Branches of the Anterior Communicating Artery

Microsurgical Anatomy

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Summary

The anterior communicating artery (ACoA) and its branches were examined in 22 human brains after injecting Indian ink or methylmethacrylate. The ACoA branches were divided into the small and the large. Small branches were from 1 to 5 in number (mean 2), and from 70 to 270 μm in diameter (mean 151 μm). Seventy-six percent of the branches originated directly from the ACoA. They tended to arise closer to the left than to the right anterior cerebral artery. Fourteen percent of them arose from the junctional site of the ACoA with the anterior cerebral arteries, and 10% from the site of origin of the subcallosal artery. Large branches were identified as the median artery of the corpus callosum, and the subcallosal artery, respectively. The former vessel was present in 9% of the patients, and the latter in 91%. The subcallosal artery was from 320 to 640 μm in size (mean 486 μm). It tended to arise from the middle of the ACoA.

In spite of the very frequent anastomoses involving the ACoA branches, care must be taken to avoid injury to these important vessels during operations of the ACoA aneurysms.

Keywords: Anterior communicating artery; microsurgical anatomy; cerebral aneurysms.

Introduction

The anterior communicating artery (ACoA) is one of the most frequent sites of the intracranial aneurysms. Depending on the investigators, the frequency of the ACoA aneurysms is reported to range from 19% to 84% of all the cerebral aneurysms. Instead of the previously used proximal occlusion of the anterior cerebral artery or the ACoA itself for ACoA aneurysms, direct surgery of these aneurysms is currently performed. For this reason, detailed knowledge of the ACoA branches is needed in order to preserve these tiny vessels during surgery. However, there has been relatively little mention of these branches in the literature, and a very small number of data concerning their micro-anatomical characteristics.

For the above mentioned reasons, we have decided to examine the site of origin, diameter, branching patterns, and interrelationship of the ACoA branches, as well as their relationship to the parent vessel and the anterior cerebral arteries. In addition to this, we have paid special attention to the anastomoses of the ACoA branches. As will be seen from our results, we have divided the ACoA branches into the small and the large. Large branches comprise the subcallosal artery and the median artery of the corpus callosum. The former vessel runs to the genu of the corpus callosum, and supplies, among other structures, the ventro-rostral part of the cingulate gyrus. The median artery of the corpus callosum is longer than the subcallosal artery, and extends to the trunk or the splenium of the corpus callosum. It may nourish, among other structures, the dorso-caudal part of the cingulate gyrus and the paracentral lobule of the right and/or the left hemisphere.

Materials and Methods

Twenty-six human brains were examined in this study. Of these, the twenty-two best prepared brains were used for taking photographs, measurements, and statistical analysis. The brains were taken from patients aged 19-67 years as soon as possible after death. Plastic catheters were placed in the basilar and both internal carotid arteries. Two substances were injected into the arterial system.

Ten brains were injected with a 10% mixture of Indian ink, gelatin, and formaldehyde. They were then fixed in 10% formaldehyde solution for three weeks. Branches of the anterior communicating and the anterior cerebral arteries were dissected under a stereoscopic microscope using surgical micro-instruments.

Arteries of the remaining sixteen brains were injected with methyl methacrylate. Three hours later, when the polymerization of that
During routine autopsy we found a saccular aneurysm of the anterior communicating artery (Fig. 10), which had not been diagnosed during the patient’s life. The cerebral arteries of that patient were injected with methylmethacrylate. Unfortunately, just after taking photographs of the aneurysm, the arteries were badly damaged, so that a micro-anatomical examination of the aneurysm was not possible.

Results

We shall first present the micro-anatomical characteristics of the anterior communicating artery (ACoA) in relation to its branches, and then the features of the branches themselves.

The “classical” ACoA, i.e. a single transverse anastomotic channel that connects the right and left anterior cerebral arteries, was found in 41% of the cases (Fig. 1). Of these, in one case, the ACoA was seen to connect the anterior cerebral artery on one side to a fenestration of the opposite artery. In 4.5% of the patients a double ACoA was noted. With the same frequency (4.5%) a fusion was observed between the two anterior cerebral arteries instead of an ACoA (Fig. 2). In 32% of the patients the ACoA was shaped like the letters Y, X, H, or O. A complicated plexiform anterior communicating artery, which consisted of four or more channels and two or more fenestrations, was noted in 9% of the cases. Also in 9% of the individuals, the ACoA was replaced by the initial part of the distal (A2) segment of the anterior cerebral artery, that was connected to the ipsilateral hypoplastic proximal (A1) segment of the same artery (Fig. 3).

The length of the ACoA varied from 0.8 to 4.6 mm (mean 2.9 mm). The ACoA ranged from 0.71 to 2.4 mm in diameter (mean 1.2 mm).

Branches of the ACoA were always present. They

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Fig. 1. “Classical” anterior communicating artery (I) that gives rise to two small branches (small arrows), and to the subcallosal artery (large arrow). Caudal and slightly dorsal and lateral view. 2 and 2’ - proximal segments, 3 and 3’ - distal segments of the right and left anterior cerebral arteries. × 10.5

Fig. 2. Fusion between the two anterior cerebral arteries. Fusion gives rise to the common stem (I) of the subcallosal and hypothalamic arteries. 2 and 2’ - proximal segments, 3 and 3’ - distal segments of the right and left anterior cerebral arteries; 4 and 4’ - right and left recurrent arteries of Heubner. Caudal view. × 7.7

substance was completed, four liters of 40% potassium hydroxide were added. After seven days, when the brain tissue was completely dissolved, the vascular plastic cast was washed in running water and dried.

The ACoA branches were examined and measured under the stereoscopic microscope. Drawings were made and photographs were taken of all the branches. The mean value, and standard deviation (± n) were calculated from the data obtained.