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Original Investigation

The Variations of the Anterior Choroidal Artery: an Intraoperative Study

Anterior Koroidal Arter Varyasyonları: İntraoperatif Çalışma

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ABSTRACT

AIM: Increasing use of surgical magnification for operations in the territory of the anterior choroidal artery (AChA) has created a need for detailed knowledge of their anatomical variations. The aim of the present study is to examine the anatomical variations of the AChA in patients operated via pterional approach.

MATERIAL and METHODS: The origin and branching pattern of AChAs were observed intraoperatively in 130 patients who were operated via a pterional approach at our center.

RESULTS: AChAs arose from the internal carotid artery (ICA) and distal to the posterior communicating artery (PCoA) at a ratio of 70%, from just distal to the original point of the PCoA in 20%, and from just proximal to the ICA bifurcation in 10% of the patients. In 95 cases, AChAs arose from the inferolateral aspect of the ICA in the posterolateral aspect in 27 and from its lateral part in 8 cases. AChAs were found as a single branch at the origins from ICA in 110 patients, as double in 17 cases and as triple in 3 patients.

CONCLUSION: Recognition of anatomical variations and microvascular relationships of AChA will allow neurosurgeons to construct a better and safer microdissection plan, to save time and can prevent postoperative neurological deficits.

KEYWORDS: Anatomy, Anterior chorodial artery, Microsurgery, Pterional approach, Variation

ÖZ

AMAÇ: Anterior koroidal arter (AKA)'in bulunduğu bölgede yapılan mikroşirürjikal ameliyat sayısının her geçen gün artması, bu damarın anatomik varyasyonların detaylı olarak bilinmesi ihtiyacını gerektirmiştir. Bu çalışmanın amacı, pterional yaklaşımla ameliyat edilen hastalarda AKA'in anatomik varyasyonlarının incelenmesidir.

YÖNTEM ve GEREÇ: Kliniğimizde pterional yaklaşımla ameliyat edilen 130 hastada intraoperatif olarak AKA'in kökeni ve dallanma modeli gözlemlendi.

BULGULAR: Hastaların %70'inde AKA'in posterior komünikan arter (PKA)'in distalinden, %20'sinde PKA'in çıkış yerinin hemen distalinden, %10'unda ise internal karotid arter (İKA)'in bifurkasyon noktasının hemen proksimalinden çıktığını gözlemledik. AKA, 95 hastada İKA'in inferolateralinden, 27 hastada posterolateralinden, 8 hastada ise lateralinden çıkıyordu. AKA'in 110 hastada tek dal, 17 hastada iki dal, 3 hastada ise üç dal halinde çıktığı görüldü.

SONUÇ: Anterior koroidal arterin anatomik varyasyonlarının ve mikrovasküler ilişkilerinin bilinmesi nöroşirürjiyene iyi ve güvenli bir mikrodiseksiyon planı kurgusu imkanı, zaman tasarrufu ve postoperatif nörolojik defisitleri önleyebilme imkanı sağlar.

ANAHTAR SÖZCÜKLER: Anatomi, Anterior koroidal arter, Mikroşirürji, Pterional yaklaşım, Varyasyon

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INTRODUCTION

The anterior choroidal artery (AChA) is an important artery in neurosurgical operations. The first description of AChA as a choroidal artery of the lateral ventricle by Vicd D'Azur in 1789 was reported by several authors (6,8,13,16). The territories of these arteries and the areas supplied by them were reported by Heubner, Duret, Kolisko and Beever (6,9,10,13,16). In fact, AChA not only supplies ventricles, but also gives branches to the diencephalon, mesencephalon and cerebrum. It also supplies the vision and motor pathways (9,11).

The available information about the variations and anatomy of AChA is incomplete. These results were based on data derived either from formalin-fixed and polyester resin-injected specimens or from the use of perfusion techniques (1,4,8-10,13). Unfortunately, the fine anatomic view obtained from these researches cannot be obtained in the operating theater. During surgery, the surgical field is dependent on the operative approach selected and the amount of brain retraction utilized for exposure.

