CASE REPORTS

Giant Posterior Cerebral Artery Aneurysms

Dev Posterior Serebral Arter Anevrizmaları

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Abstract: Two patients with giant posterior cerebral artery aneurysm are presented. In both cases, the digital substraction angiography was not able to reveal the definite site of the origin of the neck on the parent artery, and the preoperative neuroradiologic investigations were unsatisfactory in showing a clear relation between the neck of the aneurysm and adjacent vessels and neural structures. The first patient had a giant bilobed aneurysm on the left P1 segment and frontotemporal approach was utilized bilaterally in two stages. Both the transsylvian and the subtemporal routes were used to find and clip the aneurysm neck. In the second patient, there was a giant aneurysm on the left P2 segment, and most of the aneurysmal sac was embedded in the parenchyma. Since the atheromatous aneurysm neck could not be completely enclosed by the clip, a proximal ligation of the left posterior cerebral artery was also performed. A communicating hydrocephalus developed and, a ventriculo-peritonal shunting procedure was performed one month postoperatively. Both patients were in excellent condition on discharge. The operative approaches and procedures that we preferred in these cases are discussed.

Key Words: Giant aneurysm, posterior cerebral artery, surgical approach

Özet: Dev posterior serebral arter anevrizması olan iki olgu sunulmaktadır. Her iki olguda da digital substraksiyon anjiyografisi anevrizma boynunun ana arter üzerindeki yerini göstermekte yetersiz kalmıştır. Ameliyat öncesi nöroradyolojik incelemeler anevrizma boynuyla komşu damar ve sinir yapıları arasındaki ilişkileri tam olarak gösterememiştir. İlk hastada sol P1 parçası üzerinde dev iki loblu bir anevrizma vardı, cerrahide iki oturumda iki taraflı frontotemporal yaklaşım uygulandı. Anevrizma boynunu bulup kliplemek için transsilviyan ve subtemporal yollar kullanıldı. İkinci hastada sol P2 parçası üzerinde dev anevrizma vardı ve anevrizma kesesinin büyük bir bölümü parankim içine gömülüydü. Anevrizmanın ateromatöz boynu kliple tam olarak kapatılamadığı için ayrıca sol posterior serebral arter proksimalden kapatıldı. Bu hastaya bir ay sonra kommunikan hidrosefali nedeniyle ventrikülöperitoneal şant takıldı. Her iki hasta da mükemmel durumda taburcu edildiler. Bu olgularda kullanılan cerrahi yaklaşımlar ve uygulanan işlemler tartışıldı.

