

The origin and relations of the anterior choroidal artery: an anatomical study

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There has recently been an increase in surgical interventions to the inferior temporal lobe. The aim of the present study is to examine the anatomical structure and relations of the anterior choroidal artery, which extends to this region. A mixture of latex and ink was injected into the internal carotid and basilar arteries of 15 brains from fresh cadavers.

In 18 out of 30 cases (60%) the anterior choroidal artery arose from the posteroinferior aspect of the internal carotid artery, in 8 (22.2%) from the posterolateral aspect and in 4 (2%) from its anterior part. The diameter of the anterior choroidal artery was 0.94 mm on average (0.7–1.2) and the average distance from the posterior communicating artery was 5.3 mm (3.8–8 mm); its distance to the bifurcation of the carotid was found to be 4.0 mm on average (2.2–8 mm). The cisternal segment of the anterior choroidal artery and the optic tract formed a neurovascular bundle. The branches arising from the plexal segment supply the lateral geniculate body, the thalamus and the optic tract.

The resulting knowledge of the neurovascular relations of the anterior choroidal artery provides a safe surgical approach to the inferior temporal lobe.

Key words: anterior choroidal artery, anatomy, origin, dissection

INTRODUCTION

The anterior choroidal artery is a very important artery for neurosurgeons [7, 9, 11]. In 1789 Vicq D' Azyr first defined the anterior choroidal artery as the choroidal vessels of the lateral ventricle [6, 12]. Heubner, Duret, Kolisko and Beevor mentioned the courses of these arteries and the areas supplied by them [6]. In fact the anterior choroidal artery not only supplies the ventricles but also gives important branches to the diencephalon, mesencephalon and the cerebrum and also supplies motor and visual pathways [13]. Cosson et al. [1] mentioned that the anterior choroidal artery is a source of thalamic vascularisation by its cisternal branches running towards the lateral thalamus.

As surgical interventions to epileptic lesions at the amygdalohippocampal region have greatly in-

creased in recent years [2, 6, 16], a better understanding of the vascular relations and anatomy of the anterior choroidal artery may be helpful to surgeons by providing better data about the vascular anatomy of the lateral mesencephalon and the medial half of the temporal lobe.

MATERIAL AND METHOD

30 cerebral hemispheres from 15 fresh adult cadaver brains free of central nervous system disease and trauma were obtained for dissecting the anterior choroidal arteries. The internal carotid artery and the basilar artery of the removed brains were cannulated with polyethylene catheters and injected with coloured latex. The brains were then fixed in formaldehyde. The dissections were carried out with microsurgical instruments and an Opmi 99 dissection



Figure 1. Inferior view of the right hemisphere ($\times 40$); 1 — internal carotid artery, 2 — posterior communicating artery, 3 — anterior choroidal artery, 4 — uncal artery, 5 — optic chiasm, 6 — tuber cinereum, 7 — optic tract, 8 — P₁ segment of posterior cerebral artery, 9 — basilar artery, 10 — superior cerebellar artery, white arrows; branches of the anterior choroidal arteries.

microscope (Carl Zeiss, Germany) with a photographic attachment. For each specimen we recorded the origin, course, branching pattern and diameter of the anterior choroidal artery, described its relations and photographed it.

RESULTS

The anterior choroidal arteries were present in all hemispheres. The anterior choroidal artery arose from the posteroinferior aspect of the internal carotid artery in 18 of the cases (60%), from the posterolateral aspect in 8 cases (22.2%) and from the anterior part of the internal carotid artery in 4 (2%) of the total cases (Figs. 1, 2). The anterior choroidal artery normally courses dorsolaterally and then runs through the uncus and the amygdaloid body of the temporal lobe. Along this route it usually lies in close proximity to the oculomotor nerve and the posterior communicating artery. The mean calibre of the artery was 0.94 mm (0.7–1.2). The mean distance to the posterior communicating artery was 5.3 mm (3.8–8 mm) and to the carotid bifurcation it was 4.0 mm (2.2–8 mm) (Fig. 1). In all the specimens the