The AChA and perforating branches are in the surgical area of sphenoid ridge tumors, pituitary adenomas, sellar and parasellar tumors, and anterior circulating and basilar tip aneurysms (7,14-16). Better understanding of the microvascular anatomy and variations of the AChA may be helpful for operations of these areas.

The present study was undertaken to analyse the intraoperative anatomical findings of AChA in a series of patient operated via a pterional approach.

METHODS and MATERIALS

A total of 130 patients were operated via a pterional approach at our center during the period between 2002 and 2008. Informed consent was obtained from the patients.

Of the 130 patients, 62 were female and 68 were male with an age range of 15 to 70 years. 107 patients were operated via a right pterional approach and 23 via a left pterional approach. 84 patients were operated for anterior circulating aneurysms and 46 for tumors of the sellar region.

A right or left pterional craniotomy was used in all cases. Following the craniotomy, sylvian microdissection techniques described by Yasargil were employed in all cases. Dural opening was followed by opening the proximal sylvian fissure and the laterobasal frontal lobe was gently retracted medially to expose the optic nerve and internal carotid artery (ICA). The carotid cisterns were opened to release cerebrospinal fluid and to achieve an optimal relaxed brain condition. Microdissection was continued distally to the ICA bifurcation. The thickened arachnoid bands were divided and the lamina terminalis cistern was opened, if it wasn't occluded by tumors or an aneurysm, to allow the frontal lobe to be retracted. Dissection was then completed according to the lesion.

The origin and branching pattern of the AChA were examined on the basis of the operative findings. We recorded the variations of AChA not only during the operations but also using the slides taken from the operation microscope, operative records and videotapes.

RESULTS

All AChAs arising from the ICA were observed. The AChAs arose from the ICA and distal to the posterior communicating artery (PCoA) in 70% (n=91), from just distal to the original point of the PCoA in 20% (n=26), and from just proximal to the ICA bifurcation in 10% (n=13) of the patients (Figure 1). AChA arose from inferolateral aspect of the ICA (Figure 2) in 95 (73%), the posterolateral aspect in 27 (20.7%) and from its lateral

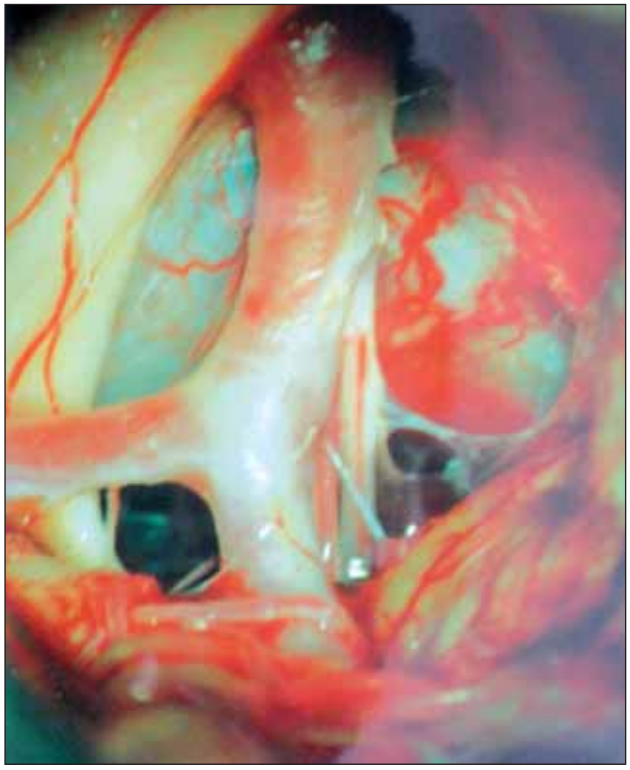

Figure 1: *Intraoperative view showing the AChA originating from just proximal to the ICA bifurcation.*

part in 8 (6.3%) cases. AChAs were found as a single branch in 110 (84.6 %), as double in 17 (13%) and as triple in 3 (2.4%) patients (Figure 3) at the origins from the ICA in the 130 cases.