Anahtar Sözcükler: Cerrahi yaklaşım, dev anevrizma, posterior serebral arter

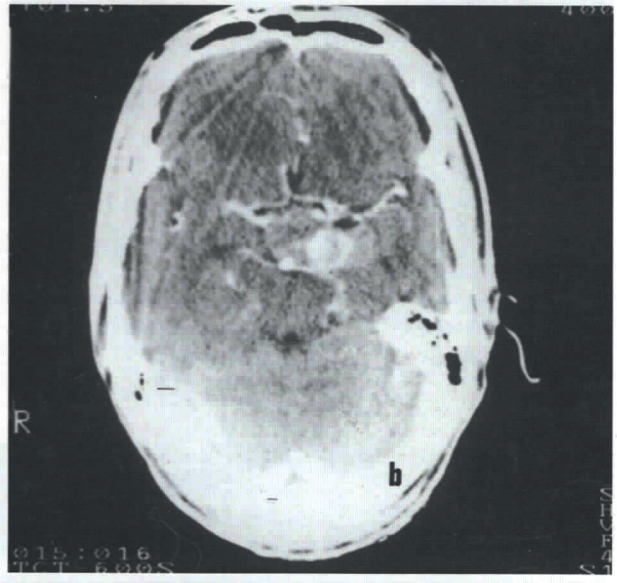
INTRODUCTION

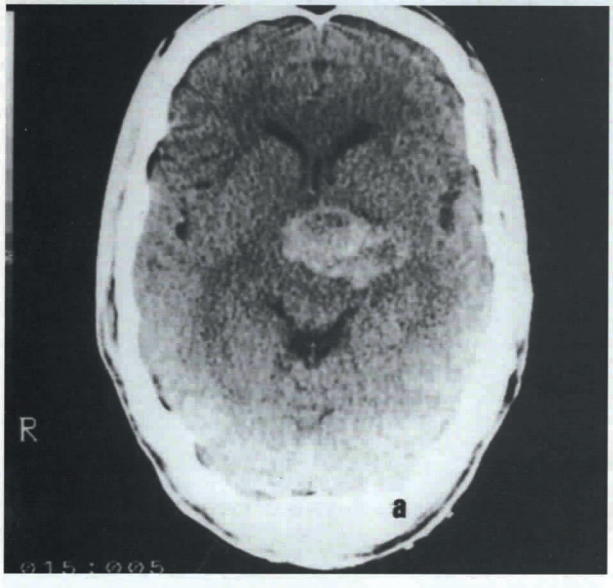
Aneurysms of the posterior cerebral artery (PCA) are rare, making up about 0.7 to 2.3 % of all cerebral aneurysms (7, 21). The P2 segment is the most common location, and only 13 % of all PCA aneurysms are considered to be distal to the P3 segment (6, 7). Some authors have mentioned that PCA aneurysms tend to become larger than other aneurysms before they are identified (19, 24). Giant aneurysm (those with a diameter greater than 25 mm) account for nearly 5 % of all intracranial aneurysms (6, 14, 22). But the incidence of giant aneurysms varies from 13 to 50 % among all PCA

aneurysms (6, 17, 18). Since the necks of the giant aneurysms are usually broad-based atheromatous structures, and deposition of intraluminal mural thrombus and bizarre recanalization are frequently encountered, the identification of the aneurysm neck may be very difficult preoperatively. Thus, the efferent vessels are widely displaced and are occasionally seen to arise from the aneurysm itself (1, 15). But the existence of good collateral circulation in the distribution of the PCA often enables neurosurgeons to have good results, even in patients whose giant aneurysms are treated with proximal ligation or trapping, unless the perforating vessels are not obliterated (2, 9). Eight patients with PCA aneurysm were treated surgically in our department between 1984 and 1996, and among them 2 (25 %) had documented giant aneurysms. In this report, the surgical approaches and procedures that we performed are discussed in relation to the anatomy and location of the aneurysms.

CASE REPORTS

Case 1: The first patient was a 36 year-old man with a 7-month history of severe headaches. Four months prior to presentation, he had a generalized seizure which was followed by two subsequent seizures within two weeks. He finally presented to our department because of his progressive visual disturbances. He was alert and fully oriented. There was no evidence of meningeal irritation or neurological deficit. His WFNS grade (8) was I. As soon as he was hospitalized, a computerized tomographic (CT) scan was performed, which showed a large bilobed suprasellar lesion with peripheral calcification and non-homogeneous enhancement (Figure 1). No evidence of cisternal hemorrhage was seen. To gather further information about the lesion, the patient underwent evaluation by magnetic resonance (MR). The study suggested that the mass was probably contiguous with the distal basilar artery, and was probably an aneurysm with intraluminal thrombus. It occupied almost all of the suprasellar and interpedincular cisterns, and the





