ISSN: 2394-0026 (P)
ISSN: 2394-0034 (O)

Case Series

Anterior cerebral artery - Anatomic region favoring aneurysms: Case series

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How to cite this article: Ashfaq ul Hassan, Rohul Afza Kaloo, Pervez Shah, Masood Tanver, Obaid, Muneeb ul Hassan, Zahida Rasool. Anterior cerebral artery - Anatomic region favoring aneurysms: Case series. IAIM, 2014; 1(3): 31-35.

Available online at www.iaimjournal.com

Received on: 21-10-2014 **Accepted on:** 28-10-2014

Abstract

Aneurysms or Dilatations in the vessels which are prone to rupture occur at bifurcations of large arteries at the base of brain. Rupture occurs into the sub-arachnoid space in the basal cisterns and into parenchyma of the brain. 80-90% of these aneurysms occur at circle of Willis. Commonest types are the Berry's aneurysms and commonest sites are at Junction of anterior communicating artery with anterior cerebral artery and bifurcation of middle cerebral artery.

Key words

Anterior cerebral artery, Aneurysm, Callosum, Terminal.

Introduction

These aneurysms may undergo small ruptures and bleed (sentinel bleeds). Sudden unexplained headaches should raise suspicion of sub-arachnoid hemorrhage (SAH) and should be investigated because major hemorrhage may be imminent and life consuming.

Case series

Case - 1

A 45 years old woman presented in Emergency Department with sudden onset headache, dizziness and neck pain. There was no past history of hypertension, diabetes, pyrexia. The patient was able to move her extremities.

ISSN: 2394-0026 (P)
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Cranial nerves were normal on examination and brain stem reflexes were normal. CT angiogram showed an aneurysm in the area of Circle of Willis in anterior circulation within the anterior cerebral artery. **(Photo – 1, Photo – 2, Photo – 3)**

Photo – 1: CT angiogram showing aneurysm of anterior cerebral artery (Case – 1)

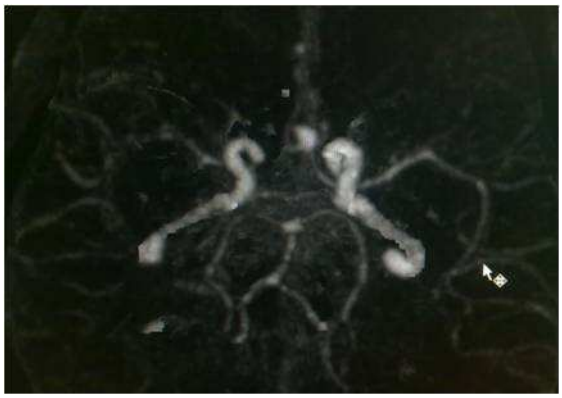


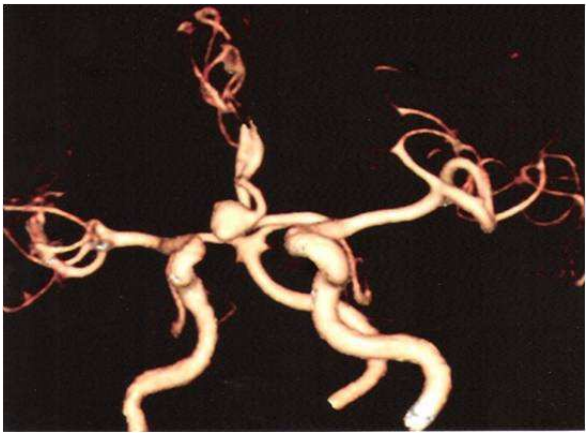
Photo – 2: CT angiogram showing aneurysm of anterior cerebral artery (Case – 1)

Case - 2

A 40 years old woman presented in Emergency Department with severe headache, projectile vomiting, dizziness and transient loss of consciousness. There was no past history of hypertension and diabetes. Patient was able to move her extremities. Cranial nerves were normal on examination and brain stem reflexes were normal. 3D CTA (CT angiogram) showed an aneurysm in the area of Circle of Willis in anterior circulation within the anterior cerebral artery. **(Photo – 4)**

Photo – 3: CT angiogram showing aneurysm of anterior cerebral artery (Case – 1)

Photo – 4: 3D CTA showing aneurysm of anterior cerebral artery (Case – 2)



Discussion

Neuro-anatomy of anterior cerebral artery

The brain receives its blood supply from two main sources:

A. The internal carotid arteries (which arise from the common carotid arteries).
B. The vertebral arteries (which arise from the subclavian arteries).