DISCUSSION

The AChA is the most important branch of the supraclinoid segment of the ICA. The AChA supplies the optic tract, uncus, lateral part of geniculate body, posterior two-thirds of the posterior limbs of internal capsule, optic radiation and choroid plexus on the lateral ventricle (9,11,16). At the same time it gives branches to the diencephalon, mesencephalon and cerebrum. The importance of this artery increases during surgery as it supplies all these structures. The classical features of AChA occlusion such as contralateral hemiplegia, hemianesthesia and hemianopsia have been reported by Foix in 1925 (9-12). Transient loss of consciousness as well as extrapyramidal findings may also occur following ischemic lesions of the pallidal area (6, 9).

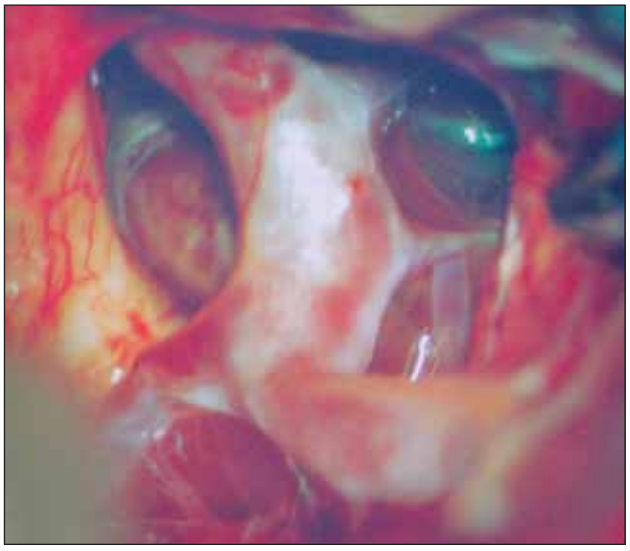

Figure 2: *Intraoperative view showing the AChA arising from the inferolateral aspect of the ICA.*

