Neurosurg Rev (2006) 29: 213–218
DOI 10.1007/s10143-006-0028-6

ORIGINAL ARTICLE

Senem Erdogmus · Figen Govsa

Anatomic features of the intracranial and intracanalicular portions of ophthalmic artery: for the surgical procedures

Received: 5 August 2005 / Revised: 30 December 2005 / Accepted: 7 March 2006 / Published online: 31 May 2006

Abstract The intracranial and intracanalicular portions of the ophthalmic artery is suspectible to various diseases and injuries; therefore, knowledge of the microanatomy of the complex bony, dural, vascular, and neural relationships of this segment is necessary for proper diagnosis and preservation of the neurovascular structures during subfrontal, pterional and intracanalicular procedures. The artery was studied in 38 human adult cadaver specimens regarding origin, intracranial and intracanalicular portions for surgical approachs. The ophthalmic artery originated from the intradural portion of the internal carotid artery, except in 5% where the ophthalmic artery originated extradurally. The ophthalmic artery originated from medial of superior wall of internal carotid artery in 73.7%, from the central in 21% and the lateral in 5.3% of the specimens. The diameter of the ophthalmic artery at its origin was 2.25±0.3 mm on the right and 2.16±0.4 mm on the left. The intracranial and intracanalicular course of the artery was divided into short limb, angle "a", long limb, angle "b" and distal part to the apex of the orbit. Awareness of variations in anatomic structures is paramount importance both for diagnosis and treatment of vascular lesions of the brain.

Keywords Ophthalmic artery · Origin · Intracranial portion · Intracanalicular portion

Introduction

The ophthalmic artery is the major branch of the supraclinoid internal carotid artery [1, 4, 10, 12, 14, 19, 23, 26, 30, 34]. Although rare, middle meningeal artery, anterior cerebral artery, basilar artery have been shown as variants of origin for the ophthalmic artery [13, 15, 24, 32, 36, 38, 40]. It passes forward along the floor of the optic canal, where it becomes incorporated into the optic sheat before penetrating and exitsing the sheath to enter the orbital apex. The ophthalmic artery may also arise extradurally from the clinoid segment or the intracavernous portion of the internal carotid artery and pass through the superior orbital fissure instead of the optic foramen [11, 13, 16, 40].

Various surgical techniques and microanatomic studies have improved the operative results of direct surgical treatment for aneurysms in the ophthalmic artery and ophthalmic segment of the internal carotid artery, which are known to be associated with blindness and high morbidity [2, 3, 6, 8, 17]. However, the surgical technique for carotid-ophthalmic aneurysms is still difficult due to peculiarities of their anatomy and their complicated anatomical relations to the surrounding structures [21, 29, 31].

To minimize the risks of a direct surgical treatment, it is essential to know precise anatomy around the origin of the ophthalmic artery. Knowledge of variations and possible patterns of origin of the ophthalmic artery are necessary for the diagnosis and important for the treatment of orbital disorders and aneurysms.

Materials and methods

For this study, dissection was performed on 19 adult male cadavers (bilaterally a total of 38 orbitas) with no macroscopic pathologies on the head or orbital regions, fixed with 10% formalin in the Anatomy Department, Faculty of Medicine, Ege University. In the cadavers where the skulls were opened and the brains were removed, in order to define better and investigate in detail the ophthalmic artery and its branches, liquid latex neoprene 601 A mixture coloured with powder eosin paint was injected through the internal carotid artery before the dissection.

A frontotemporal craniotomy and orbito-optic osteotomy was carried out by the superior approach following the collapse of the root of the orbit. The orbital part of the frontal bone was removed by careful dissection, thus enabling the visualisation of orbital structures. By means of a high-speed drill, the bony walls of the optic canal were

S. Erdogmus · F. Govsa (✉)
Department of Anatomy, Faculty of Medicine, Ege University, 35100 Izmir, Turkey
e-mail: fgovsa@yahoo.com
Tel.: +90-232-3903366
Fax: +90-232-3393546

removed. After the removal of the bony walls and the connective fatty tissue of the orbit, the origin and course of the ophthalmic artery were as well as around distal dural ring structures were studied. The intracranial and intracanalicular portions were classified as short limb, angle "a", long limb, angle "b" and distal part by Hayreh and Dass [14]. Measurements were carried out by means of a digital calliper in milimetres. To the data gathered as a result of the measurements, Student's *t*-test was applied for statistical analysis. The findings were recorded by a digital camera.

