Surgical Intervention for a Giant Aneurysm of the Vertebral Artery

—Case Report—

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Summary: A radical operation in an elderly man with a giant aneurysm of the vertebral artery was successfully performed. The aneurysm in the posterior fossa caused symptoms such as a disturbance of the lower cranial nerves, as well as pyramidal and cerebellar signs. An aneurysmectomy was performed for decompression of the brain stem and cranial nerves. An extended lateral suboccipital approach was chosen which made it possible to remove the rim of the foramen magnum and reach the condylar fossa. This approach also made access to the vertebro-basilar junction possible for trapping. After resection of the aneurysm and thrombectomy (endaneurysmal microendarterectomy), the aneurysmal neck as well as its clipping was closed, and consequently its parent artery. The procedure is described in this report.

Key words: giant aneurysm — vertebral artery — MRI — endaneurysmal microendarterectomy — occipital condyle

Introduction

There are some reports on the symptoms of a giant aneurysm, which directly compresses adjacent structures in the posterior fossa. In particular, various neurological deficits are known to result from pressure on the medulla oblongata, lower cranial nerves and pons. A giant aneurysm commonly manifests itself as a laminated intramural thrombus. If an aneurysm is successfully removed, the mass effect can be released. Ligation of the proximal vertebral artery, known as the conventional method, is likely to facilitate gradual formation of an intraluminal thrombus and the neurological signs can not be satisfactorily alleviated. The ideal neurosurgical intervention would be

extirpation of the aneurysm, while preserving the parent artery. In this report, focus is placed on the necessary conditions for radical surgical intervention and the procedures used for a successful surgery.

Report of a case

Clinical and radiological findings: The patient was a 64 year-old man with a 9 month history of a mild gait disturbance, dizziness and vertigo. Three months prior to admission, he complained of weakness in the left leg and ataxia. In addition, dysphagia and dysarthria had developed slowly over 4 weeks.

On admission in December, 1988, a

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neurological examination revealed a fast fine lateral gaze nystagmus to the right, a widebased gait (cerebellar ataxia), a right intentional tremor, a dysfunction of the right lower cranial nerves (9-12) and a diffuse hyperreflexia.

Plain CT demonstrated a heterogeneous high density mass in the right lower cerebellum, while enhanced CT displayed a mild enhancement of the mass wall (Byrd, 1978) (Fig. 1).

Angiography of the right vertebral artery demonstrated a small saccular aneurysm with a vascular channel. However, the right posteroinferior cerebellar artery could not be clearly visualized (Fig. 2). The left vertebral artery was dominant compared to the right. MRI (T_1 : repetition time (TR) 600 ms and echo time (TE) 15 ms and T_2 : TR 3000 ms and TE 90 ms) demonstrated a relatively thick, signal void ring at the margin of the lumen. The central lumen displayed a mixed signal (Horos, 1986) (Fig. 3).

Fig. 1. Plain CT scan demonstrating a large oval area of high density with a heterogeneous configuration occupying the right half of the posterior fossa ($\uparrow$).

Fig. 2. Preoperative right vertebral angiograms, lateral (a) and anteroposterior (b) views, showing a small saccular aneurysm with a light vascular channel ($\uparrow$).

Fig. 3. T₁ (a) and T₂ (b) weighted images of the vertebral aneurysm signal void ring at the lumen's periphery on both T₁ and T₂ images (↑). The central lumen displays a mixed signal intensity.

Based on the results mentioned above, the diagnosis of a giant aneurysm of the right vertebral artery with a laminated intramural thrombus was made.