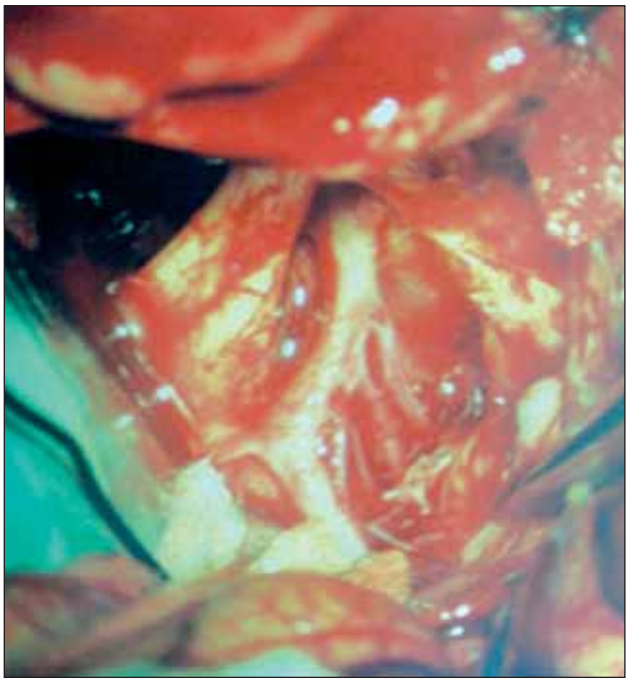

Figure 3: *Intraoperative view showing the triple AChAs.*

Although the distribution of the AChA has been well characterized (1,10,17), there continues to be some uncertainty about the origin and branching pattern of the artery. It was reported that it arose from the ICA by Erdem and Yasargil (3). Hussein also reported the same results in his study (6). Herman in 1966 and Glimber in 1986 reported that it might arise from the middle cerebral artery in their studies (10,15). Rhoton et al. reported that only one AChA arose from the PCoA in their study on 25 cadavers in 1979 (9). Yasargil reported that all arose from the ICA except for one from the PCoA (18). A study with 70 cadavers by Hussein et al. in 1987 and another study by Morandi et al. reported that the AChA arose from the ICA at a rate of 97.5 and 96, respectively (6,8). All AChAs arose from the ICA in our study.

Rhoton et al. reported in 1979 that the AChA arose from the inferolateral part of the ICA, 2-5 mm distal part of PCoA and 2-8 mm proximal part of the bifurcation (9). In a study with 25 cadavers, Gibo et al. reported in 1981 that the AChA arose from the ICA at a rate of 100%, with 66% from the posterolateral aspect, 28% the posteromedial aspect and 6% the lateral aspect (5). Uz et al. reported in a study with 15 cadavers that the AChA arose from the posteroinferior, posterolateral and anterior part of the ICA at a rate of 60%, 27% and 13% respectively and on average 5.3 mm distal to the PCoA and 4 mm proximal to the bifurcation (13). Aydin et al. reported in 230 operated patients that the AChA arose distal to the PCoA, just distal to the origin of the PCoA and proximal to the bifurcation of the ICA at a rate of 70%, 20% and 10% respectively (2). In our study, we observed that the AChA arose from the inferolateral, posterolateral and lateral aspect of ICA at a rate of 73%, 20.7% and 16.3% respectively. We observed that the AChA arose distal to PCoA in 70%, just distal to origin of PCoA in 20% and just proximal to the ICA bifurcations in 10%. Hussein et al. (6) reported that the AChA arose from the inferolateral wall of ICA and 3.2 mm (1.1-5.9 mm) distal to the PCoA and 5.2 mm (2.2-7.0 mm) proximal to the carotid bifurcation. In a study with

50 cadavers, Ferreira et al. reported that the AChA arose from the ICA at a rate of 98% at a location 2.4 mm distal to the PCoA and 4.7 mm proximal to the carotid bifurcation (4).

The diameter of the AChA is very small compared to the length and the areas it supplies The diameter of the AChA has been reported as 0.5-2.3 mm by Saeki et al. (12), 0.5-1.5 mm by Rhoton et al. (9), 0.5-2.1 mm by Gibo et al. (5) and 0.4-3.4 mm by Hussein et al. (6). The small diameter makes it difficult for arterial catheterization for arteriovenous malformation (6).

AChA may found as single, double or triple. Saeki et al. reported AChA as single branch at a rate of 96% (12). In a study with 50 cadavers, Rhoton et al. reported in 1979 that all AChAs were found as a single branch (9). In a study by Yasargil, it was found as a single branch at a rate of 70% while 2-4 independent choroidal vessels were encountered in 30% of his cases (18). In an intraoperative study by Aydin et al. found AChAs as a single branch at a rate of 84%, as double in 28% and as triple in 4% the patients, at the origin from the ICA (2). Hussein et al.reported that AChAs were found as single branch at a rate of 89% (6). In our study, we observed as single branch in 110 cases (84.6%), double in 17 cases (13%) and triple in 3 cases (2.4%), at the origin from the ICA. Our results are similar to Yasargil's and Aydin's results as our study is an intraoperative study.

Several classifications have been used for the AChA. Rhoton et al. divided it into two segments; the cisternal segment, extending from its origin to the choroidal fissure, and the plexal segment extending from the choroidal fissure to the area where it enters into the choroidal plexus on the temporal horn (9). Hussein (6) divides AChA into the three segments according to the surgical areas of interest; the carotid cistern, the crural cistern and the ventricular space. AChA gives 4-18 branches with an average of 9.