Results

Origin

The ophthalmic artery arose from the supraclinoid segment of the internal carotid artery in all specimens (Figs. 1, 2). Abnormal origins of the artery were not observed. The ophthalmic artery commonly arose just above the upper ring, from the medial half of the anterior wall of the internal carotid artery. The origin of the ophthalmic artery was usually located under the anterior clinoid process. Of the 38 specimens, the ophthalmic artery originated from the intradural portion of the internal carotid artery in 36 specimens (95%) (intradural type) and from the extradural portion in two (5%) (extradural trans-optic strut type) (Fig. 2). There was no specimen which the ophthalmic artery demonstrated extradural supraoptic strut type in the present study.

Regarding the direction of the origin of the ophthalmic artery from superior wall of the internal carotid artery in the intradural type, they were located in the medial third in 73.7% of cases, the central third in 21% cases and the lateral third in 5.3% of cases on the right. The ophthalmic artery arose from the medial third in 78.9%, central third in 15.8% and lateral third in 5.3% of the cases on the left (Fig. 1). Bilaterally, 63.2% of the cases were observed medial third to be symmetrical. The diameters of origin of the ophthalmic artery were showed in Table 1. Relationship of origin of the ophthalmic artery with the optic nerve was given Table 2. There were no significant differences between the vessel diameters of the right and left sides in any subject ($P>0.05$).

Regarding the course of the ophthalmic artery, it originated from internal carotid artery and first ran medially and then turned laterally on the upper surface of the optic strut and below the intracranial optic nerve (Figs. 1, 2). It ran freely above the optic strut inside the posterior part of the optic canal, but anteriorly, it pierced the dura on the upper surface of the optic strut and exited the optic canal outside the optic sheath to course on the inferolateral aspect of the optic nerve and sheath at the orbital apex (Figs. 3, 4). The carotid-dural ring was continuous from the interclinoid ligament to the optic sheath, and coursed medially and obliquely over the internal carotid artery.

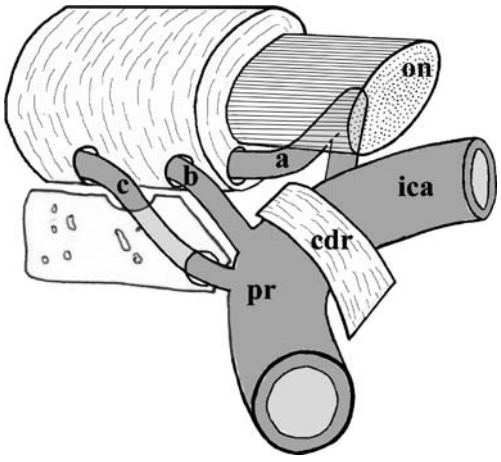

Fig. 2 Illustration of classification of the ophthalmic artery (**a** intradural type, **b** extradural supraoptic strut type, **c** extradural transoptic strut type; *on* optic nerve, *pr* proximal ring, *cdr* carotid dural ring, *ica* internal carotid artery

Fig. 1 Schematic drawing origin (**a** medial, **b** central, **c** lateral) and exit (**d** lateral, **e** medial) of superior wall of the ophthalmic artery

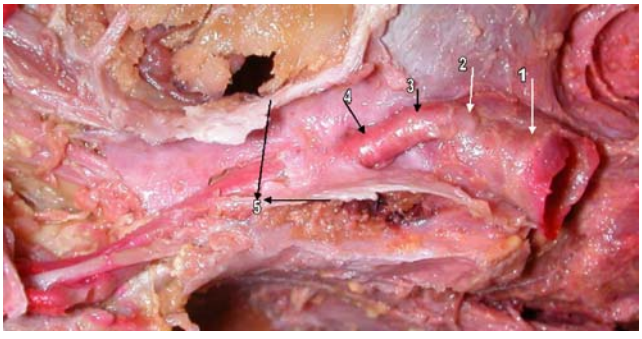

Fig. 3 Photographs of the origin, intracranial and intracanalicular portions of ophthalmic artery (*1* internal carotid artery, *2* origin, *3* intracranial portion, *4* intracanalicular portion, *5* optic canal)

Table 1 The measurements of origin, intracranial and intracanalicular portions of the ophthalmic artery

