RESEARCH ARTICLE / ARAŞTIRMA MAKALESİ

DOI: 10.4274/atfm.galenos.2020.75046
Journal of Ankara University Faculty of Medicine 2020;73(2):167-171

SURGICAL SCIENCES / CERRAHİ TIP BİLİMLERİ

Surgical Treatment and Outcomes for Basilar Apex Aneurysms

Baziler Tepe Anevrizmalarının Cerrahi Tedavisi ve Sonuçları

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Abstract

Objectives: Basilar apex aneurysms constitute 5-10% of all intracranial aneurysms. Endovascular and surgical methods are used to treat these aneurysms. Surgical treatment is the gold standard for complete occlusion. Different surgical approaches may be applied depending on the morphological structure of the aneurysm.

Materials and Methods: Thirty-eight basilar apex aneurysms were detected in our institution between October 2017 and January 2020. Sixteen of these patients underwent surgical treatment. The demographic characteristics, angiographic properties, surgical method applied, Glasgow coma scores and Modified Rankin scores (mRS) of the patients were recorded.

Results: Five of the patients were male, 11 were female and the average age was 48.3 years (age range: 20-74 years). While insidental was detected in four of the patients, 12 of them applied with subarachnoid hemorrhage (SAH). As a surgical operation, to nine of them Pterional, to two of them Pretemporal and five of them fronto orbitozygomatic (FROZ) approach were applied. The aneurysm was clipped in all of the patients. In one patient, because the dome of the aneurysm could not be completely closed, wrapping was done. Follow-up angiograms showed that complete occlusion was maintained in all of the aneurysms except the one with wrapping. Two of the patients died. In the follow-up for 2-16 months for the remaining 14 patients, the mRS was 0 in five of the patients, one in six of the patients, two in one of the patients and three in two of the patients.

Conclusion: Basilar apex aneurysms are rare. Various complications may be encountered during endovascular and surgical treatment. Surgical treatment is the superior option to ensure occlusion. Different surgical approaches may be chosen depending on the location and morphological structure of the aneurysm

Key Words: Basilar Apex Aneurysm, Complex Aneurysms, Surgical Treatment

Öz

Amaç: Baziler tepe anevrizmaları tüm intrakranial anevrizmaların %5-10'unu oluşturur. Tedavisinde endovasküler ve cerrahi yöntemler kullanılmaktadır. Cerrahi tedavi tam oklüzyon için hala altın standarttır. Anevrizmanın morfolojik yapısına göre farklı cerrahi yaklaşımlar uygulanabilir.

Gereç ve Yöntem: Kliniğimizde Ekim 2017- Ocak 2020 tarihleri arasında toplam 38 baziler tepe anevrizması saptandı. Bunlardan 16 hastaya cerrahi tedavi uygulandı. Hastaların demografik özellikleri, anjiyografik özellikleri, uygulanan cerrahi yöntem, Glaskow koma skorları, modifiye Rankin skorları (mRS) kayıt edildi.

Bulgular: Hastaların beşi erkek, 11'i kadındı, ortalama yaş 48,3 (20-74) idi. Hastaların dört tanesi insidental saptanırken 12 tanesi subaraknoid kanama ile başvurdu. Cerrahi işlem olarak dokuzuna Pterional, ikisine Pretemporal, beşine fronto orbitozygomatik yaklaşım uygulandı. Tüm hastalarda anevrizma klipe edildi. Bir hastada baziler arter anevrizma domu tam kapatılamadığı için Wrapping uygulandı. Yapılan kontrol anjiyogramlarında bu anevrizma dışındaki tüm anevrizmalarda tam oklüzyon sağlandığı görüldü. Hastalardan iki tanesi exitus oldu. Kalan 14 hastanın 2-16 aylık takiplerinde beş hastada mRS 0, altı hastada mRS 1, bir hastada mRS 2, iki hastada mRS üç olarak saptandı.

Sonuç: Baziler tepe anevrizmaları nadir görülür. Endovasküler veya cerrahi tedavisinde farklı komplikasyonlarla karşılaşılabilir. Oklüzyon sağlanması açısından cerrahi tedavi üstündür. Anevrizmanın yerleşim yerine ve morfolojik yapısına göre farklı cerrahi yaklaşımlar seçilebilir.