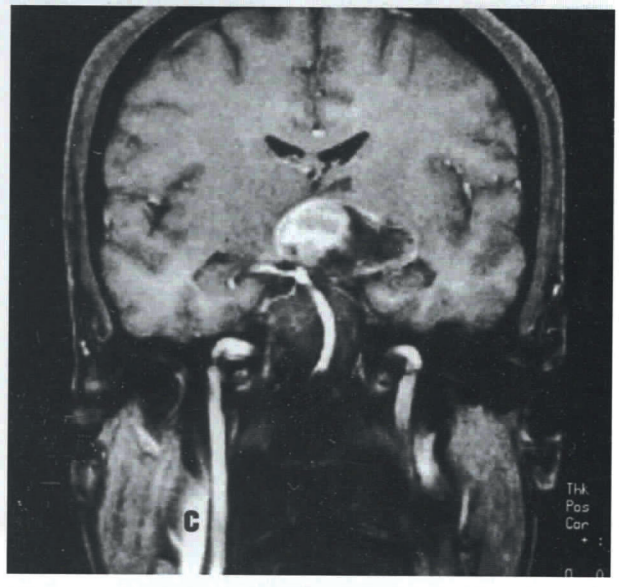


Figure 1, a) Preoperative plain CT scans of the first case showed a large bilobed suprasellar lesion with peripheral calcification, b) it was enhancing inhomogeneously, c) preoperative enhanced MR images of the first case on the coronary plane showed a giant bilobed lesion suggesting an aneurysm with heavy intraluminal thrombus formations. The suprasellar and interpedincular cisterns and third ventricle was occupied by this lesion.

third ventricle. Thus, the midbrain and left optic tract were compressed. No sign of hydrocephalus was observed (Figure 1). Angiography demonstrated a giant aneurysm with a fine elongated neck. But this aneurysm clearly did not originate from the basilar artery. Even though it was probably a PCA aneurysm, the superimposition of vascular structures upon the aneurysm made the neck's origin on the PCA difficult to be interpreted. The left posterior communicating artery (PCoA) was patent during the Allcock test (Figure 2). Though the aneurysm mass was located on the left side, its neck seemed to be easily clippable via a contralateral approach. Therefore, we first tried to approach the aneurysm via a large right frontotemporoparietal craniotomy. Initially, we attempted to visualize the aneurysm neck between the right internal carotid artery (ICA) and the optic nerve through a transsylvian approach. But the body of the aneurysm did not permit us to see this region. Then we tried to approach this region via a subtemporal approach. We quickly encountered the right PCA, superior cerebeller artery, and aneurysm wall. We dissected proximally to find the neck, we could only visualize the third cranial nerve, basilar tip, and the first 2 mm of the left P1 segment. Since it was not possible to obliterate this giant aneurysm through this approach, we decided to end the operation at that stage, and try to manage it via the opposite side. Except a mild right ptosis, his postoperative neurologic condition was the same as preoperatively. Four days later, he underwent a left large frontotemporoparietal craniotomy. We tried to visualize the basilar tip, left PCA and the aneurysm neck between the left ICA and optic nerve via a transsylvian approach. We identified the left PCoA crossing over the aneurysm wall laterally, but we could not see the basilar tip, left P1, or neck of the aneurysm. Then we used the subtemporal route and easily encountered the aneurysm wall. Dissection of the aneurysm disclosed that the left PCA was displaced posteroinferiorly and located under the aneurysmal sac. So we were not able to see the left PCA