	Origin		Short limb		Long limb		Distal part	
	Right	Left	Right	Left	Right	Left	Right	Left
Length (min–max)	–	–	2.13±0.3 (1.6–2.6)	2.19±0.3 (1.5–2.9)	4.12±0.8 (1.9–5.5)	4.12±0.9 (1.9–5.2)	5.39±0.9 (3.9–6.8)	5.44±0.9 (4.1–6.8)
Diameter (min-max)	2.25±0.3 (1.7–2.8)	2.16±0.4 (1.1–2.7)	2.07±0.2 (1.7–2.6)	1.98±0.4 (1.6–2.6)	1.97±0.3 (1.6–2.8)	1.84±0.3 (1.5–2.3)	1.82±0.2 (1.4–2.2)	1.70±0.3 (1.1–2)

P>0.05

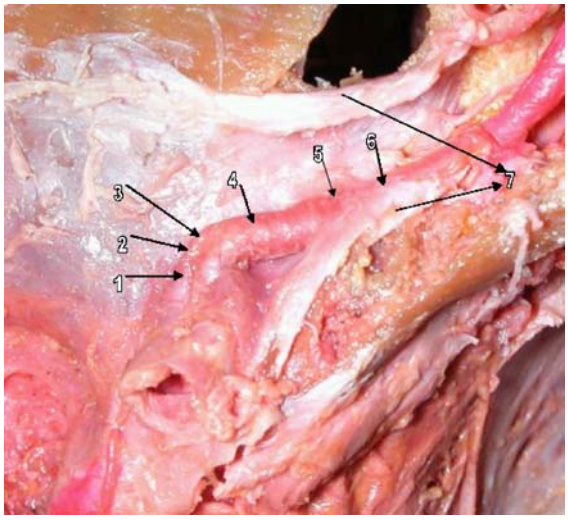

Fig. 4 Cadaveric photograph showing the ophthalmic artery originating from extradural internal carotid artery, entering the optic canal through the optic strut (trans-optic strut type). (*1* origin, *2* short limb, *3* angle "a", *4* long limb, *5* angle "b", *6* optic strut and distal part, *7* optic canal)

Relationship of intracranial portion of the ophthalmic artery with the optic nerve

The intracranial course of ophthalmic artery was studied, considering its neighbouring with the optic nerve. The ophthalmic artery was located on the inferolateral of the optic nerve in 63.2% of the cases on the right. Relationship of intracranial and intracanalicular portions of the ophthalmic artery with the optic nerve was given Table 2. Bilaterally, 52.6% of the cases were observed inferolateral of the nerve to be symmetrical. The distance of medial border to both origins of the ophthalmic arteries was measured as 13.7±3.3 mm (min-max: 5.6–20 mm).

Course

The intracranial and intracanalicular course of the artery was divided into short limb, angle "a", long limb, angle "b" and distal part to the apex of the orbit (Figs. 3, 4).

Short limb The direction of short limb of the artery was forward and medially in 78.9% of cases, forward and laterally in 15.8% of the cases, forward and laterally in 5.3% of the cases on the right. The direction of the short limb was forward and medially in 73.7% of the cases; forward and laterally in 15.8% of the cases; forward, upward and medially in 5.3% of the cases; forward, upward and laterally in 5.3% of the cases on the left. Bilaterally, 68.4% of the cases were forward and medially to be symmetrical.

The measurements of intracranial and intracanalicular portions of the ophthalmic artery were showed in Table 1. There were no significant*P*>0.05).

Angle "a" The angle "a" was defined as angle of short limb with long limb of the artery (Fig. 4). Relative positions of angle "a" tended in 78.9% of cases to shift lateral side of the optic nerve on the right. Relationship of angle "a" with the optic nerve was given Table 2. Bilaterally, 73.7% of the cases were observed lateral side of the optic nerve to be symmetrical.

Long limb The long limb was directed forward and paralel with inferior surface of the optic nerve in all specimens (Fig. 4). The short limb, angle "a" and part of long limb of the ophthalmic artery were in subdural space. The measurements of intracranial and intracanalicular portions of the ophthalmic artery were showed in Table 1. There were no significant differences between the vessel parameters of the right and left sides in any subject (*P*>0.05).

