ANTERIOR CHOROIDAL ARTERY

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1. Core Definition

The **Anterior Choroidal Artery** (AChA) is a vital, narrow caliber vessel that forms a critical part of the cerebral circulation, supplying blood to numerous deep structures located in the telencephalon and diencephalon. Although small, the AChA is functionally indispensable because the structures it perfuses--such as the **internal capsule**, the globus pallidus, and specific thalamic nuclei--are responsible for integrating major motor, sensory, and limbic pathways. Its occlusion, therefore, results in severe and often devastating neurological deficits, collectively categorized as the Anterior Choroidal Artery syndrome. This artery holds an intermediate position, both anatomically and functionally, often considered a crucial bridge between the anterior circulation system, primarily derived from the internal carotid artery, and the more posterior structures it eventually reaches, distinguishing it from the posterior choroidal arteries which originate from the posterior cerebral artery system.

The AChA is typically recognized as a terminal branch originating from the posterior aspect of the **Internal Carotid Artery** (ICA), specifically distal to the origin point of the posterior communicating artery (PCoA). Its path is notably long and complex relative to its size, allowing it to traverse significant anatomical distances through the basal cisterns before penetrating the brain parenchyma. The vessel's trajectory is crucial for neurosurgical planning and for understanding clinical pathology, as it initially lies within the arachnoid sheath, intimately associated with the **optic tract** and the uncus of the temporal lobe, before dividing into its essential terminal branches that enter the brain substance. Clinically, its importance is magnified by the fact that the territory it supplies generally lacks robust collateral circulation, making the areas it feeds highly vulnerable to ischemia following even partial blockage.

Understanding the precise definition of the AChA necessitates appreciating its role in supplying the **choroid plexus** of the temporal horn of the lateral ventricle, which is a key function hinted at by its name. However, its supply to the internal capsule--the highway for corticospinal, corticobulbar, and major sensory projection fibers--is arguably its most clinically significant function. The resultant ischemia from AChA occlusion affects these fibers, leading to contralateral hemiplegia and hemianesthesia, emphasizing that while named for the choroid plexus, its broader deep supply dictates its profound neurological importance. The structure is an essential component in the vascular ring that supports the deep brain structures, working in concert with the lenticulostriate and thalamoperforating arteries, yet maintaining its own distinct and critical vascular territory.

2. Anatomical Origin and Course

The origin of the AChA is generally consistent, arising from the posterior wall of the ICA, usually 2 to 5 millimeters distal to the origin of the PCoA, though slight variations are observed. Following its origin, the artery enters its first and longest segment, the **cisternal segment**, which spans the ambient and crural cisterns. In this segment, the AChA follows a posterior and slightly lateral course, maintaining close proximity to the crucial surrounding neurovascular structures. It runs alongside the oculomotor nerve (CN III) initially and then traces the superior-medial aspect of the **optic tract**, often spiraling around it. This intimate relationship with the optic tract means that surgical manipulation or aneurysm formation in this area can directly affect visual pathways, leading to specific field cuts.

As the AChA continues its course, it passes inferior to the temporal lobe, traversing the crural cistern, and approaching the area of the **lateral geniculate body**. It then reaches the most vulnerable point in its trajectory, known as the choroidal point, where it turns superiorly and posteriorly to penetrate the brain parenchyma. For descriptive purposes, neurosurgeons often divide the AChA into two major segments: the aforementioned cisternal segment (or pre-plexal segment), which is extracerebral, and the second, the **plexal segment** (or post-plexal segment), which is intracerebral and involves the final distribution within the ventricle. The cisternal segment is frequently the target in imaging studies and is the part most associated with aneurysmal pathology arising from the ICA complex.

Upon reaching the choroidal fissure, the AChA enters the temporal horn of the lateral ventricle, marking the beginning of the plexal segment. It travels along the choroid plexus, giving off its terminal branches. These terminal branches are categorized into two groups: the **anterior group** and the **posterior group**. The anterior branches supply the deep grey matter and white matter tracts before entering the ventricle (e.g., the globus pallidus and internal capsule), while the posterior branches run within the ventricle itself, supplying the choroid plexus and reaching structures like the lateral geniculate nucleus and specific parts of the thalamus and hippocampus. This dual distribution pattern highlights why a single occlusion event can produce such a widespread array of deficits affecting both motion/sensation and higher-order functions.

