Anterior communicating artery duplication

- Comprehensive Classification of Variations of the Anterior Part of the Circle of Willis in Fresh Cadavers Anterior Communicating Artery
- Partial duplication of the anterior communicating artery: A case report
- Bilateral duplication of the posterior communicating artery
- Dual fenestration of the A1 and azygos A2 segments of the anterior cerebral artery illustrated by Magnetic Resonance Imaging
- Accessory anterior cerebral artery of duplicate origin associated with accessory middle cerebral artery and anterior cerebral artery fenestration
- True fenestration of an extremely long anterior communicating artery diagnosed by magnetic resonance angiography
- Persistent primitive olfactory artery associated with accessory middle cerebral artery and partially duplicated anterior communicating artery
- Accessory middle cerebral artery of distal origin associated with an anterior communicating artery duplication that mimicked an aneurysm

Anterior communicating artery (ACoA) duplication refers to the presence of two separate arterial segments connecting the left and right anterior cerebral artery (ACAs) at the level of the A1-A2 junction. It is a rare anatomical variation, usually identified incidentally during imaging or autopsy.

Anatomical Description

Normal Anatomy: In typical cerebrovascular anatomy, a single anterior communicating artery bridges the two ACAs, allowing for collateral blood flow between the hemispheres.

Duplication: ACoA duplication involves two distinct vascular channels, either running parallel to each other or with one positioned anteriorly and the other posteriorly.

Clinical and Imaging Features

Incidence:

Rarely reported; its exact prevalence is uncertain. May be underdiagnosed due to its subtle appearance on standard imaging.

Associated Conditions

Aneurysms: The presence of duplicated ACoAs may predispose to aneurysmal development due to

turbulent flow dynamics at the branching points. Collateral Circulation: Duplication might enhance collateral blood flow in cases of proximal ACA occlusion, providing a potential protective effect. Cerebrovascular Events: Altered hemodynamics could theoretically increase the risk of ischemic or hemorrhagic events, though direct evidence is limited.

Imaging

Magnetic Resonance Angiography (MRA)

High-resolution MRA with 3D volume rendering can effectively visualize duplicated segments.

A case of distal origin accessory middle cerebral artery associated with ACoA duplication diagnosed by magnetic resonance angiography (MRA).

A 63-year-old man visited another hospital for screening examinations for cerebrovascular disease. He was noted to have a possible intracranial aneurysm at the A1-A2 junction of the right anterior cerebral artery on MRA. He was referred to the hospital for its management. More detailed 3-Tesla MRA volume rendering images revealed ACoA duplication, not an aneurysm. MRA also showed the right distal origin accessory MCA arising from the A2 segment distal to the ACoA duplication.

This rare combination of anatomical variations requires careful imaging assessment. MRA volume rendering images were useful in this case $^{1)}$.

This case report effectively showcases the diagnostic capabilities of high-resolution MRA in identifying complex cerebrovascular anomalies. However, it could benefit from a more detailed exploration of the clinical and hemodynamic implications of the findings, as well as follow-up data to guide management strategies. Despite its limitations, the report is a valuable contribution to the understanding of rare anatomical variations and the importance of advanced imaging in neurovascular diagnosis.

Digital Subtraction Angiography (DSA)

Considered the gold standard for evaluating complex vascular anomalies like ACoA duplication.

CT Angiography (CTA)

Useful for identifying larger duplications but may miss subtle variants.

Pathophysiology and Development

ACoA duplication arises from variations during embryological development of the anterior circulation. Abnormal persistence or division of the primordial arterial channels leads to the formation of two distinct communicating vessels.

Clinical Significance

Differential Diagnosis:

ACoA duplication can mimic an intracranial aneurysm or other vascular pathologies on low-resolution imaging. Differentiating a duplicated ACoA from vascular artifacts or pathologies is critical to avoid misdiagnosis and unnecessary interventions. Surgical Implications:

Awareness of this variation is crucial during aneurysm clipping or other surgical interventions in the anterior circulation to prevent inadvertent injury to the duplicated segments. Risk of Aneurysms:

Hemodynamic stress at branching points may increase the likelihood of aneurysm formation at the ACoA complex, warranting close monitoring if duplication is detected. Endovascular Procedures:

Variations like ACoA duplication can complicate catheter navigation and treatment planning, making pre-procedural imaging essential.

Management

Incidental Findings: No specific treatment is required for asymptomatic ACoA duplication. Regular follow-up may be recommended if associated anomalies like aneurysms are identified. Aneurysms or Pathologies: If associated with an aneurysm, treatment depends on size, location, and rupture risk. Options include endovascular coiling or surgical clipping. Stroke Risk: In ischemic conditions, its role in collateral circulation can influence management strategies.

Conclusion

Anterior communicating artery duplication is a rare vascular anomaly with potential clinical and surgical implications. Accurate identification and characterization using advanced imaging modalities like MRA or DSA are essential for proper diagnosis and management. Understanding its role in cerebrovascular hemodynamics can help guide therapeutic decisions, particularly in the context of aneurysms or stroke.

Case reports

A case of distal origin accessory middle cerebral artery associated with ACoA duplication diagnosed by magnetic resonance angiography (MRA).

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A fenestrated AComA with a saccular aneurysm (neck diameter 9 mm; dome height 8 mm) projecting superiorly from the distal AComA branch, as well as an anomalous artery arising from the posterior surface of the same AComA. (2) A duplicate AComA with a saccular aneurysm (neck diameter of 5 mm; dome height of 9 mm) projecting superioposteriorly from the distal AComA branch, as well as an anomalous artery arising from the anterior surface of the same AComA was diagnosed. Both were treated by microsurgical titanium clip occlusion.

Clinical discussion: Anatomical variations are believed to enhance the risk of anterior communicating artery (AComA) aneurysms, accounting for \sim 30% of all intracranial aneurysms. In such circumstances, the goal is to occlude the aneurysmal lesions safely while preserving the patency of other branches.

AComA aneurysms accompanied by anomalous triplicated A2 and fenestrated AComA are rare and challenging. Such complex cases response best using microsurgery using titanium clip occlusion with durable favorable outcomes ³⁾.

This case underscores the importance of recognizing and managing the heightened risks associated with AComA aneurysms in the context of anatomical variations. Microsurgical titanium clip occlusion remains the preferred approach for such challenging scenarios, provided that careful intraoperative and postoperative protocols are followed. Further details on intraoperative techniques and long-term outcomes would strengthen the clinical discussion and contribute valuable insights to the literature on managing complex AComA aneurysms.

1) 2)

Endo H, Ono H, Nakamura H. Accessory middle cerebral artery of distal origin associated with an anterior communicating artery duplication that mimicked an aneurysm. Surg Radiol Anat. 2024 Dec 22;47(1):39. doi: 10.1007/s00276-024-03542-3. PMID: 39710787.

3)

Hosseini EM, Aghamiri SH, Haridas A, Natarajan S, Peyvandi M, Sourani A. Anterior communicating artery aneurysm with concomitant A2 segment triplication and anterior communicating artery fenestration, A rare case series on microsurgical treatment. Ann Med Surg (Lond). 2024 Oct 16;86(12):7351-7355. doi: 10.1097/MS9.000000000002646. PMID: 39649906; PMCID: PMC11623910.

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