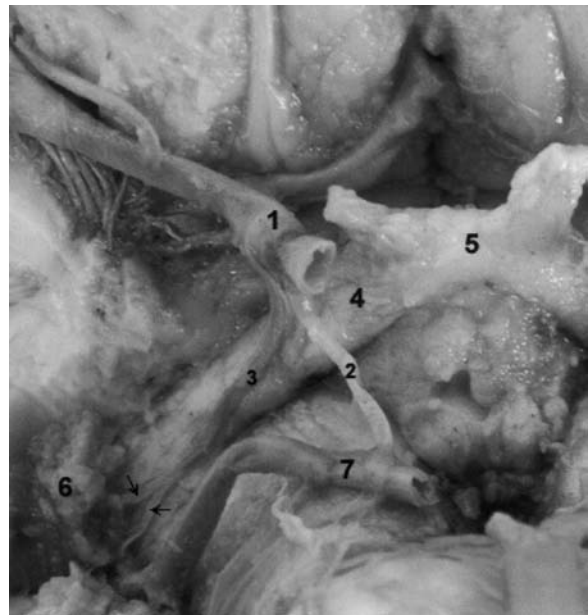


Figure 2. Inferior view of the brain ($\times 40$); 1 — Internal carotid artery, 2 — posterior communicating artery, 3 — anterior choroidal artery, 4 — optic tract, 5 — optic chiasm, 6 — choroid plexus of lateral ventricle, 7 — posterior cerebral artery, black arrows, lateral and medial branches in the plexus of the anterior choroidal artery.

anterior choroidal artery arose from the C4 part of the internal carotid artery as the first branch after the exit of the posterior communicating artery.

The anterior choroidal artery had a long course, which was examined as two separate segments, the cisternal (extraventricular segment) and the plexal (intraventricular segment), as defined by Rhoton in his paper [13]. The cisternal segment is the part which begins from the origin of the artery and extends to the place where it enters the ventricle. In the present study the anterior choroidal artery coursed on the posterolateral aspect of the posterior communicating artery and on the dorsolateral part of the optic chiasm at the cisternal segment. It then crossed the optic chiasm from lateral to medial and passed to the lateral part of the cerebral peduncle (Fig. 2) and reached the anterior of the lateral geniculate body. When crossing the optic chiasm it lay on the superomedial part of the uncus. It entered the temporal horn of the choroid plexus and after this the level plexal segment began.

In most cases the anterior choroidal artery entered the choroid plexus from its posteromedial aspect and divided into lateral and medial branches in the plexus (Fig. 2), the medial branch being larger than the lateral. The medial branch was on the lateral part of the choroid plexus of the inferior horn of the lateral ventricle. It then curved posterosuperiorly and at this area of curve was in close relationship with the lateral posterior choroidal artery. The anterior choroidal artery gave rise to many thin branches to supply blood to many structures such as the optic tract, the optic nerve, the lateral part of the mesencephalon and the uncus during the cisternal segment. The branch to the uncus arises 1–2 mm away from the origin of the artery (45%) and is termed the uncal artery (Figs. 1, 2). The pattern of the perforating branches of the anterior choroidal artery was as set

out in most textbooks of anatomy. These branches supplied areas such as the *globus pallidus*, the caudate nucleus, the amygdala, the hypothalamus, the red nucleus, the *substantia nigra* and the posterior limb of the internal capsule.

DISCUSSION

As the brain develops, the blood flow of the artery through the choroid plexus increases and at this time a large part of the telencephalic region that is supplied by this artery begins to take its blood flow from the posterior cerebral artery. It is known from human embryological studies that the anterior choroidal artery is an early-developed artery of the brain and plays an important part in the blood supply of the brain [5, 10].