3. Distribution and Supplied Structures (Territory)

The territory supplied by the AChA is remarkably complex and disproportionately critical for such a small vessel. Its distribution is broadly divided into the deep telencephalic structures, the diencephalic structures, and the limbic structures. Key among the telencephalic supply is the **posterior limb of the internal capsule**, which is the main conduit for motor fibers descending from the cortex and sensory fibers ascending to the cortex. Specifically, the AChA supplies the posterior two-thirds of this limb, meaning motor control for the contralateral side of the body is

heavily reliant on this artery, making it susceptible to severe motor deficits upon compromise. Furthermore, it supplies the inferior portion of the **globus pallidus**, a critical component of the basal ganglia involved in the regulation of voluntary movement.

In the diencephalon, the AChA is responsible for perfusing parts of the thalamus, particularly the lateral geniculate body (LGB) and the ventrolateral nucleus. The LGB is the primary relay center for visual information processing, receiving input from the optic tract (which the AChA closely accompanies). Consequently, blockage of the AChA often results in a **homonymous hemianopia**--blindness in the corresponding half of the visual field--due to ischemia of the LGB and/or the optic tract itself. The supply to the ventrolateral nucleus of the thalamus contributes to sensory processing and integration, further complicating the sensory deficits associated with AChA occlusion.

Beyond the major motor and sensory highways, the AChA is crucial for limbic and deep ventricular structures. It provides the primary blood supply to the **choroid plexus** of the temporal horn of the lateral ventricle, where cerebrospinal fluid is produced. Additionally, it supplies the uncus, the piriform cortex, and the **amygdala**--deep brain nuclei integral to emotion, memory, and olfactory processing. Its territory also encompasses portions of the hippocampus and the tail of the caudate nucleus. The involvement of these limbic structures means that infarcts in the AChA territory can sometimes present with cognitive or affective symptoms, although the dominant clinical picture remains the striking motor and sensory loss due to internal capsule involvement.

4. Segmentation and Vascular Variations

Neuroanatomists and neurosurgeons often recognize the importance of segmenting the AChA to precisely locate pathology and plan surgical approaches. As mentioned, the **cisternal segment** is the portion originating from the ICA up to the choroidal fissure, lying within the subarachnoid space. This segment is frequently associated with the development of rare but highly dangerous aneurysms due to flow dynamics near its origin. The **plexal segment** begins at the choroidal fissure and continues along the choroid plexus within the ventricle. The distinction is clinically vital: the cisternal segment is accessible via certain microsurgical approaches, while the plexal segment is deep and highly protected.

Vascular variations, while not always common, are important considerations. In a minority of cases, the AChA may originate from the middle cerebral artery (MCA) or the posterior communicating artery, rather than the ICA. Furthermore, the artery may be duplicated (a dual AChA) or, conversely, extremely hypoplastic (underdeveloped), resulting in compensatory enlargement of other deep perforating arteries, particularly the lateral striate arteries. The existence of a duplicated AChA is generally protective, as occlusion of one vessel may spare some territories. In contrast, a single, dominant AChA makes the supplied area highly susceptible to

large, devastating infarcts upon occlusion.

Regarding collateral circulation, the AChA territory is notorious for its relative lack of adequate backup perfusion, especially the perforating branches supplying the internal capsule. While some minor anastomoses exist--primarily with the **lateral striate arteries** (branches of the MCA) and the **posterior choroidal arteries** (branches of the PCA)--these connections are often insufficient to prevent significant damage when the main AChA trunk is occluded. The posterior choroidal arteries supply the posterior parts of the choroid plexus and some deep structures in the posterior thalamus, and their communication with the terminal branches of the AChA can sometimes limit the extent of a posterior infarct, but rarely prevents the catastrophic damage to the internal capsule. This inherent vulnerability underscores why AChA occlusion is a major cause of lacunar syndrome variants.