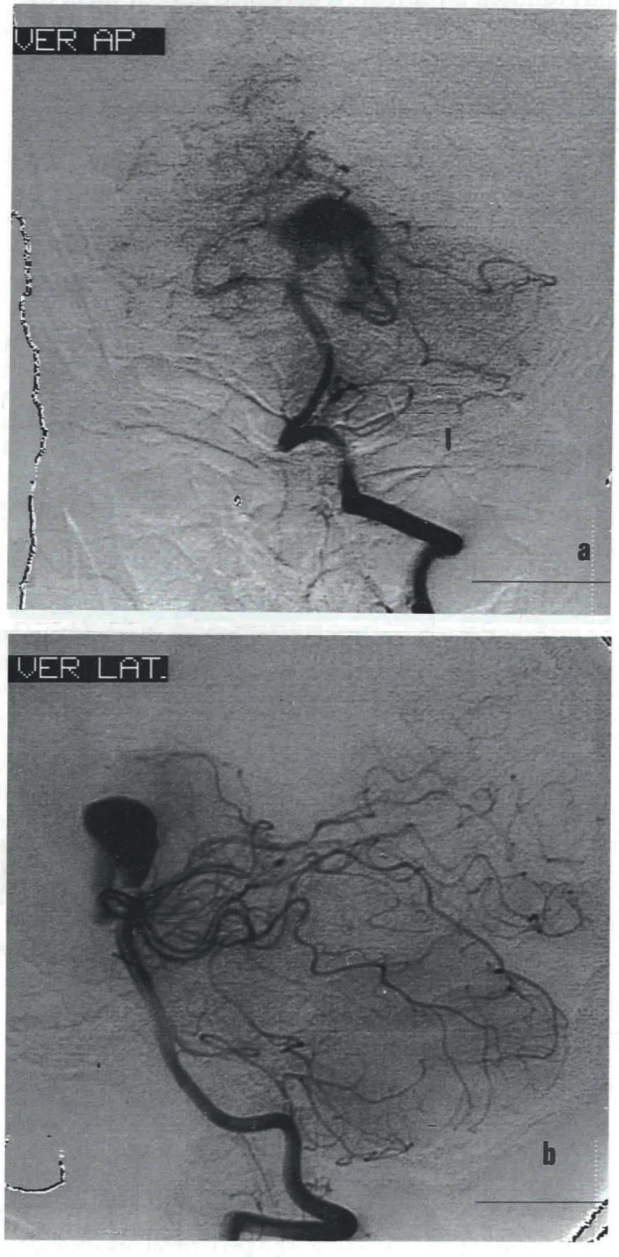


Figure 2: In the first case, a giant left PCA aneurysm with a fine elongated neck was visible on his preoperative DSA. (a, and b), but the site of its origin on the left PCA was unclear. Postoperative angiogram showed the disappearance of the aneurysm (c).

segments beyond the aneurysm. The PCoA was entering and then leaving the aneurysm wall, and it was not possible to dissect it from the aneurysm. But a definite neck on the left P1 segment and a several milimeters of this segment proximal to the neck were identified (Figure 3). The neck could have been attached about 6-7 mm distal to the basilar tip. At this moment, we were able to manage a probable hemorrhage which would occur during the insicion of the aneurysm after clippage. Then we clipped the neck adequately. Before opening the aneurysm, a probable connection with the lumen of the left PCoA was eliminated by placing another clip on the junction between the PCoA and the aneurysm wall, in order to reconstruct the left PCoA. After we confirmed the presence of blood flow through the left PCoA and its exclusion from aneurysm, we opened the aneurysm to evacuate the intraluminal thrombus to reduce its size (Figure 3). No bleeding was encountered from the sac. Then, we finished the operation with adequate closure of the dura, bone, and skin flaps. Postoperatively, he had a left total third cranial nerve palsy, and he quickly returned to his preoperative neurological status. His control angiogram one week postoperatively, showed that the aneurysm had totally disappeared, and no sign of vasospasm was visible (Figure 2). He was discharged two weeks after surgery, and was examined in the first postoperative month. Diplopia due to a mild left oculomotor nerve paresis was his only complaint and his control CT scan was normal except for the appearance due to the calcified aneurysm wall and thrombus. The size of the lesion had decreased compared to its preoperative appearance.

Case 2: The second patient was a 49 year-old woman. She was brought to the hospital with a sudden and severe headache which had started during swimming and had been followed by vomiting on the beach. There was no associated loss of consciousness. She was alert and fully oriented, and her physical examination was normal except for the presence of meningeal irritation signs. She was in grade I according to WFNS scale. Her initial CT scan revealed diffuse ventricular hemorrhage, and an enhancing round lesion in the left ambient cistern. Digital substraction angiography (DSA) on the second day of subarachnoid hemorrhage, suggested a giant aneurysm of the distal P2 segment of the left posterior cerebral artery with no evidence of angiospasm (Figure 4). The next day, she underwent