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Anterior cerebral artery is the "smaller" of the two terminal branches of the internal carotid artery. It passes "medially and forwards" towards the middle line and then turns sharply "upwards" in the longitudinal fissure to reach the genu of the corpus callosum; it then runs "backwards" along the upper surface of the corpus callosum to reach the splenium where it ends by turning "upwards" anterior to the parieto-occipital sulcus. Branches of the anterior cerebral artery are [1, 2]

1. Cortical branches and
2. Central branches which penetrate to supply the anterior part of the corpus striatum and part of the anterior limb of the internal capsule.
3. Branches to the septal region including septum lucidum.
4. Branches to all parts of the corpus callosum except the splenium (which is supplied by the posterior cerebral artery).

Clinical importance of the anterior cerebral artery lies in the fact that it supplies 3 important regions on the medial surface:

a. The motor and sensory areas of the "lower limb" (in the paracentral lobule).
b. The septal region (where a small lesion may result in prolonged unconsciousness).
c. The corpus callosum: Apraxia may result from a lesion to the corpus callosum [3].

The vessel is divided into A1 (between carotid bifurcation and anterior communicating artery), A2 (from rostrum to genu of corpus callosum) and A3 segments (around the genu of corpus callosum).

Physiological aspects of blood flow

The grey matter contains more capillaries than the white matter (needs more oxygen). The arterial blood pressure (and especially the difference between the arterial and venous blood pressure) is the main factor in regulating the volume of blood flow to the brain. More than 25% of the blood circulates in the human brain at rest. At rest also, about 25% of the oxygen inspired is absorbed by the brain. Glucose is the principal substance oxidized by the brain. Unconsciousness develops 5-10 seconds after sudden stoppage of blood flow to the head.

Pathological considerations

The anterior circulation is notorious for aneurysm formation. Aneurysms may remain clinically silent or may present with varied symptoms like severe onset headache, vomiting, neck pain, loss of consciousness or focal neuro deficit depending on the site of leakage. Most of them occur in the territory of anterior and middle cerebral artery. The cerebral and dural arteries have the following characteristics:

- Thin walls when compared to their lumen.
- Very well developed internal elastic lamina.
- Few smooth muscle fibers.

Histologically, the arteries form the main components of the vascular system. On the whole, the general arrangement of a medium sized vessel has 3 layers from within outwards which are tunica intima, tunica media and tunica adventitia. Cerebral vessels have less marked tunica media and very little elastic tissue in tunica externa. There are minimal defects or gaps in media called locus minoris resistentiae which are major risk factors for development of aneurysms. Also the location of cerebral aneuryms favors sites of bifurcation of vessels where disturbances of cerebral blood flow are generated. At these areas there is more turbulence and more chance of endothelial damage which has been proven to be a nidus for aneurysm formation. This fact can be made

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worse by associated atherosclerosis which leads to disturbances in laminar flow.

Pathologically, congenital defects in the muscle and elastic tissue of the arterial media gradually deteriorate as they are exposed over time to the hemodynamic stresses of pulsatile blood flow. The types of aneurysms are saccular or fusiform. Endogenous factors like altered blood flow, elevated blood pressure, germ line mutations, endothelial repair defects contribute.

