The Lateral Perforating Branches of the Anterior and Middle Cerebral Arteries*

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It is well known that aneurysms occur at the site of branching of the large vessels at the base of the brain. Two relatively common sites are in the region of the anterior communicating vessel and the site of branching of the main stem of the middle cerebral artery. Unfortunately, these sites frequently are the location of important lateral perforating vessels which irrigate large cell masses enclosing bands of traversing axone fiber bundles, namely the internal capsule. Frequently, the small perforating vessels are not well visualized at operation and damage to them will, at times, produce severe neurological deficits. These vessels can be well demonstrated in autopsy specimens of fresh brain by gross dissection and roentgenography, after injection of radiopaque substances. In order to define the precise location of the lateral perforating vessels, it was thought helpful to present a brief overall survey of certain vascular relationships to the brain.

Anatomy

The anatomico-vascular relationship of the central nervous system follows a well organized pattern. The brain can be described as a multi-segment unit arbitrarily formed caudo-rostrally by 5 territories: the myelencephalon, metencephalon, mesencephalon, diencephalon, and telencephalon. In horizontal cross-section it can be described again as a multi-segment unit containing a central base, lateral base and dorsal supra-segmental portion (Fig. 1a and b).

While functionally the adult human brain can still be considered in terms of its primitive state, anatomically the numerous gyrations of the cell masses in their attempt to accommodate to the relatively small cranial cavity present a grossly different final form. Nevertheless, anatomically the adult rostral brain can be described by depicting the cerebral hemispheres as dorsal overgrowths from the rostral segment of the neural tube expanding in all directions to cover the rest of the brain; the basal ganglia, the rostral base segment of the neural tube from which the hemispheres grow dorsally, as caudalateral expansions about the diencephalon; and the white matter from the base of the brain as a lateral outgrowth from the neural tube. The latero-caudal expansion from the midline of the rostrally situated basal ganglia, therefore, encloses a large group of white fibers between itself and the thalamus to produce

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Fig. 1. Diagrams of basic design of the brain. (a) Lateral view showing the various components of the brain in relation to its basic segmentation. (b) Cross-section of primitive brain. (c) Dorsal view of rostral brain indicating formation of the internal capsule by growth of the basal ganglia lateral to the white matter.
Fig. 2. Diagrams of the brain vascular patterns. (a) Double “four-segment” units made up caudally of PIC—posterior inferior cerebellar artery; AIC—anterior inferior cerebellar artery; SC—superior cerebellar artery; Mes—mesencephalic artery; and rostrally of PC—posterior cerebral artery; ACh—anterior choroidal artery; MC—middle cerebral artery; and AC—anterior cerebral artery. ICA—internal carotid artery; Bas—basilar artery; V—vertebral artery. (b) Cross-section of basic brain showing perforating arteries arising from the main cerebral arteries. One notes the central, lateral, and distal perforating arteries arising from each main cerebral artery.

The vascular pattern of this primitive-type brain can be shown as a double “four-segment” unit (Fig. 2). The caudal “four-segment” unit is made up proximo-distally by the posterior inferior cerebellar, anterior inferior cerebellar, superior cerebellar and mesencephalic arteries, all arising from the vertebro-basilar artery. The rostral “four-segment” unit is made up of the posterior cerebral (posterior communicating), anterior choroidal, middle cerebral, and anterior cerebral arteries arising from the internal carotid artery. Each of the major vessels which go to make up a “four-segment” vascular unit is similar in design. Each large vessel gives off first central perforators to the central base cells, then single, or at times multiple, lateral perforators to the lateral cell mass, and finally distal perforators to the supra-segmental cell mass on the dorsum of the neural tube. Using this overall basic pattern of the brain, it now can be seen that the lateral perforators of the anterior and middle cerebral arteries will irrigate primarily the most rostral ventro-lateral cell masses of the brain.

The most rostral part of the lateral cell mass in the neural tube, the head of the caudate nucleus and rostro-mesial part of the putamen, is irrigated by the lateral perforating vessel of the most distal segment of the internal carotid artery, the anterior cerebral artery. This lateral perforating branch from the anterior cerebral artery is often referred to as Heubner’s artery. It usually arises from the lateral aspect of the anterior cerebral vessel at about the level of the anterior communicating artery, but actually may arise from any site on the lateral aspect of the proximal portion of the anterior cerebral artery (Fig. 3). It passes caudo-laterally alongside, or dorsal to, the main proximal portion of the anterior cerebral artery. Heubner’s artery then continues laterally to reach the rostro-mesial portion of the anterior perforated substance. At this site it begins to divide and send perforating branches into the cerebral substance immediately rostral to the perforating branches of the middle cerebral artery. On entering the cerebral substance the vessel courses rostro-mesially to irrigate the most rostro-mesial portion of the lateral cell mass (Figs. 4 and 5). Its terminal branches supply the antero-mesial aspect of the head of the caudate nucleus and adjoining putamen, part of the septal nucleus, and cells in the rostro-lateral area of the olfactory trigone. Fiber tracts lying in the domain of the ramifications of this vessel are the fronto-pontine fibers of the anterior limb of the internal capsule, the intermediate olfactory stria and fibers of the ventral portion of the internal capsule passing through