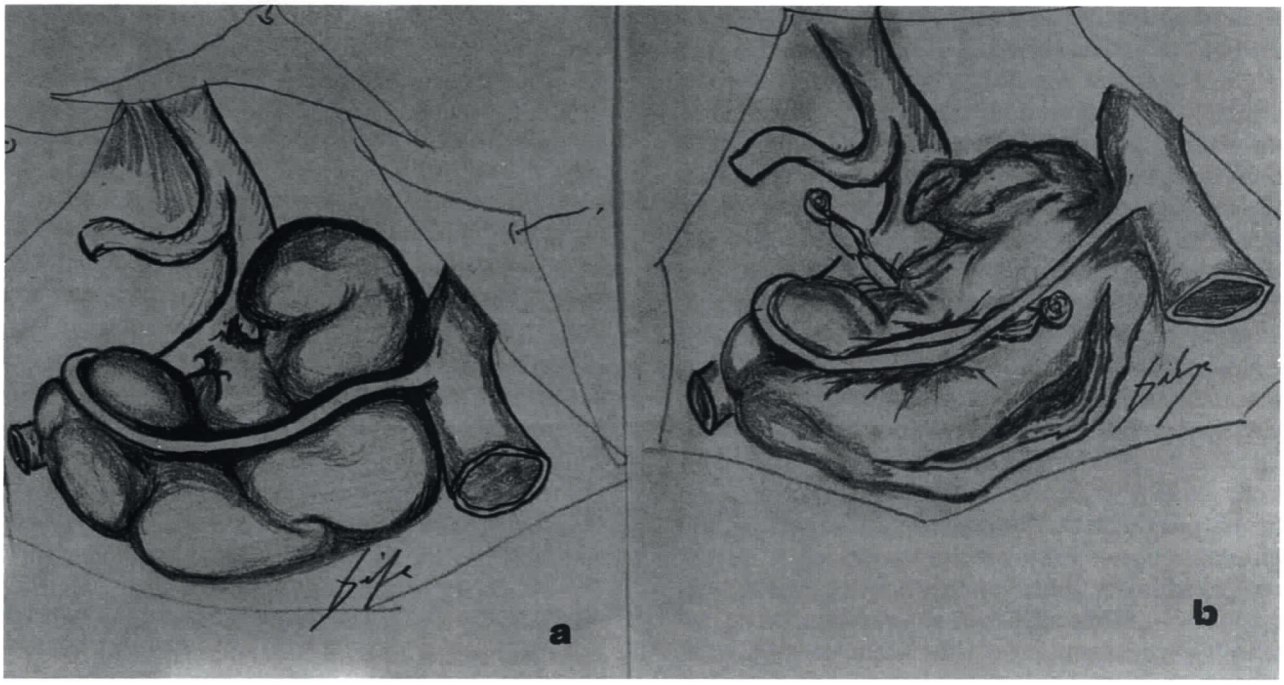


Figure 3: Schematic illustration of preoperative (a), and postoperative (b) surgical anatomy of the first case. After clipping the neck of aneurysm, another clip was applied between the left PCoA and the aneurysm wall where they were stuck to each other. This was performed to exclude any possible communication between them and thus, to secure and reinforce the adequacy of the blood flow through the PCoA. Then the aneurysm wall was opened safely and decompressed with removing thrombus.