Anahtar Kelimeler: Baziler Tepe Anevrizması, Kompleks Anevrizmalar, Cerrahi Tedavi

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Received/Geliş Tarihi: 28.04.2020 **Accepted/Kabul Tarihi:** 21.05.2020

Introduction

Basilar apex aneurysms are rare. They are difficult to access due to their location and have a tendency to bleed (1,2). These aneurysms are located in a deep area that can only be reached through a narrow corridor that contains cranial nerves that are vitally important. Also, deep feeders arising from this area feed the brainstem (3). All of these features complicate surgery involving a basilar apex aneurysm. Although it is easy to reach these areas with endovascular treatments, this method has an occlusion rate of about 68% in aneurysms with wide necks and a high rate of a second bleeding, which poses additional risks for the patient (4). Large aneurysms, aneurysms with wide necks and aneurysms with posterior projection and anatomical variations (fenestration, high or low location of the dome of aneurysm) further complicate an already difficult surgery (5). In addition, if the patient has multiple aneurysms, a very intricate situation occurs. These factors have led to an increase in the use of different methods to facilitate basilar apex aneurysm surgery to ensure complete occlusion. In this article, we share our experiences related to 16 basilar apex aneurysms that were treated in our institution for which different surgical approaches were used.

Materials and Methods

Of the 38 basilar apex aneurysms detected between October 2017 and January 2020. Twenty-two of these patients were treated endovascularly. Endovascular treatment was performed in patients with elderly, comorbid diseases and those who thought that proximal control would be difficult. Sixteen patients that underwent surgery were included in this study. The demographic data of those that were included in the study were recorded. Patients who had ruptured aneurysms had head computed tomography (CT) scans, and GCS and Fischer scores were recorded. All of the patients underwent digital subtraction angiography (DSA) and the localisations and size of their aneurysms, the presence of multiple aneurysms and the anatomical variations were revealed (Figure 1,2). CT angiography was also done on the patients to determine the location of the dome in relation to the sella (Figure 3). The aneurysms with wide necks or with posterior projection, large aneurysms and those with anatomical variations (fenestration, high and low location of the dome in relation to the sella) were categorised as complex aneurysms. The surgical approach to be employed for the patient was determined according to these findings. Follow-up DSAs were done on the 1st-3rd days after the operation to check the occlusions of the aneurysms (Figure 4). The modified Rankin scores of the patients after their follow-up for 2-16 months were recorded.

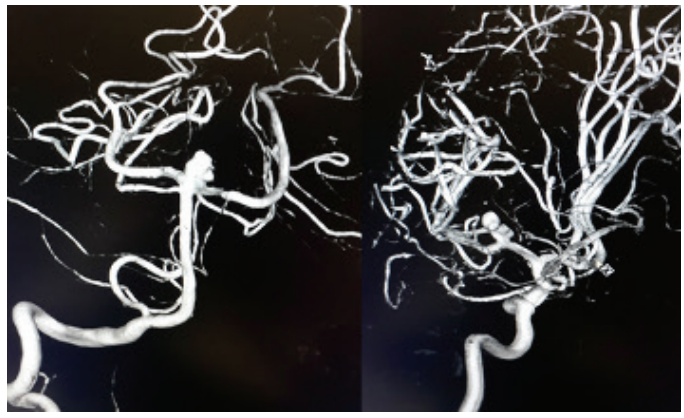

Figure 1: MCA aneurysm observed with basilar apex aneurysm

MCA: Middle cerebral artery

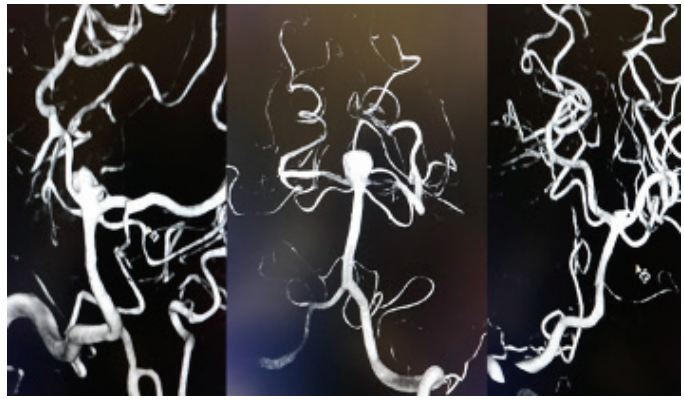

Figure 2: Complex aneurysm findings observed in basilar apex aneurysms (fenestration, wide neck, posterior projection)

