed tomography angiography; DSA, digital subtraction angiography; EVD, external ventricular drainage; FDS, flow diverter stent; HBP, high blood pressure; HC, hypercholesterolemia; ICA, internal carotid artery; mRS, modified Rankin Scale; SAC, stent-assisted coiling technique; SAH, subarachnoid hemorrhage; WFNS, World Federation of Neurosurgical Societies.

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http://dx.doi.org/10.1016/j.ejrad.2013.09.017

The physiopathology of this type of aneurysm remains obscure. The main hypothesis is that BBAs arise from a dissection, although their rupture is typically spontaneous [8,15,16]. Nevertheless, the critical point is not just the difficulty in their diagnosis but also the complexity of their treatment, which is always challenging no matter the therapeutic method or approach chosen. Several surgical or endovascular approaches have been proposed to treat this life-threatening condition. The extremely fragile wall of BBAs makes the management complicated and risky. We report a single-center experience with a multidisciplinary approach to BBAs along with a systematic review of the literature on the different methods and approaches used to treat this condition.

2. Methods

We collected information from the prospectively and consecutively collected database of our institution, which includes all intracranial aneurysms, treated or not, that are evaluated at our center. We selected all BBAs treated from December 2003 to June 2013. We defined a BBA aneurysm as any small aneurysm located in a non-branching zone of the ICA that produced a SAH. We excluded saccular aneurysms, confirmed intracranial dissections, fusiform aneurysm and complicated or partially thrombosed aneurysms. The radiological, epidemiological and clinical data were prospectively collected at our aneurysm clinic. We queried our database using the keywords ICA aneurysms, BBA, SAH and ruptured aneurysms smaller than 5 mm. One neuroradiologist (AMG, APN) and one neurosurgeon (PB, IR, KS) reviewed the data, and neither was involved in the procedure to obtain the relevant information for this study from the database and the patient's record. The senior author (VMP) performed most of the procedures. Certified physicians performed periodic clinical exams, and the clinical status of the patients was established from the report of the mRS (AMG, PB, IR). The diagnostic neuroradiological team (KOL) independently reviewed the images.

2.1. Therapeutic and management decisions

After a neurosurgical evaluation, the patient was sent to a normal DSA room or a hybrid room. If necessary, an external ventricular drain (EVD) was placed under general anesthesia just before diagnostic angiography. Patients placed in a standard DSA room who then required surgical treatment were transferred to an emergency operating room. In some cases, the treatment, endovascular or not, was conducted in a hybrid DSA-operating room, a multifunctional space with high quality DSA images in a surgical environment. The main advantage of such an operating room is to enable endovascular and neurosurgical approaches in the same operating space, making perioperative DSA possible and avoiding the additional transfer of patients.

The management of intracranial aneurysms (IAs) in our institution consists of a multidisciplinary evaluation by the neurosurgical and neuroradiological teams. All patients are evaluated after their presentation to the ER, and the treatment is performed when the patient is stable for the procedure, usually within a timeframe of less than 24 h after admission. By consensus, the treatment of choice for BBA at our institution is a primary endovascular approach with backup by the neurosurgical team in case of failure or peri-procedural complications. For many years at our institution, stenting plus coiling was the standard endovascular treatment, with the exception of one patient whose aneurysm was clipped after a failed endovascular attempt with vascular occlusion due to a complex lesion. Recently, new intracranial stents with a dense porosity, known as flow-diverting stents (FDS), have been used. We recently performed three cases using FDSs with a multilayer technique based on previous successful experience with their use in intracranial dissections [17]. An EVD for hydrocephalus was placed before the endovascular procedure because of the use of antiplatelet therapy and consequent bleeding risk.

2.2. Procedure and center guidelines

2.2.1. Endovascular procedure

A 6F femoral sheath was the standard approach for endovascular cases. A 6F-guiding catheter (Envoy, Codman, Raynham, MA, USA) was selectively placed into the corresponding ICA. The strategy was to place a microcatheter (Echelon 10, Covidien, Irvine, CA, USA) inside the aneurysm and deploy one intracranial stent (Enterprise, Codman, Raynham, MA, USA) over the intracranial portion of the ICA, thereby jailing the previous microcatheter within or just in front of the aneurysm. Then, coiling of the aneurysm pouch was performed with bare coils. For those cases using a FDS, a Marksman microcatheter (Covidien, Irvine, CA, USA) was used to deploy two pipeline-type FDSs (Covidien Neurovascular, Irvine, CA, USA) telescopically.

2.2.2. Surgical procedure

The surgical procedure performed in our series consisted of clipping the BBA over a non-diseased portion of the artery around the aneurysm, creating a residual arterial stenosis but with complete exclusion of the aneurysm.

2.3. Systematic review

We conducted a systematic review of all reports of blister-like aneurysms, assessing factors of the described management with respect to technical and clinical success and survival. We searched the literature using MEDLINE and EMBASE from January 1, 1965 through July 1, 2013. We included BBA aneurysms located at non-branching portions of the ICA. The studies were limited to those

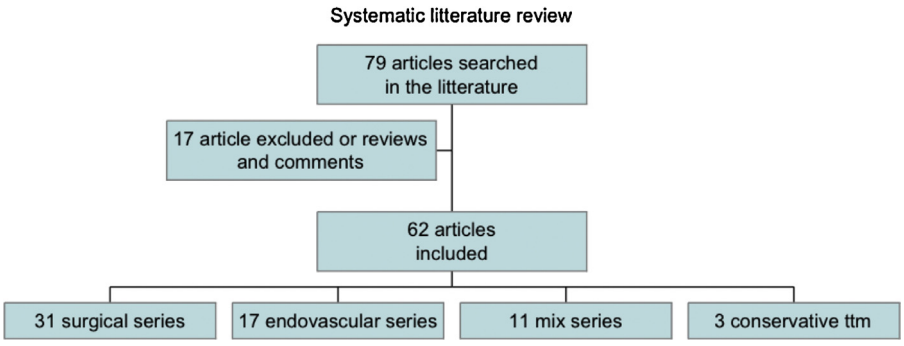

Fig. 1. Chart of the literature search.

Please cite this article in press as: Gonzalez AM, et al. Blood blister-like aneurysms: Single center experience and systematic literature review. Eur J Radiol (2013), http://dx.doi.org/10.1016/j.ejrad.2013.09.017