Caroticochoroidal aneurysms form 4-5% of intracranial aneurysms. The aneurysms of this artery are generally located near its origin and related to the medial part of the temporal lobe and it is often located at the uncus. Consequently, this part of the temporal lobe may be removed to see the AChA, its branches and aneurysms (6).

We concluded from this intraoperative study that the recognition of the anatomical variations of the AChA and detailed knowledge of the microvascular relationship of the ICA and PCoA will allow neurosurgeons to construct a better and safer microdissection plan, to save time and can prevent postoperative neurological deficits.

REFERENCES

1. Abbie AA: The blood supply of the lateral geniculate body, with a note on the morphology of the choroidal arteries. J Anat 67: 491-521, 1933
2. Aydin IH, Kadioglu HH, Takci E, Kayaoglu CR, Tuzun Y, Arik M: The variations of anterior choroidal artery in anterior circulation aneurysms. Poster presentation. CNS Meeting, San Diego, California, USA, 2001
3. Erdem A, Yaşargil G, Roth P: Microsurgical anatomy of the hippocampal arteries. J Neurosurg 79:256-265, 1993
4. Ferreira A, Braga FM: Microsurgical anatomy of the anterior choroidal artery. Arq Neuropsiquiatr 48:448-453, 1990
5. Gibo H, Lenkey C, Rhoton AL Jr: Microsurgical anatomy of the supraclinoid portion of the internal carotid artery. J Neurosurg 55:560-574, 1981
6. Hussein S, Renella RR, Dietz H: Microsurgical anatomy of the anterior choroidal artery. Acta Neurochir 92:19-28, 1988
7. Malis LI: Surgical resection of tumors of skull base. In: Wilkins, ed. Neurosurgery, vol:1. New York: McGraw-Hill Company, 1985:1011-1021
8. Morandi X, Brassier G, Dernault P, Mercier P, Scarabin JM, Duval JM: Microsurgical anatomy of the anterior choroidal artery. Surg Radiol Anat 18:275-280, 1996
9. Rhoton AL Jr, Fujii K, Fradd B: Microsurgical anatomy of the anterior choroidal artery. Surg Neurol 12:171-187, 1979
10. Rhoton AL Jr: The supratentorial arteries. Neurosurgery 51 (4 Suppl): 53-120, 2002
11. Rosner SS, Rhoton AL Jr, Ono M, Barry M: Microsurgical anatomy of the anterior perforating arteries. J Neurosurg 61:468-485, 1984
12. Saeki N, Rhoton AL Jr: Microsurgical anatomy of the upper basilar artery and the posterior circle of Willis. J Neurosurg 46:563-578, 1977
13. Uz A, Erbil KM, Esmer AF: The origin and relations of the anterior choroidal artery: An anatomical study. Folia Morphol 64:269-272, 2005
14. Wilkins RH, Odom GL: General operative technique. In: Youmans JR, ed. Neurological Surgery, vol: 2, Philedelphia, WB Saunders, 1982:1136-1159
15. Yasargil MG, Fox JL, Ray MW: The operative approach to aneurysms of the anterior communicating artery. Microneurosurgery, vol: 2. New York: Springer-Verlag, 1975:113-170
16. Yasargil MG, Antic J, Laciga R, Jain KK, Hodosh RM, Smith RD: Microsurgical pterional approach to aneurysms of the basilar bifurcation. Surg Neurol 6:83-91, 1976
17. Yasargil MG, Yonas H, Gasser JC: Anterior choroidal artery aneurysms: Their anatomy and surgical significance. Surg Neurol 9:129-138, 1978
18. Yasargil MG: Operative anatomy. In Yaşargil MG (ed). Microneurosurgery, vol: I. Stuttgart: Thieme-Verlag, 1984:5-168