

Endovascular Management of Vertebral Artery Aneurysms

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Abstract

Background: The management outcome of a series of ruptured vertebral artery (VA) aneurysms was reviewed. **Method:** This is a retrospective study of prospectively collected data of 60 cases with ruptured VA aneurysms in the author's database from the year 2004. All cases were managed with coiling, stent-assisted coiling, flow diversion or endovascular parent artery sacrifice. Nimodipine and hypertensive, hypervolemic therapy was applied as standard. Outcome was assessed at 6 months with modified Rankin score (mRS). **Results:** There were 26 females and 34 males. Age range is 18 to 70 with a mean age of 42. There were 27 dissecting aneurysms and 33 saccular aneurysms. 50 (83%) cases were World Federation of Neurological Surgeons (WFNS) grade one to three. There were four WFNS grade four and six WFNS grade five. 25 cases of dissecting aneurysms were managed with parent artery coil occlusion. Two dissecting aneurysms affecting the dominant VA were treated with flow diverters. At 6 months follow up 50 (83%) achieved good outcome with mRS one to two. There were eight cases with poor outcome and two deaths. Six-month follow-up MR angiogram documented stable occlusion for the 24 cases with dissecting aneurysms treated with parent artery coil occlusion who survived. The two treated with flow diversion demonstrated good remodeling at 6 months on angiography. Six-month follow-up angiogram for the 32 cases of saccular aneurysm who survived documented stable aneurysm obliteration. **Conclusion:** Good outcome can be achieved with endovascular treatment for ruptured VA aneurysms. Parent artery occlusion is a safe and effective technique for ruptured VA dissecting aneurysm.

Keywords

Vertebral Artery, Aneurysm, Dissecting Aneurysm, Dissection

1. Introduction

VA aneurysm accounts for 0.5% to 3% of intracranial aneurysms [1]. In the In-

ternational Subarachnoid Aneurysm Trial (ISAT) VA aneurysms accounted for 1.4% of cases with subarachnoid hemorrhage [2]. The results of the ISAT study led to widespread adoption of endovascular treatment for ruptured aneurysms. The V4 intradural segment of the VA meets its contralateral counterpart to form basilar artery. The dominance of affected VA and its two important branches posterior-inferior-cerebellar artery (PICA) and anterior spinal artery (ASA) are the main determinants of strategies for treating ruptured VA aneurysm, surgically or endovascularly.

2. Methods

This is a retrospective study of a prospectively maintained database of cases with subarachnoid hemorrhage and aneurysms. The database was maintained with patients' consent for the purpose of audit and research publications without compromising patients' particulars. The inclusion criteria for this study were subarachnoid hemorrhage confirmed by lumbar puncture, documented on CT or MRI and catheter angiogram confirmed location of aneurysm along V4 segment of the VA up to vertebral confluence. Unruptured aneurysm and surgically managed cases including PICA-PICA bypass cases were excluded.

3. Results

A total of 60 cases met the criteria. There were 26 females and 34 males. Age range is 18 to 70 with a mean age of 42. 50 cases (83%) were WFNS grade one to three at presentation. There were four WFNS grade four and six WFNS grade 5. All cases with Glasgow Coma Scale of eight or less at presentation were intubated for airway control. Nimodipine, hypertensive, hypervolemic therapy were administered as standard. Intervention was performed either on the same day of admission or the next day.

Out of the 60 aneurysms, 27 had angiography findings of fusiform/nonsaccular dilatation of vertebral artery with proximal stenosis and "pearl and string sign". Although none of the cases showed pathognomonic double lumen or intimal flap, they were managed as dissecting aneurysms. 25 of the 27 cases involved co-dominant or non-dominant vertebral artery. They were managed with coil occlusion of the involved VA, taking care to preserve the PICA and ASA. For the coil occlusion procedure, no antiplatelet or anticoagulants were administered as these were cases with hemorrhage and there was a possibility that CSF diversion procedure may be required. The two cases involving dominant VA were treated with flow diverter insertion. For these two cases, intravenous integrilin and heparin were administered prior to flow diverter deployment. Subsequently the cases were maintained on aspirin and clopidogrel. At 6 months follow-up, among 22 cases who presented with good WFNS grade, 20 (91%) had good outcome and two (9%) had poor outcome. All 5 cases who presented with poor WFNS grade had poor outcome including one death. Overall, good outcome occurred in 20 out of 27 cases (74%), poor outcome occurred in 5 cases (19%)

including one death (4%) in this group of VA dissecting aneurysms.

Out of the 33 saccular aneurysms, two were giant aneurysms over 25 mm, two were large aneurysms over 10 mm and the rest were small aneurysms below 10 mm. Out of the 29 small aneurysms, only two had wide neck greater than 4 mm. The rest had favorable configuration of narrow neck aneurysms. The two giant aneurysms involved two young adults presenting with WFNS grade 5. One involved the non-dominant VA and the other involved the co-dominant VA. These two cases were treated with coil occlusion of parent VA successfully. Both cases had good recovery at 6 months and follow-up MRI and MRA at 6 months showed stable occlusion of VA with resolution of aneurysm. The 27 small aneurysms with narrow neck were treated with straight coiling of aneurysm with preservation of parent VA. These cases were not given antiplatelets or anticoagulation for reasons given above. For the two wide neck aneurysms and the two large aneurysms, which were treated early in the series, were managed with staged partial coiling followed by delayed stent-assisted coiling with Neuroform (Stryker Neurovascular, Fremont, California, USA) and Enterprise stents (Cor-dis Neurovascular, Miami, Florida, USA). For these four cases aspirin and clopidogrel were given for 5 days prior to stent placement and heparin was administered during the procedure. Subsequently the cases were maintained on aspirin and clopidogrel. At 6 months follow up all cases presenting with good WFNS grade achieved good outcome of mRS 0 to 2. Among the five cases who presented with WFNS grade four and five, two (40%) achieved good outcome. There was one death (3%) and two poor outcome (6%). Follow-up angiography at 6 months in all the cases who survived showed stable occlusion of aneurysms with no recurrence.

