Successful Endosaccular Coiling after a Balloon Occlusion Test of the Caudal Channel of a Double Origin of the Posterior Inferior Cerebellar Artery Originating from the Aneurysm Neck

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Summary

Therapeutic strategies for unruptured aneurysms in elective procedures must be carefully planned with respect to safety. We describe the case of a patient who presented with an unruptured aneurysm associated with a double origin of the posterior inferior cerebellar artery (DOPICA), a rare variant of aberrant origin. A three-dimensional rotational angiogram clearly showed that the aneurysm incorporated the origin of the DOPICA caudal channel, which was more dominant than the cranial one. The aneurysm was completely obliterated using detachable coils after a balloon occlusion test (BOT) of the caudal channel was conducted to confirm the tolerance of the patient following sudden interruption of the more prominent flow coming from the caudal channel of the DOPICA. This report affirms the need to suspect anomalies associated with a DOPICA that predispose to intracranial aneurysms and highlights the potential role of a BOT in pretreatment hemodynamic evaluations of unusual aneurysms accompanying a particular developmental anomaly.

Introduction

A double origin of the posterior inferior cerebellar artery (DOPICA) has seldom been reported^{1,3-5}, and some authors have suggested that DOPICA may represent a risk factor for subsequent aneurysm development⁴. We report on a patient with an unruptured aneurysm

of a DOPICA that was cured by coil embolization following a balloon occlusion test (BOT) of one channel of the DOPICA arising from the neck of the aneurysm.

Case Report

A 65-year-old woman, who presented with an incidental vertebral artery (VA) aneurysm observed on a brain magnetic resonance angiogram (not shown here), was referred to our department for evaluation. Cerebral angiography showed a saccular aneurysm in the right vertebral artery (VA)-PICA junction. Both anterior inferior cerebellar arteries and the left PICA were all hypoplastic compared to the well-developed PICA on the right side (Figure 1A,B). The right PICA consisted of two channels in their intracranial origin, which converged into a common PICA, indicating a DOPICA (Figure 1C). The reconstructed three-dimensional rotational angiogram (3DRA) clearly demonstrated a saccular aneurysm and the caudal channel, which was more hyperplastic than the cranial one, of the DOPICA arising from the base of the aneurysm (Figure 1D). The endovascular treatment chosen was coil embolization of the PICA aneurysm. A balloon occlusion test (BOT) of the caudal channel arising from the aneurysm neck was planned (Figure 1E) in order to confirm the tolerance of the patient following a sudden temporary interruption of the more prominent caudal channel flow, and which precluded any ischemic

symptoms in relation to the PICA occlusion. The test occlusion was performed for over 30 minutes under systemic heparinization (an initial bolus of 70 U/kg and a continuous injection of 1000 U/h) with continuous neurologic examinations during the entire procedure. While the

patient was under local anesthesia, the right VA on the side to be tested was catheterized selectively using Seldinger's technique with a 6F-guiding catheter (Envoy; Cordis Endovascular) in order to perform the test occlusion. The left VA was then catheterized consecutive-

Figure 1 Right vertebral angiogram, anteroposterior (A), lateral (B), and oblique (C) views showing a saccular aneurysm on the right vertebral artery-posterior inferior cerebellar artery (VA-PICA) juncture and prominent PICA flow on the right side. D) Enlarged reconstruction of 3D rotational angiogram demonstrating the right PICA, which consisted of two channels, and indicating a double origin (DO) PICA and an aneurysm from which the hyperplastic caudal channel arose. E) Computer simulation image before the balloon occlusion test (BOT) of the caudal channel of the DOPICA after automated aneurysm detection (blue) and balloon inflation (yellow). F) Left vertebral injection during the BOT showing flow only through the hypoplastic cranial channel. Non-subtracted (G) and subtracted (H) right vertebral angiogram after coil embolization demonstrating complete obliteration of the aneurysm.