Variations in the origin of this artery are not, in fact, observed very often. According to Erdem and Yaşargil's [2] report based on 30 hemispheres, the anterior choroidal artery emerges from the internal carotid artery. Other investigators, however, have mentioned this artery as arising from the posterior communicating artery [6, 13]. This may be explained by the anterior choroidal artery arising from the rostral and caudal parts of the internal carotid artery phylogenetically. During the embryological period these parts of the internal carotid artery are, in any case, the posterior communicating artery itself. Morandi et al. [12] examined 50 arteries and in 2 cases found an ectopic origin of the anterior choroidal artery arising from the bifurcation of the internal carotid artery (Table 1). This ectopic origin may be due to deficiency in the development of the distal part of the internal carotid artery or deficiency in the migration of the distal part of the anterior choroidal artery. Some other authors have identified a duplicated anterior choroidal artery [6] but in the present study the anterior choroidal artery arose from

Table 1. The caliber and origine of the anterior choroidal artery according to different authors

Authors	Caliber of ACHA	Origin of ACHA		
		ICA	PCOA	Bifurcation of ICA
Erdem et al. [2]	0.93	100%	–	–
Fujii et al. [3]	1.2	98%	2%	–
Gibo et al. [4]	1.0	100%	–	–
Morandi et al. [12]		96%	2%	2%
Hussein et al. [6]	0.9	97.5%	2.5%	–
Present study	0.94	100%	–	–

ACHA — anterior choroidal artery; ICA — internal carotid artery; PCOA — posterior communicating artery

the internal carotid artery as a single branch in all the cases examined. The duplication may be confused with the uncal artery. The uncal artery arose from the anterior choroidal artery in 45% of our cases and the distance from the origin of the anterior choroidal artery was approximately 0.5 mm. In the present study the distance between the origins of the uncal and anterior choroidal arteries was exiguous. These two arteries may, therefore, be supposed to have the same origin and may be thought of as a duplicated anterior choroidal artery.

In view of its length and the areas supplied by this artery, the calibre of the anterior choroidal artery is too small. Erdem and Yaşargil [2] gave the calibre of this artery as 0.93 mm. Hussein et al. [6] found it to be 0.9 mm while in the present study it was 0.94 mm. As the calibre of this artery is so small, it is difficult to perform selective catheterisation during treatment of arteriovenous malformations of this artery [2].

Caroticochoroidal aneurisms make up 3.4–5% of intracranial aneurisms. The origin of the anterior choroidal artery is in the carotid cistern [3, 4, 14, 15, 17]. Generally the aneurisms of this artery are located near its origin and it is related to the medial part of the temporal lobe and it is often located at the uncus. Consequently, in order to see the anterior choroidal artery, its branches and the aneurisms, this part of the temporal lobe must be removed. Bilateral obstructions of the anterior choroidal artery at the level of the choroid fissure can be tolerated because there are many anastomoses between the anterior and posterior choroidal arteries at the inferior horn of the lateral ventricle. However, when there are obstructions in the carotid cistern, early neurological vision-related deficiencies may occur [3, 8, 16, 18]. Occlusion of the anterior choroidal artery in the first segment may lead to contralateral hemiparesis and hemianopsia, as described by Foix in 1925. Transient loss of consciousness as well as extrapyramidal signs may also occur following an ischaemic lesion in the pallidal area [6]. In 1952, while performing a pedunculotomy on a patient incapacitated with Parkinsonism, Cooper had to clip the anterior choroidal artery. The operation was terminated without cutting the peduncle. Postoperatively, tremor and rigidity disappeared from the extremities involved and voluntary motor function was preserved. Surgical occlusions were than made by Cooper in 50 patients with Parkinsonism. He reported good relief of tremor and rigidity [14].

As a result of the length and thinness of the anterior choroidal artery, it is especially related to the optic tract and inferior parts of the inferior temporal lobe. Understanding of its microanatomy continues to be important because of its role in the supply of important visual and motor pathways and its frequent involvement in basal tumours and aneurysms. Therefore, in order to keep neurological damages to a minimum, neurosurgeons must, be aware of the course and relations of the anterior choroidal artery during the treatment of arteriovenous malformations and aneurysms and in interventions to the inferior temporal lobe.

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