Angle "b" The part of long limb, angle "b" and distal part of the artery were determined in optic canal (Fig. 4). Angle "b"

Table 2 Relationship of origin, intracranial and intracanalicular portions of the ophthalmic artery with optic nerve

	Origin		Angle "a"		Angle "b"	
	Right	Left	Right	Left	Right	Left
Inferolateral	63.2%	78.9%	78.9%	84.2%	73.7%	78.9%
Inferocentral	15.7%	15.8%	–	–	10.5%	10.5%
Inferomedial	21.1%	5.3%	21.1%	15.8%	15.8%	10.5%

was situated at at the point where the ophthalmic artery penetrated the dural sheath of the optic nerve.

The different relationships of intracanalicular course of ophthalmic artery with optic nerve were inferolateral position of the nerve in 73.7% of specimens on the right. Relationship of angle "b" with the optic nerve was given Table 2. Bilaterally, 63.2% of the cases were inferolateral position of the optic nerve to be symmetrical.

Distal part The distal part was related to inferior and lateral aspect of the optic nerve in the optic canal. The ophthalmic artery ran within the substance of the dural sheath until it emerged at the apex of the orbit, which it usually entered at the infero-lateral aspect of the optic nerve (Fig. 4). The diameter of distal part of the ophthalmic artery was showed in Table 1. There were no significant differences between the vessel measurements of the right and left sides in any subject ($P>0.05$).

Exit at the optic canal

In about 80% the ophthalmic artery existed the orbital orifice of the lateral side of the optic canal (Figs. 2, 4), in about 20% at its medial side (Figs. 2, 3).

Discussion

Surgical exposure of the clinoid (C5) segment of the internal carotid artery has become a critical component of many contemporary neurosurgical approaches (exposure of ophthalmic segment aneurysms, cavernous sinus neoplasms, or clinoid meningiomas) [2, 11, 16, 20, 39]. The intracranial and intracanalicular portions of the ophthalmic artery is suspectible to various disease and injuries; therefore knowledge of the microanatomy of the complex bony, dural, vascular, and neural relationships of this segment is necessary for proper diagnosis and preservation of the neurovascular structures during subfrontal, pterional and intracanalicular procedures [18, 27, 33, 35, 37].

The incidence of aneurysms in the carotid-ophthalmic region has been reported as 0.5–11% of all intracranial aneurysms [6]. The aneurysms occur in bilateral ophthalmic segments in 20–47% of the multiple aneurysm cases. The contralateral approach has been indicated variously for small and medially located aneurysms, large and unruptured aneurysms projecting superomedially, aneurysms associated with pituitary tumors, and carotid-ophthalmic aneurysms displacing the optic nerve superolaterally [6, 30, 34].

It has been reported that in the majority of cases the ophthalmic artery originates from the intradural portion of the internal carotid artery and fewer cases from the extradural and interdural portion [10, 14, 26]. The ophthalmic artery usually originates from the intradural portion of the internal carotid artery in 79.9–98%; however, the extradural origin of the ophthalmic artery is reported in 2–10% [14]. Hokama et al. [16] classified the extradurally originating ophthalmic artery into two groups, trans-optic strut type and supra-optic strut type. They reported that the ophthalmic artery originated from the intradural portion of the internal carotid artery, except in 5% where the ophthalmic artery originated extradurally [16]. The distal dural ring is between the intradural and the extradural portions of the internal carotid artery. Kim et al. [25] observed that the ophthalmic artery arose at the insertion of the distal dural ring into the internal carotid artery (3%) and from the clinoid (C5) segment proximal to the distal dural ring (6%). The approximately 2–3 mm long intracranial portion of the ophthalmic artery originates from the internal carotid artery below the intracranial portion of optic nerve. Govsa et al. [11] reported that the ophthalmic artery was observed running in the subdural space in 80%, between the two dura layers in 10%.

Whether an aneurysm arises proximal or distal to the distal dural ring therefore determines if there is a risk of life-threatening subarachnoid hemorrhage. Collignon and Link found that the ophthalmic artery was intradural and was distal from the optic strut 0.5–7 mm [5]. They reported the optic strut can be a good landmark separating the intradural from the extradural space along the anterior and medial internal carotid artery where most aneurysms arise, and is more reliable than ophthalmic artery. Even the intracranial and intracanalicular portions of ophthalmic artery can also be easily injured at a point where it penetrates the optic sheath while the anterior clinoid process is drilled. The distal dural ring is tightly adhesive to the wall of the internal carotid artery and there is no surgical plane between them. It should, therefore, be dissected from the internal carotid artery in a circumferential fashion without entering the adventitial or muscle layers of the internal carotid artery. It is a plane inclined downward both in the anterior to posterior and lateral to medial direction; therefore, dissection of the distal dural ring needs careful attention to complete the procedure [25].