ly with a 5F-diagnostic catheter (Berenstein; Cook Medical) in order to evaluate the effectiveness of clamping and of alternative blood flow. After the diagnostic angiography was performed, baseline activated clotting times were obtained prior to the procedure. A 0.010-inch guidewire (X-Pedion; ev3) and a nondetachable balloon catheter (4 mm, 7 mm in length, HyperForm; ev3) were placed in the right VA across the neck of the aneurysm incorporating the caudal channel of the DOPICA, and the balloon was then inflated (Figure 1F). The criteria for determining the patient's tolerance during the BOT were clinical tolerance and angiographic visualization of the PICA as well as the rate of opacification and emptying of the tested lesion by an injection in the contralateral VA. Hypotension that consisted of a drop of 20 mmHg in the systolic blood pressure was induced with a calcium channel blocker for ten minutes at the end of the test occlusion in order to check for autoregulation irregularities during unpredictable hypotension that may cause inadequate cerebral perfusion. After the BOT, the PICA aneurysm and the origin of the caudal channel were obliterated using detachable coils while the patient was under general anesthesia. Under the roadmap image, a steam-shaped microcatheter (Excelsior SL-10; Boston Scientific) and a guidewire (0.014 inch, Transend; Boston Scientific) complex were navigated through the right V4 segment and then to the PICA aneurysm, resulting in stable positioning in the sac. Aneurysm coiling was performed with a HydroCoil (MicroVention) and a Guglielmi detachable coil (Boston Scientific), which resulted in complete occlusion of the sac and delaying of the contrast opacification at the origin of the caudal channel of DOPICA (Figure 1G and H). The patient awoke promptly after the intervention without neurological deficits. The postoperative CT scan was normal (not shown here), and the patient was discharged the next day. Postcoiling magnetic resonance images were not obtained because the patient did not have neurological deficits or abnormal findings on the postoperative CT scan.

Discussion

DOPICA is a condition in which two channels arise from the same VA and subsequently converge to create a distal PICA⁶. A retrospec-

tive study reported that the incidence of DOPICA is 1.45%⁵. DOPICA represents an embryologic persistence of the normal anastomosis between the lateral spinal artery and the PICA². Originating lateral to the medulla, the lateral spinal artery arises from either the PICA or the intradural VA and forms the caudal component of a DOPICA. The rostral component of a DOPICA is the PICA proper, which is embryologically derived from a hypertrophied radiculospinal artery^{2,4}. Certain congenital anomalies may predispose an individual to aneurysmal formation^{3,4,6,7}. Pasco et al.⁶ suggested that DOPICA may be the manifestation of an underlying incomplete or regional vascular developmental disorganization that weakly, yet measurably, increases the tendency toward the formation of acquired intracranial aneurysms. Therapeutic occlusion of one channel of a DOPICA associated with an aneurysm usually may not cause a worsening of the patient's neurological condition, owing to the presence of the DOPICA as an alternative flow pathway^{1,4}. Perforating vessels are likely to arise from both channels of the DOPICA. The cranial channel bears most of the medullary perforators, and it is, in all likelihood, a large perforating vessel itself⁶. Supposing that both the cranial and caudal channels of a DOPICA have a perforator-bearing segment and that the cranial root gives rise to most of the medullary perforating arteries, internal trapping or occlusion of the cranial channel should be performed with caution. In our patient, owing to the facts that not only the right PICA was the most dominant cerebellar artery supplying the inferior cerebellum and the brain stem, but also that the caudal channel was more prominent than the cranial channel, the risk of ischemia after occlusion of the origin of the caudal channel was considered to have an uncertain prognosis. In order to reduce the risk of ischemia following sudden interruption of dominant blood flow of the DOPICA, BOT was warranted before permanent obliteration. However, in the present case, the BOT did not clearly reveal the future real occlusion site, which was near the origin of the caudal channel of DOPICA at the base of the aneurysm. In addition, it is well known that very small medullary perforators frequently arise from the anterior and lateral medullary segments of the PICA, and arise more often, but not totally, from the cranial channel compared to the caudal channel in the case of DOPICA^{2,5,6}. Thus, a VA BOT before the caudal channel occlusion can-

not completely exclude the risk of occluding such perforators, although there is a rich anastomotic plexiform network between perforators in the brain stem¹. To the best of our knowledge, this is the first reported case of a

BOT that was conducted in order to plan the neuroendovascular therapy of a DOPICA. A management strategy in an elective procedure for unruptured aneurysms must first be planned carefully for safety.

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