Operative procedure: Under general anesthesia, the patient was placed in a lateral position with the head tilted toward the ipsilateral shoulder. A J-shaped skin incision was made. A lateral suboccipital craniectomy was added large enough to visualize the sigmoid and transverse sinus. After craniectomy, the lamina of C₁ was removed. Then extensive removal of the bone (from the lateral margin of the foramen magnum to the condylar fossa) was performed. The occipital condyle was partially removed. In this procedure, particular attention was made to identify the vertebral artery which runs parallel to the laminal

groove of the atlas and is covered with the periosteal sheath. The dura was opened from the C₁ level to the right lateral sinus. Immediately, the proximal vertebral artery close to the medulla oblongata could be identified. The aneurysm and cerebellum were gently lifted upwardly and medially with a self-retractor. The distal vertebral artery (vertebrobasilar junction) became exposed, inferior to the 11th cranial nerves (Fig. 4a, b). 600 ml of 20% mannitol and 300 mg of thiopental were infused to prevent brain ischemia. The systolic blood pressure was maintained at 130-140 mmHg. Temporary vascular clips were placed at the proximal and distal vertebral artery. The incision was then extended laterally to the aneurysmal dome. A part of the dome adjacent to the 9th and 10th cranial

a

b

Fig. 4a. Photogram demonstrating that as the aneurysm (open arrow) and cerebellum were gently lifted up ward and medially with a self-retractor, the bilateral distal vertebral artery (solid curved arrow) low cranial nerve (open curved arrow) and proximal vertebral artery (solid arrow) were exposed.

Fig. 4b. Photogram revealing the temporary trapping with resection of the aneurysm dome and the aneurysmal lumen closing (open arrow).

nerves was resected. Intramural thrombectomy was performed (in the dome of the aneurysmal neck) within an ultrasonic aspirator. After internal decompression, an attempt was made to place the clip at the aneurysmal neck, but this failed due to the arteriosclerotic plaque and calcification. The plaque was therefore separated from the intima by a microendarterectomy, and the lumen was flushed with heparinized saline. The lumen was then closed with 7-0 nylon and the clip was placed across the aneurysmal neck. After 80 minutes of local circulatory arrest, the temporary clip was removed in the distal and proximal order. No leakage was observed. During occlusion of the

parent artery, the ABR did not change. Ninety days after the operation, the patient had almost completely recovered from the ataxia and dizziness, but the dysphagia remained.

Discussion

The incidence of giant cerebral aneurysms (greater than 25 mm in diameter) is reported to be 3-5% (Kuwabara, 1981) of all types of cerebral aneurysms and is extremely low 0.1-0.3% (Morley, 1969), in the region of the vertebral artery. The direct effect on the brain stem (medulla and pons) of an aneurysmal rupture in

the area of the vertebrobasilar artery is thought to give rise to rapid disturbances of consciousness for relatively long periods, later accompanied by respiratory failure or weakness of the lower extremities. Since a laminated intramural thrombus coexists with the giant cerebral aneurysm, a mass effect and/or symptoms of cerebral ischemia due to compression or occlusion of the parent or perforating artery and embolism are more likely to appear than symptoms of subarachnoid hemorrhage. Major symptoms from the mass effect are due to injuries of the cranial nerves, particularly the 8th, which is the most sensitive to stretching as well as the facial, trigeminal and other lower cranial nerves. Cerebellar or contralateral pyramidal signs have also been reported (Tullenken, 1976; Bohl, 1977).

Surgical treatment for a giant aneurysm in the area of the vertebral artery involves ligation or trappings which is commonly performed by an indirect surgical approach, and occlusion as a radiological intervention. Ligation can be categorized as extra and intracranial portion. Drake (1975) carried out extracranial ligation (unilateral) on patients, one of which died, and 8 intracranial ligations, all of which were good or excellent. He described in a later report, that the collateral circulation should be reduced to facilitate laminated thrombus formation in the aneurysm. In this sense, occlusion near the aneurysmal neck, distal to PICA (posterior inferior cerebellar artery), is preferred.