The ophthalmic artery generally arises on the anteromedial aspect of the ophthalmic segment of the internal carotid artery, and courses forward along the inferior surface of the optic nerve [5, 16, 18, 34, 37]. The origins of the arteries were located in the superomedial aspect of the internal carotid artery in 71% and on the superior aspect in 29% [10, 19, 27, 33]. Jimenez-Castellanos et al. [19] observed that the ophthalmic artery usually arose as the first branch of the internal carotid artery as it pierced the dura to emerge from the cavernous sinus on the medial side of the anterior clinoid process and entered the orbital cavity through the optic canal. Hayreh and Dass reported that the ophthalmic artery originated from anteromedial surface of the vessel in 53.6% of their specimens [14]. Lang [27] observed the origin in the anteromedial and upper side of the siphon in 45% of their specimens. Study by Nishio et al. [34] reported that the ophthalmic artery arose from the supraclinoid segment of the internal carotid artery in 84%, and within the cavernous sinus in 14%.

The origin of the ophthalmic artery from the anterior cerebral artery, the internal carotid artery bifurcation or double ophthalmic artery originating from the same in-

ternal carotid artery can be explained with relative ease by the stages before the formation of the primitive ophthalmic artery. Any variations in the origin of the ophthalmic artery are uncommon and well-explained by the comparative anatomy and human embryology [7, 9, 22, 28, 35]. In the study by Govsa et al. [11], the ophthalmic artery was on the inferomedial side of the optic nerve in 26.1%, directly below the nerve in 33.7% and on its inferolateral side in 40.2% of the specimens at the entrance point to the optic canal. The diameter of the ophthalmic arteries, as they existed from the internal carotid artery, varied from 0.3 mm to 2.9 mm, averaging 1.5 mm [11].

The ophthalmic artery mostly arises at the upper medial circumference of the internal carotid artery. In this case rises in pressure in inner of the skull, arteriosclerosis, aneurysms of the ophthalmic artery, the nerve can be pressed from below to the membranous roof of the optic canal. Optic nerve compression should be suspected or excluded in any case of visual loss and with any type of visual field defect that cannot be explained by ophthalmoscopically.

We describe the detailed anatomic features of the origin, intracranial and intracanalicular portion of ophthalmic artery, clarify the anatomic relationship of structures in the paraclinoid region. This study supports the usefulness of the contralateral pterional approach to the origin of ophthalmic artery and the medial aspect of the supraclinoid segment of the internal carotid artery. Preoperative evaluation of ophthalmic and carotid arteries in patients using transcranial Doppler sonography enables determination of cerebrovascular occlusion. For this reason intracranial and intracanalicular portions are important to have data about the normal size of the artery. An adequate knowledge of the anatomy of the intracranial and intracanalicular portion of ophthalmic artery is essential for anterior clinoidectomy, especially in drilling of the optic strut, for approaching the juxtra-dural region successfully. Removal of the bone of the optic canal is a common step in exposing tumours and aneurysms in the region. Our study may help in the development of new strategies by precisely defining the anatomy of the structures in the optic canal. Probably, the results of our measurements differ from those of other investigators due to differences of the populations investigated.