Figure 3: CT angiography image showing the location of the aneurysm in relation to the sella

CT: Computed tomography

Results

Five of the patients were male, 11 were female and the average age was 48.3 (age range, 20-74 years). While 12 of the patients presented with subarachnoid haemorrhage (SAH), four of the patients were detected incidentally. The GCS was detected

to be 14 for four of the patients who presented with SAH, 13 for four of the patients, 12,11,9 and 8 for one patient each. Seven patients were described as having a complex aneurysm. The FROZ approach was employed for five of these patients (Figure 5), the PT approach for two of the patients and the pterional approach was used for the rest. Multiple aneurysms were detected in six patients and the accompanying aneurysms were of the anterior communicating artery (Acom A), the middle cerebral artery, the posterior communicating artery (Pcom) and the internal carotid artery. All of the aneurysms were clipped. However, the aneurysm could not be completely closed in a

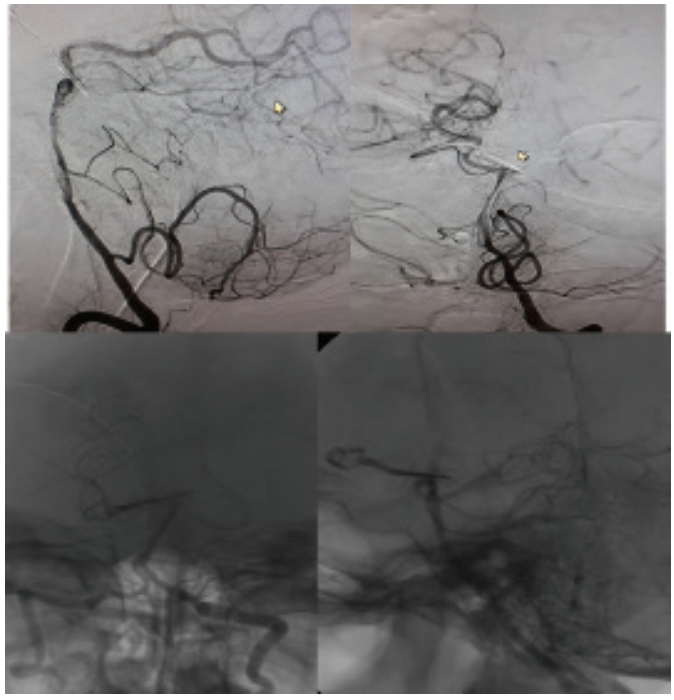

Figure 4: Follow-up DSA images of the patients after the operation
DSA: Digital subtraction angiography

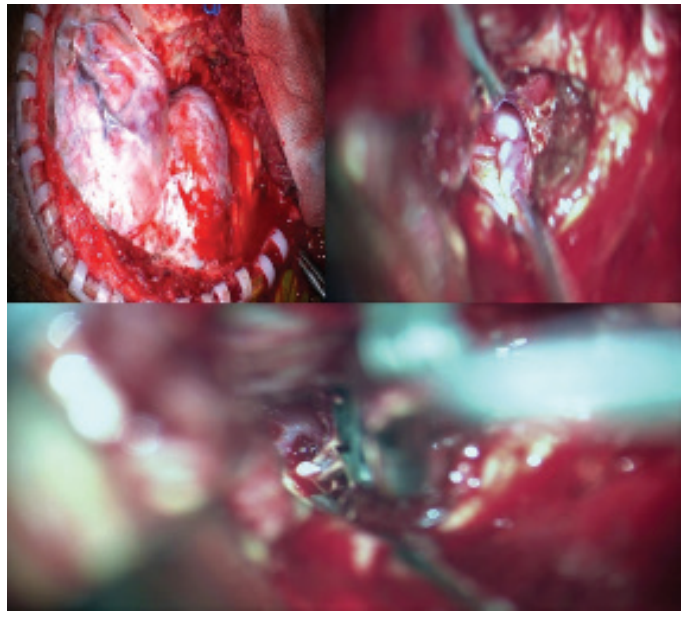

Figure 5: The image right before the dura was opened during the operation, the images before the aneurysm was clipped and at the moment of clipping