Treatment complications directly attributable to endovascular intervention include two symptomatic cerebellar infarcts (3%), one each in coiling of aneurysm and VA coil occlusion for dissecting aneurysm. There was no hemorrhagic complication. 12 cases (20%) required ventriculoperitoneal shunt insertion. One case who was on double antiplatelet therapy for flow diversion for dissecting aneurysm developed asymptomatic subcortical hemorrhage post-ventriculoperitoneal shunt insertion.

At 6 months follow up 50 cases (83%) achieved good outcome with mRS one to two. There were eight cases with poor outcome (13%) and two deaths (3%). The two deaths both presented with WFNS grade 5.

4. Discussion

Current endovascular treatment options for saccular VA aneurysms include direct coiling of aneurysm (with or without adjunct techniques such as balloon remodeling or neck bridging), intrasaccular devices, stent assisted coiling or flow diverter with or without coiling [3] [4]. Sometimes when there is anticipated need for CSF diversion procedure or surgical decompression, staged partial coiling followed by flow diverter or stent insertion and additional coiling (usual-

ly two to three weeks after hemorrhage) when the patient is able to tolerate double antiplatelets is done to minimize the risk of postoperative hemorrhagic complications. For giant aneurysms involving the non-dominant or co-dominant VA, coil occlusion without antiplatelets or heparin may be the simplest and safest solution because of the potential need for decompression due to the mass effect or the need for ventriculoperitoneal shunt [5].

For VA dissecting aneurysms the current endovascular options include deconstructive or reconstructive procedures. The risk of rebleeding for ruptured VA dissecting aneurysm is very high [6] [7]. Therefore, early intervention is paramount. Endovascular deconstructive techniques include proximal occlusion or endovascular trapping with balloons or coils. Coils are easier to control and will not deflate like balloons. Some reports incorporated balloon occlusion test prior to balloon or coil occlusion. In any case, detachable balloons are not available in many parts of the world [3] including the author's practice. Reconstructive techniques include flow diversion or stent placement with or without additional coiling. However, stent or flow diverter placement requires dual antiplatelet administration [3]. This could increase the risk of bleeding when surgical decompression or CSF diversion procedures are required [7] [8]. To date, the technique of choice for intervention of ruptured VA dissecting aneurysm remains controversial although in the current flow diverter era reconstructive techniques to keep the VA patent are gaining popularity. Unfortunately, early fatal rebleeding has been reported with these stent or flow diverter assisted endovascular reconstructive procedures [9]. Endovascular parent artery occlusion also has been reported to have a higher immediate postoperative occlusion rate, compared to stent assisted or flow diverter assisted techniques [10]. Therefore, when the anatomy is favorable (namely co-dominant or dominant contralateral vertebral artery and no involvement of PICA in the aneurysmal segment), endovascular parent artery coil occlusion has been the author's preferred option.

The outcome for this series is comparable to published literature. In this series, all ruptured saccular aneurysm cases with good WFNS grade at presentation had good outcome. Among the five cases who presented with WFNS grade four and five, two (40%) achieved good outcome. There was one death (3%) and two poor outcome (6%). All the cases who survived had angiographic stability at 6 months. For ruptured VA saccular aneurysm, Mericle *et al.* reported that of the patients who presented with a favorable clinical grade 87% had good outcomes at follow-up. Of the patients who presented with a poor clinical grade, 50% had good outcomes at follow-up. Angiographic occlusion was achieved in 97% of cases [4].

For VA dissecting aneurysms the outcome for this series (74% good outcome) is also comparable to published literature for parent artery occlusion, which was done in the majority of cases [10]-[15], where good outcomes were reported between 59% and 100% of cases. Our study, similar to Raper *et al.* [15] and Peluso *et al.* [14], showed no recurrence at follow-up, demonstrating durable effect of the simple treatment strategy.

It is worth noting that there were two cerebellar infarcts (3%) directly attributable to endovascular intervention in this series. It is tempting to consider using antiplatelet agent or anticoagulation in this setting to reduce thromboembolic complication. However, it is important to take note that the use of these agents may increase the risk of bleeding should the patient require surgical intervention, as had happened in one case in this series post ventriculoperitoneal shunt, albeit asymptomatic.

5. Conclusion

Good outcome can be achieved with endovascular treatment for ruptured VA aneurysms, even in some patients with poor WFNS grade at presentation. Parent artery occlusion is a safe, effective and durable treatment for ruptured VA dissecting aneurysms when the anatomy is favorable.

Conflicts of Interest

There is no conflict of interest to declare.

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