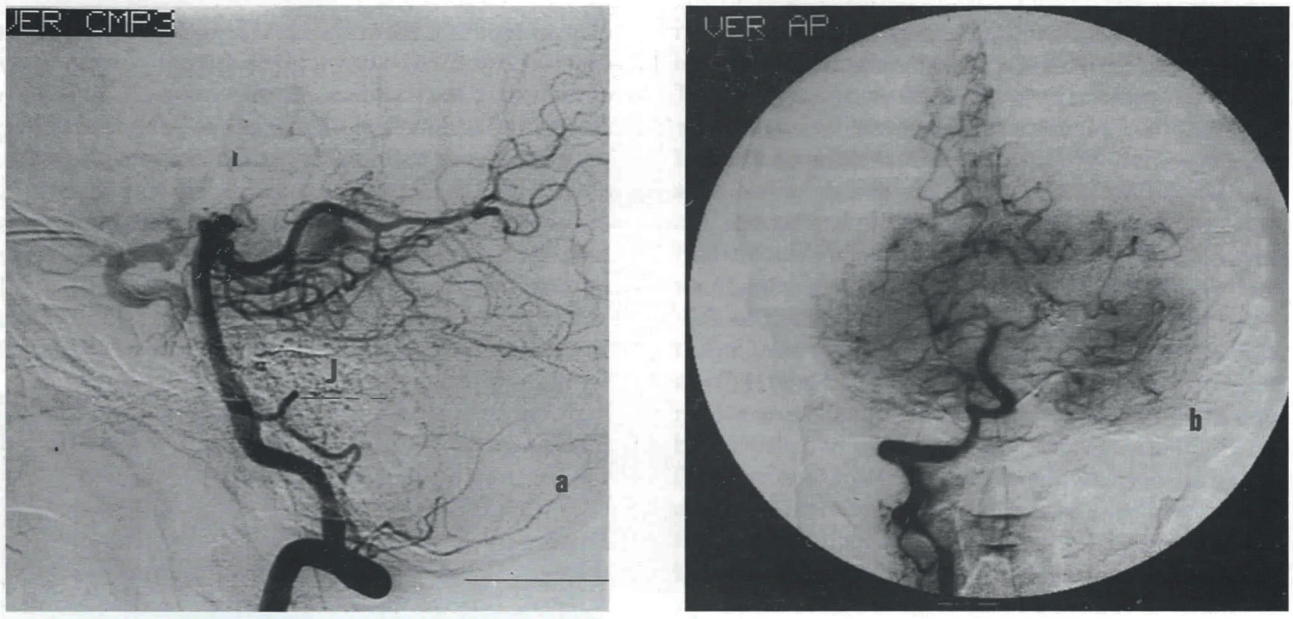


Figure 4: Preoperative lateral view (a) of the second case during vertebral angiogram disclosed a giant aneurysm of the left distal P2 segment. Patency of the left PCoA was proven with Allcock's test. Postoperative A/P view (b) on vertebral angiogram showed the disappearance of the aneurysmal dilatation and presence of the collateral circulation distal to clippage site via the contralateral distal PCA branches.

a left subtemporal craniotomy. During exploration of the left ambient cistern, the left PCA and SCA were identified. After dissection of the PCA, a small part of the aneurysm neck was encountered in the distal P2 segment. Since the aneurysm, which originated from the medial aspect of P2 and projected anteriorly, was almost totally embedded in the diencephalon (Figure 5), we first tried to obliterate the aneurysm by applying a permanent clip on its neck. But the strength of the clip failed to overcome the resistance produced by the atheromatous plaque and the intraluminal pressure. The clip was not able to prevent blood flow into the aneurysm sac, and no decrease in the tension of pulsating aneurysm wall was observed. Then, we placed another permanent clip proximal to the aneurysm on the P2 segment. Because the aneurysm seemed to become smaller and nonpulsatile, we opened and cut the sac distal to the first clip (Figure 5). There was no bleeding, and the aneurysm was out of the circulation. After coagulation of aneurysm wall, we finished the operation with appropriate closure of dura, bone, and skin flaps, respectively. In the early postoperative period, she quickly recovered to her preoperative neurologic status, except for a mild left pitosis. A control angiogram on the 11th day postsurgery, showed abscence of any aneurysmal dilatation, and the PCA segments distal to the clippage site were nourished via collateral circulation coming from the contralateral distal PCA branches (Figure 4). She developed a communicating hydrocephalus at the end of first month. Eventually, she underwent a ventriculo-peritoneal shunt procedure. Her latest neurologic examination on the third postoperative month revealed no deficit. Thus, her left ptosis had totally disappeared.

DISCUSSION

Krayenbühl and Yaşargil (12), and Zeal and Rhoton (24) proposed a classification of the parts of the trunk of the PCA. They designated the part of the artery between its origin and the posterior communicating artery (PCoA) as the P1 segment. The P2 segment begins at the PCoA and terminates at the posterior edge of the midbrain.The anterior half of the P2 segment is designated P2A and the posterior half P2P. The P3 segment proceeds posteriorly from the pulvinar to the anterior limit of the calcarine fissure. Thirty-one percent of PCA aneurysms arose on the P1 segment and PCA-PCoA junction, 56 % on the P2 segment, and 13 % further distally. The P2 segment is the most common location and the aneurysms on this segment are likely to be giant in size.