Table 1: Demographic and radiological findings of the patients and their discharge score

	Age	Gender	SAH	Evidence of complex aneurysm	Concomitant aneurysm	GCS	Approach	Complication	mRS
1	74	F	+	-	ICA, MCA	14	Pterional	-	1
2	50	F	+	-	-	13	Pterional	-	1
3	48	F	+	Wide neck	AcomA, ICA	9	FROZ	Ischemia (Thalamus)	6 (ext)
4	44	F	+	Posterior projection	Pcom	14	FROZ	-	1
5	20	F	+	-	Pcom	14	Pterional	3. CN affected	0
6	50	M	-	Posterior projection	-	15	FROZ	-	0
7	55	M	-	Subsellar	-	15	PT	-	1
8	54	F	+	-	-	12	Pterional	Vasospasm	3
9	42	F	-	-	MCA	15	Pterional	-	1
10	55	F	+	Giant aneursym	-	8	FROZ	Per op Haem, HC	6 (ext)
11	62	M	+	-	-	13	Pterional	HC	3
12	37	M	+	Fenestration	-	14	FROZ	-	0
13	61	F	+	-	ICA, AcomA	13	Pterional	-	0
14	40	F	+	Subsellar	-	13	PT	3. CN affected	2
15	33	M	-	-	-	15	Pterional		0
16	48	F	+		-	11	Pterional		1

AcomA: Anterior communican artery, ICA: Internal carotid artery, Pcom: Posterior communican artery, MCA: Middle cerebral artery, F: Female, M: Male, SAH: Subarachnoid haemorrhage, Post: Posterior, Inf: Inferior, Aneu: Aneursym, GCS: Glaskow Coma scale, PT: Pretemporal, FROZ: Frontoorbitozygomatic, Ext: Exitus, Haem: Haemorrhage, HC: Hydrocephalus, CN: Cranial nerve, mRS: Modifiye Rankin score

wide-necked aneurysm and wrapping was done. Complications developed in six of the patients (hydrocephaly, vasospasm, deep feeder ischaemia, oculomotor nerve involvement, per-op haemorrhage). The patients underwent a follow-up DSA on the 1st-3rd post-operative days. Complete occlusion was observed in all of the aneurysms except the aneurysm that underwent wrapping. Two of the patients died, and in the 2-16 months follow-up of the other 14 patients, the mRS was detected as 0 in five patients, 1 in six patients, 2 in one patient, and 3 in two patients (Table 1).

Discussion

The surgical treatment of basilar apex aneurysms began with the description of the microsurgical approaches that could be applied in this area by Drake (6) and Yasargil et al. (7). In this situation, the surgical field is very narrow and proximal control is difficult. The rate of complications is higher when compared with anterior circulation aneurysms. It is difficult to observe and spare the perforating arteries during the clipping of the aneurysm. Because of these complications and with the development of other options for treatment, endovascular treatments have become preferable for aneurysms in this region. Recanalisation rates have been found to be low for narrow-necked aneurysms with small diameters (8). However, occlusion rates have been observed to decrease to as low as 57% in wide-necked and partially thrombosed aneurysms with large diameters (9). Complete occlusion of aneurysms in this region is very important because the re-bleeding rates are high. Therefore, the interest in surgical approaches has increased over time.

Progress in imaging techniques has clearly revealed the relationship of aneurysms with the sella and the clivus, and different microsurgical techniques have been proposed according to the location of the aneurysm. Several techniques that have been recommended include the pterional approach for basilar apex aneurysms with high and normal locations, the pretemporal, trans-cavernous approach for those with a retrosellar location and the middle fossa approach and petrosectomy for those with a sub-sellar location (10-12).