5. Clinical Significance: Infarction and Pathology (AChA Syndrome)

Occlusion of the AChA--most commonly due to embolism, atherothrombosis, or small vessel disease (lipohyalinosis in hypertension)--produces a specific and severe clinical presentation known as the **Anterior Choroidal Artery Syndrome**. This syndrome is characterized by a triad of symptoms reflecting the involvement of the key structures in its vascular territory: contralateral hemiplegia, contralateral hemianesthesia, and contralateral homonymous hemianopia. This combination of deficits results from simultaneous damage to the motor fibers (internal capsule), sensory fibers (internal capsule/thalamus), and visual pathways (optic tract/lateral geniculate body).

The **contralateral hemiplegia** is typically the most prominent and debilitating feature, stemming from ischemia to the corticospinal and corticobulbar tracts passing through the posterior limb of the internal capsule. Depending on the exact location and completeness of the occlusion, the hemiplegia can range from weakness (paresis) to complete paralysis. Similarly, the **contralateral hemianesthesia** arises from damage to the ascending sensory pathways, causing loss of touch, pain, temperature, and proprioception on the opposite side of the body. The visual deficit, **homonymous hemianopia**, confirms the involvement of the deep visual processing centers, particularly the lateral geniculate nucleus, distinguishing this syndrome from those affecting only the primary visual cortex (which is supplied by the PCA).

Aneurysms involving the AChA are relatively rare compared to those found on the ACoA or PCoA, but when they do occur, they pose significant neurosurgical challenges due to their deep location, their small size, and their critical relationship to the surrounding neurovascular structures. Aneurysms at the ICA-AChA junction must be carefully managed to avoid accidental clipping or damage to the parent artery or the AChA itself, which would precipitate the devastating AChA syndrome. Furthermore, the artery's close proximity to the optic apparatus makes both unruptured

and ruptured aneurysms prone to causing visual field deficits or cranial nerve palsies due to mass effect or hemorrhage into the cisterns.

6. Surgical and Imaging Considerations

The AChA serves as a crucial anatomical landmark in neurosurgery, particularly during approaches to the deep temporal lobe, the third ventricle, and the basal cisterns. Surgeons must meticulously identify and preserve the AChA during procedures involving the anterior communicating artery, the posterior communicating artery, and deep-seated tumors like gliomas or meningiomas in the crural or ambient cisterns. Damage to this artery, even minor traction or coagulation, risks immediate and irreversible neurological deficits. The artery's location, running along the optic tract and toward the temporal horn, defines the boundaries for safely navigating these deep brain areas.

In the context of cerebral angiography, visualization of the AChA is essential for diagnostics, though its small caliber can make clear imaging difficult. It is typically seen arising from the ICA and arching backward. Digital subtraction angiography (DSA) provides the clearest image, showing its path and the extent of its filling. In ischemic stroke evaluation, Magnetic Resonance Imaging (MRI) with Diffusion-Weighted Imaging (DWI) is the definitive modality for confirming an AChA infarct, which appears as a characteristic pattern of ischemia affecting the posterior limb of the internal capsule, extending into the globus pallidus and potentially involving the thalamus and optic tract area.

During complex vascular procedures, such as treating aneurysms arising from the ICA or those bordering the PCoA, temporary occlusion of the ICA may be required. However, the reliance of the deep brain structures on the AChA means that the duration of temporary occlusion must be minimized, and intraoperative monitoring, such as somatosensory evoked potentials (SSEPs), is often employed to detect early signs of ischemia to the supplied structures. The surgical challenge lies in achieving proximal control of the ICA while dissecting the delicate deep cisterns where the AChA begins its course, often necessitating highly specialized microsurgical techniques.

7. Further Reading

Anterior Choroidal Artery (AChA) - Wikipedia
Anterior Choroidal Artery - Radiopaedia
Anatomy of the anterior choroidal artery: microsurgical approach and clinical significance
The Internal Capsule and Anterior Choroidal Artery Syndrome