Two problems, however, must be solved in regard to the ligation. 1) How often do ruptures and growing aneurysms occur after ligations? 2) Do clinical symptoms after ligation of the vertebral artery appear on the affected side? Drake (1975), Dimsdale (1959), Poulson (1959) and Shibata (1982) observed a reduction of the aneurysm based on the CT and clinical signs. Kusaka (1978) verified that

proximal ligation reduces the aneurysm in model experiments. Dilatation of the intact vertebral artery after ligation clearly indicates that there is a reduction of the blood flow on the affected side. However, aneurysmal rupture occurred 28 hours after ligation in some cases (Miyaki, 1964); thrombus formation in the aneurysm due to the change of blood flow may develop slowly (Sugita, 1988). If the vertebral artery on the intact side is similar to or larger than that on the affected side, blood flow in the basilar region may not change after ligation. Listen (1982) reported that the blood flow after ligation is influenced by the distribution of perforators to the medulla. On the average, 0.5 perforators originate proximal to the PICA, 1.8 distal and 1.0 from the PICA itself. Among these, 20 to 30% of the perforators distribute directly to the medulla and the rest become a circumflex artery. The incidence of medullary syndrome is therefore estimated to be relatively low (Kodama, 1982).

The ideal operative procedure would be trapping with aneurysmectomy and reconstruction of the parent artery (Fig. 5). For trapping, the distal artery must be exposed. By the conventional suboccipital approach, the brain stem is likely to be heavily compressed during retraction and the prognosis will be poor unless internal decompression of the aneurysm is performed.

To facilitate temporal clipping of the distal vertebral artery, an extensive craniectomy of the foramen magnum was performed the dissection was made exteriorly from the lateral margin of the foramen magnum and part of the posterior occipital condyle was excised. It was then extended further exteriorly towards the condylar fossa (Heros, 1986; George, 1988). It is important with this approach to identify the vertebral artery, as soon as possible, where it crosses the laminar groove of the atlas and perforates

Fig. 5. DSA of the vertebral artery demonstrating the preservation of the parent artery and the closed neck of the aneurysm.

the dura mater. Bleeding from the vertebral venous plexus or meningeal artery perforating the cranium may indicate the vicinity of the vertebral artery which is covered by the periosteum (Oliveria, 1985). With this approach, even the vertebro-basilar junction usually becomes visible between the 9, 10th and 11th nerve by mild retraction.

Before the trapping, monitoring of ABR was started to estimate the effect of retraction on the 8th nerve, as well as the degree of compression and ischemia of the brain stem (Law, 1985). Under general anesthesia, types I to V ABR waves are usually low in amplitude. If the retraction is too great or anesthetic hypotension occurs (40 mmHg), all peak amplitudes become flat and the postoperative recovery will be impaired in parallel with the duration of flattening (Grundy, 1972). Therefore, normotension (130-140 mmHg) should be maintained, and 600 ml of 20% mannitol (Onuma, 1979; Kodama,

1982) and 300 mg of thiopental (Sundt, 1982; Sekhar, 1983) are recommended for brain protection.

There are some problems in regard to reconstruction after the trapping. Neck occlusion only by clipping is usually impossible, as an atheroma or calcification of the aneurysmal wall is always present, particularly in those cases with a laminated intraluminal thrombus. If the thrombus is tough and fibrous in nature, ultrasonic aspiration is preferred for a delicate thrombectomy in a short period (Symon, 1984). For endaneurysmal microdissector from the dome of aneurysm towards the neck (Hylton, 1988). As the wall was sclerotic and fragile, ample margin had to be left for suturing. The suture was further tightened by clipping. Eighty minutes were required for the release of the trapping, while the time for the temporary clipping should be minimized to 40 minutes for safety. The success of this direct approach in the present case may have been due to following conditions: 1) A small diameter neck (angiographic identification), 2) An aneurysm located in the vertebral artery proximal to the vertebro-basilar junction (Drake, 1975), 3) no change of ABR during the surgical procedure and 4) successful radical decompression. In conclusion, one must consider the potential risks in selecting the surgical method. Functional angiography and interventional approaches also must be considered for better results in the future (Hahn, 1986).

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