References

1. Brucher J (1969) Origin of the ophthalmic artery from the middle meningeal artery. Radiology 93:51–52
2. Cawley CM, Zipfel GJ, Day AL (1998) Surgical treatment of paraclinoid and ophthalmic aneurysms. Neurosurg Clin N Am 9(4):765–783
3. Chen P, Dunn IF, Aglio LS, Day AL, Frerichs KU, Friedlander RM (2005) Intraoperative awakening for vision examination during ophthalmic artery aneurysm clipping: technical case report. Neurosurgery 56(2 Suppl):E440, discussion E440
4. Chou PI, Sadun AA, Lee H (1995) Vasculature and morphometry of the optic canal and intracanalicular optic nerve. J Neuroophthalmol 15(3):186–190
5. Collignon F, Link M (2005) Paraclinoid and cavernous sinus regions: measurement of critical structures relevant for surgical procedure. Clin Anat 18(1):3–9
6. Day AL (1990) Aneurysms of the ophthalmic segment: a clinical and anatomical analysis. J Neurosurg 72(5):677–691
7. Diamond MK (1991) Homologies of the meningeal-orbital arteries of humans: a reappraisal. J Anat 178:223–241
8. Flaharty PM, Sergott RC, Lieb W, Bosley TM, Savino PJ (1993) Optic nerve sheath decompression may improve blood flow in anterior ischemic optic neuropathy. Ophthalmology 100 (3):297–302, discussion 303–305
9. Georgiou C, Cassell MD (1992) The foramen meningo-orbitale and its relationship to the development of the ophthalmic artery. J Anat 180(Pt 1):119–125
10. Gibo H, Lenkey C, Rhoton AL Jr (1981) Microsurgical anatomy of the supraclinoid portion of the carotid artery. J Neurosurg 55:560–574
11. Govsa F, Erturk M, Kayalioglu G, Pinar Y, Ozer MA, Ozgur T (1999) Neuro-arterial relations in the region of the optic canal. Surg Radiol Anat 21:329–335
12. Hayreh SS, Dass R (1962) The ophthalmic artery I. Origin and intra-cranial and intra-canalicular course. Brit J Ophthal 46: 65–98
13. Hamada J, Kitamura I, Kurino M, Sueyoshi N, Uemura S, Ushio Y (1991) Abnormal origin of bilateral ophthalmic arteries. J Neurosurg 74(2):287–289
14. Hassler W, Zenter J, Voight K (1989) Abnomal origin of the ophthalmic artery from the anterior cerebral artery. Neuroradiology 31:85–87
15. Hiura A (1980) An anomalous ophthalmic artery arising from the middle meningeal artery. Anat Anz 147:473–476
16. Hokama M, Hongo K, Gibo H, Kyoshima K, Kobayashi S (2001) Microsurgical anatomy of the ophthalmic artery and the distal dural ring for the juxta-dural ring aneurysms via the pterional approach. Neurol Res 23(4):331–335
17. Hwang JF, Chen SN, Chiu SL, Wu SL (2004) Embolic cilioretinal artery occlusion due to carotid artery dissection. Am J Ophthalmol 138(3):496–498
18. Jesus OD (1997) The clinoidal space: anatomical review and surgical implications. Acta Neurochir (Wien) 139:361–365
19. Jimenez-Castellanos J, Carmona A, Castellanos L, Catalina-Herrera CJ (1995) Microsurgical anatomy of the human ophthalmic artery: a mesoscopic study of its origin, course and collateral branches. Surg Radiol Anat 17(2):139–143
20. Jo-Osvatic A, Basic N, Basic V, Jukic T, Nikolic V, Stimac D (1999) Topoanatomic relations of the ophthalmic artery viewed in four horizontal layers. Surg Radiol Anat 21:371–375
21. Kakizawa Y, Tanaka Y, Orz Y, Iwashita T, Hongo K, Kobayashi S (2000) Parameters for contralateral approach to ophthalmic segment aneurysms of the internal carotid artery. Neurosurgery 47(5):1130–1136, discussion 1136–1137
22. Kaku Y, Yoshimura S, Sakai N (2004) Surgery for carotid dural ring aneurysms. Surg Neurol 61(6):546–550
23. Kayalioglu G, Govsa F, Erturk M, Pinar Y, Ozer MA, Ozgur T (1999) The cavernous sinus: topographic morphometry of its contents. Surg Radiol Anat 21:255–260
24. Kerty E (1999) The ophthalmology of internal carotid artery dissection. Acta Ophthalmol Scand 77(4):418–421
25. Kim JM, Romano A, Sanan A, van Loveren HR, Keller JT (2000) Microsurgical anatomic features and nomenclature of the paraclinoid region. Neurosurgery 46(3):670–680, discussion 680–682
26. Kyoshima K, Oikawa S, Kobayashi S (2000) Interdural origin of the ophthalmic artery at the dural ring of the internal carotid artery. Report of two cases. J Neurosurg 92(3):488–489
27. Lang J (1995) Skull Base and related structures. Atlas of clinical anatomy. Schattauer, Stuttgart, pp 112–187
28. Liu Q, Rhoton AL Jr (2001) Middle meningeal origin of the ophthalmic artery. Neurosurgery 49(2):401–406, discussion 406–407