The operative approach varies with the site of the aneurysm. Aneurysms of the initial segment of

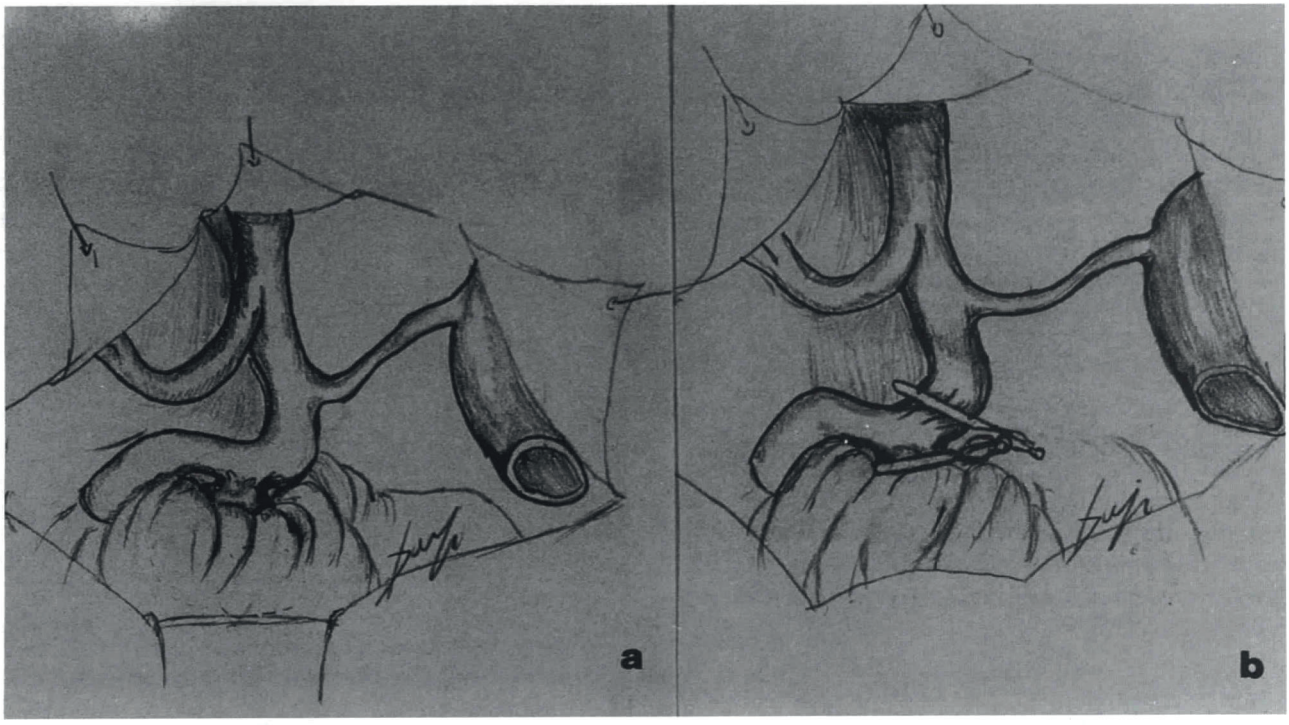


Figure 5: Schematic illustration of a) preoperative, and b) postoperative surgical anatomy of the second case. Aneurysm on the left distal P2 segment was embedded in diencephalon almost totally except for its neck. After the failure of the first clippage attempt on the neck, another clip was placed on the left P2 segment between the PCoA and the aneurysm neck in order to perform a proximal ligation procedure.