Nanda et al. (5) described other posterior circulation aneurysms, brain oedema and highly located and large aneurysms as complex aneurysms. Different surgical approaches were recommended for these aneurysms. Of the 33 patients in their study, the transcavernous approach was used for four patients, the sub-temporal approach for six patients, the pterional approach for eight patients, the "half and half" approach for eight patients and the FTOZ approach was used for seven patients, and they reported that good outcomes were achieved in 71.9 % of the patients. In their study, Higa et al. (13) detected multiple aneurysms in 32% of the cases. In our study, we detected multiple aneurysms in six of the 16 patients (37%), and all of the additional aneurysms were located in the anterior circulation. We believe that the surgical procedures for these aneurysms also contributed to the morbidity and mortality of the patients. Therefore, we think that the aneurysms that were located in the anterior location accompanying the basilar apex aneurysm should have been included in Nanda et al. (5) description of complex aneurysms.

Lozier et al. (14) studied 98 patients and stated that non-giant basilar apex aneurysms could be operated on with a 90% expectation of a good outcome, and that if the aneurysm was un-ruptured as well as non-giant, the success rate increased to 97%. The mortality rate in this study was 6.1%. Also, in this study, it was emphasised that the long-term reason for mortality and morbidity was perforation of an artery.

Hernesniemi et al. (15) stated that the sub-temporal approach was a simple and efficient method for treating basilar apex aneurysms regardless of the size, location, and projection of the aneurysm and that posterior clinoidectomy and petrosectomy were not needed.

Sanai et al. (16) reported 97% complete occlusion, 57% good discharge scores and 10.5% mortality in their study of 96 patients with basilar apex aneurysms on whom they performed operations using mostly the pterional and orbitozygomatic approaches. Krisht et al. (17) performed surgery on 50 complex basilar apex aneurysms using the transzygomatic and pretemporal transcavernous approaches. They reported 98% complete occlusion, 88% good outcomes and 2% mortality of the patients.

Endovascular treatment is another alternative for the treatment of basilar peak aneurysms. In their study, Abecassis et al. (18) emphasized that recurrence rate is higher in endovascular treatment compared to surgery, but costs are lower and patient outcome scores are better.

In our study, we performed surgery on 16 patients, and four of the patients had been detected incidentally. Two of the patients died (12%). Seven of our patients had findings in accordance with the description of a complex aneurysm. The patients who fulfilled the definition of a complex aneurysm underwent an operation using the FROZ or pretemporal approach according to the location of the aneurysm, and the others experienced the pterional approach. When necessary, the anterior and posterior clinoid processes were drilled to provide an area to see and clip the aneurysm. In accordance with the studies in the literature, the discharge scores of the patients with un-ruptured aneurysms who did not have the characteristics of a complex aneurysm were better. Again, in accordance with the literature, the factor that increased the mortality and morbidity

the most was damage from perforating an artery. The complete occlusion rate was 93%, and 68% of the patients had good discharge scores (mRS 0,1). We attribute the high rate of death and the low rate of good discharge scores to the small number of patients and the high number of multiple aneurysms.

Conclusion

The hemodynamics and the progression of posterior circulation aneurysms are different than with anterior circulation aneurysms. The fact that the aneurysm is located in a narrow corridor with the presence of perforating arteries of vital importance affects the mortality and morbidity of the patients. A good evaluation of the basilar apex aneurysm in the pre-operative period is very important to select the appropriate surgical technique. When aneurysms that are not complex are operated on with the appropriate methods, favourable results are achieved. Although recently endovascular methods have been the preferred treatment for basilar apex aneurysms, the inability to ensure complete aneurysm occlusion and the risk of thromboembolism sometimes prevents the use of this method. The correct approach is to make a patient-based evaluation and to choose the most appropriate treatment method.

Ethics

Ethics Committee Approval: Adana City Training and Research Hospital Ethics Committee (date: 03. 04. 2020, no: 902).

Informed Consent: Informed consent was obtained.

Peer-review: Externally peer-reviewed.

Financial Disclosure: The author declared that this study received no financial support.

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