29. Martini E, Guiducci M, Campi L, Cavallini GM (2005) Ocular blood flow evaluation in injured and healthy fellow eyes. Eur J Ophthalmol 15(1):48–55
30. Matsumura Y, Nagashima M (1999) Anatomical variations in the origin of the human ophthalmic artery with special reference to the cavernous sinus and surrounding meninges. Cells Tissues Organs 164(2):112–121
31. Mittra RA, Sergott RC, Flaharty PM, Lieb WE, Savino PJ, Bosley TM, Hedges TR Jr (1993) Optic nerve decompression improves hemodynamic parameters in papilledema. Ophthalmology 100(7):987–997
32. Morandi X, Le Bourdon E, Darnault P, Brassier G, Duval JM (1998) Unusual origin of the ophthalmic artery and occlusion of the central retinal artery. Surg Radiol Anat 20(1):69–71
33. Natori Y, Rhoton AL Jr (1994) Transcranial approach to the orbit: microsurgical anatomy. J Neurosurg 81(1):78–86
34. Nishio S, Matsushima T, Fukui M, Sawada K, Kitamura K (1985) Microsurgical anatomy around the origin of the ophthalmic artery with reference to contralateral pterional surgical approach to the carotid-ophthalmic aneurysm. Acta Neurochir (Wien) 76(3–4):82–89
35. Pretterklieber ML, Schindler A, Krammer EB (1994) Unilateral persistence of the dorsal ophthalmic artery in man. Acta Anat (Basel) 149(4):300–305
36. Sade B, Tampieri D, Mohr G (2004) Ophthalmic artery originating from basilar artery: a rare variant. Am J Neuroradiol 25(10):1730–1731
37. Seoane E, Rhoton AL Jr, de Oliveira E (1998) Microsurgical anatomy of the dural collar (carotid collar) and rings around the clinoid segment of the internal carotid artery. Neurosurgery 42 (4):869–884, discussion 884–886
38. Shimada K, Kaneko Y, Sato I, Ezure H, Murakami G (1995) Classification of the ophthalmic artery that arises from the middle meningeal artery in Japanese adults. Okajimas Folia Anat Jpn 72(2–3):163–176
39. Tanaka Y, Hongo K, Tada T (2002) Radiometric analysis of paraclinoid carotid artery aneurysms. J Neurosurg 96:649–653
40. Weinberg PE, Patronas NJ, Kim KS, Melen O (1981) Anomalous origin of the ophthalmic artery in a patient with amaurosis fugax. Arch Neurol 38:315–317

Comments

Evandro De Oliveira, São Paulo, Brazil

Erdogmus and Govsa present us with an anatomic study of intracranial and intracanalicular portions of ophthalmic artery. They described the different origins and courses in 38 cadaver specimens. As they clearly point out, the importance of anatomic knowledge of this intricate anatomic region is of paramount importance to achieve a good clinical outcome in the management of paraclinoid aneurysms, meningiomas and pituitary tumors. The anatomical photographs are clear, and help to understand the relationship of the origin of the ophthalmic artery with major anatomical landmarks. The discussion is well oriented and the references were thoroughly selected. In conclusion, this paper is recommended for those neurosurgeons interested in the anatomy of this interesting region.

Kazuhiro Hongo, Matsumoto, Japan

This is a paper reporting on the microsurgical anatomy of the ophthalmic artery. It is well known that the ophthalmic artery has a wide variation in terms of its origin and course, and knowing the detalied anatomy is essential, especially for the surgery on the paraclinoid aneurysm. The authors, using 38 cadaver specimens, analyzed the origin of the ophthalmic artery, and also analyzed the course of the intracanalicular portion. Same as in previous reports, the ophthalmic artery originated extradurally in 5%. The course of the ophthalmic artery is well analyzed by dividing into five parts: short limb, angle “a”, long limb, angle “b”, and distal part. For clipping of the paraclinoid aneurysm, removal of the anterior clinoid process and drilling of the optic strut are necessary. For the contralateral approach to the paraclinoid aneurysm, exposure of the medial side of the ophthalmic portion of the internal carotid artery is necessary. Especially in these situations, knowing the detailed anatomy of the ophthalmic artery is quite important. This paper gives a helpful information for the readers of this journal.