the PCA (either P1 or P1-P2 junction) can be treated by the surgical approach (pterional or subtemporal) used for basilar tip aneurysms (18). They are located at the origin of the thalamoperforating and the circumflex arteries in the interpedincular cistern. However, we feel it more useful to place these aneurysms in a separate class apart from basilar tip aneurysms since the surgical results tend to be considerably better than in PCA aneurysms. The key is to preserve the perforators and the long circumferential branches from the P1 segment, and this is easier to accomplish in PCA aneurysms than with basilar tip aneurysms (4,10,11). Both approaches have some limitations. The working space is relatively small through a pterional route (23). On the other hand, it is sometimes difficult to obtain good visualization of the contralateral P1 segment and its perforators via the subtemporal route (7). Thus, the excessive elevation of the temporal lobe and possible injury to the basal temporal veins may also cause postoperative temporal lobe edema. Our first case had an aneurysm located on the left P1 segment. We decided to perform a right-sided approach since the exposure of the aneurysm neck could be obscured by the large fundus which was located predominantley on the left side. To maximize exposure, we made a wide frontotemporoparietal craniotomy to approach the aneurysmal neck via either a transsylvian or a subtemporal route. We used these two contralateral routes, but still were not able to clip the aneurysm. Then, we performed a left-sided (ipsilateral) approach via a similar sized craniotomy. Both the transsylvian and subtemporal routes were needed for exposing and clipping the aneurysm neck. Another clip was also applied in order to reconstruct the left PCoA which was stuck to the aneurysm wall before opening the aneurysmal sac. The aim of this second clip was to secure and reinforce the adequacy of the blood flow through the PCoA that could nourish the distal territory of PCA in the event of an ischemic event. In the giant aneurysms of P1 segment and P1-P2 junction, the craniotomies should be so designed that either approach can be used whenever needed. Aneurysms arising from the P2 segment are best approached subtemporally and they sometimes require some resection of the parahypocampal gyrus to which the aneurysm is usually stuck (5, 10). In our second case, the aneurysm neck was located at the medial aspect of the left P2 segment. We also used the subtemporal route and easily approached the aneurysm in the ambient cistern. Aneurysms of the P3 segment can be approached by either a

subtemporal or an occipital interhemispheric route. But the posterior interhemispheric route is usually preferred because subtemporal approach to these lesions which are located in the parasplenial region necessitates excessive retraction in most cases (10, 18, 23).

In the treatment of PCA aneurysms, the greatest problem is the management of unclippable aneurysms (3). Although clipping is the treatment of choice for giant saccular aneurysms, proximal ligation and trapping procedures are also preferred for giant or fusiform aneurysms. One can expect the collateral circulation of the PCA to perfuse the area distal to the occluded site (13, 20, 23). The potential for collateral between the anterior and middle cerebral arteries to the distal PCA is usually awesome, making surgical revascularization unnecessary(16).

The decision between proximal ligation and trapping is based on whether there are any small branches originating from the segment to be trapped, because these perforators have no collateral circulation. In such cases, proximal ligation should be preferred to avoid serious neurological deficits (10). In our second case, only a small part of the aneurysm neck was visible, and rest of the fundus was embedded in the diencephalon. Several pedincular perforators were identified behind the aneurysm neck. After we applied the first clip on the atheromatous neck, the aneurysm was still pulsating. Because the clip had failed to close it completely it would not be safe to remove the first one or to put another clip distal to the former on the aneurysm neck, otherwise the aneurysm might have ruptured due to an inadvertent retraction exerted on the stuck dome. Therefore, we decided to perform proximal ligation with another clip placed just distal to the PCA-PCoA junction in order to preserve the pedincular perforating arteries. As soon as we clipped the P2 segment, the aneurysm became non-pulsatile. The absence of any bleeding after opening the sac suggested that the clip arms had overcome the resistance through the neck due to the decrease in the inraluminal pressure of PCA. Fortunately, the patient was discharged without any neurological deficit.

In rare cases with unclippable aneurysms, aneurysm excision and end-to-end anastomosis of the parent artery can be attempted. But either end-to-end anastomosis and revascularization technics are not easy procedures and require a fair amount of temporal lobe retraction as well as a prolonged occlusion time. Since excellent and good results are reported in as many as 85 % of cases whose PCA aneurysm had been treated by proximal ligation or trapping, some degree of visual field defects can be acceptable when complex giant aneurysms are to be managed by one of these procedures.

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