A modest incidence of familial saccular aneurysms as well as their association with polycystic kidney disease, Ehlers-Danlos syndrome, Marfans syndrome, Coarctation of aorta, Bicuspid valvular disease, Neurofibromatosis, Fibromuscular dysplasia, Autosomal polycystic kidney disease [4, 5, 6] and other connective tissue disorders implicates hereditary factors. Although hypertension is not a significant risk factor for aneurysmal SAH, aneurysms have been known to rupture under conditions associated with a sudden rise in blood pressure, including extremes of emotional excitement and physical exertion such as heavy exercise, coitus and athletic events. Aneurismal rupture is a serious complication and risk of rupture is directly correlated with the size of aneurysm.

Radiographic assessment

The risk of rupture significantly increases with sizes greater than 6 mm [7]. Aneurysms with a daughter sac are also more liable to rupture. The pathogenesis of aneurysms reflects a combination of congenital, acquired, and hereditary factors.

The assessment of aneurysms also requires detailed radiological procedure which can delineate and determine the exact size along three axis, the maximal width of the neck of aneurysm, lobulations, orientation and vascular profile of any smaller branch arising from the aneurysm. CT scans reveal sub-arachnoid blood within the basal cisterns in about three quarters of patients within 48 hours of bleeding. Magnetic resonance (MR) images in contrast to CT Scans have a lower index of accuracy. Detection of intracranial blood on the CT scan localized to the basal cisterns, the sylvian fissure, or the intra-hemispheric fissure more indicates rupture of a saccular aneurysm. Cerebral angiography remains the definitive study to detect the source of SAH. The definitive therapy for a ruptured saccular aneurysm consists of surgical clipping of the aneurysm to prevent re-bleeding. Medical therapy aims to reduce the risk of re-bleeding and cerebral vasospasm and to prevent other medical complications before and after surgical intervention. Digital Subtraction Angiography is now performed in most of the centres of the world and is particularly specific for aneurysms. Multi-detector CT angiography (MD CTA) has replaced the Digital Subtraction Angiography at many places in view of being more non invasive, with higher sensitivity and specificity [8, 9, 10, 11, 12, 13]. It offers complete anatomic details and has faster scanning options.

Conclusion

The aneurysms can rupture and bleed causing significant morbidity and mortality. A simple headache can be a presentation of this deadly pathological entity which simulates a time bomb. Every physician should rule out the possibility of underlying aneurysm.

References

1 Bracard S., Roland J., Picard L. Les vaisseaux du névraxe: Anatomie et pathologie. Livre 1: Variations des artères de l'encéphale Aulnay sous Bois:

ISSN: 2394-0026 (P)
ISSN: 2394-0034 (O)

Documentation du laboratoire Guerbet, 1984.

2 Lasjaunias P., Berenstein A., Ter Brugge K.G. Surgical neuroangiography clinical vascular anatomy and variations Berlin: Springer, 2001, p. 479–631.

3 Stefani M.A., Schneider F.L., Marrone A.C., Severino A.G., Jackowski A.P., Wallace M.C. Anatomic variations of anterior cerebral artery cortical branches, Clin Anat, 2000; 13: 231-236.

4 Nahm AM, Henriquez DE, Ritz E. Renal cystic disease (ADPKD and ARPKD). Nephrol. Dial. Transplant., 2002; 17(2): 311-4.

5 Konen E, Merchant N, Provost Y, et al. Coarctation of the aorta before and after correction: The role of cardiovascular MRI. AJR Am J Roentgenol., 2004; 182(5): 1333-9.

6 Wardlaw JM, White PM. The detection and management of unruptured intracranial aneurysms. Brain, 2000; 123(Pt 2): 205-21.

7 Wiebers DO, Whisnant JP, Huston J, et al. Unruptured intracranial aneurysms: Natural history, clinical outcome, and risks of surgical and endovascular treatment. Lancet, 2003; 362(9378): 103-10.

8 Kokkinis C., Vlychou M., Zavras G.M., Hadjigeorgiou G.M., Papadimitriou A., Fezoulidis I.V. The role of 3D-computed tomography angiography (3D-CTA) in investigation of spontaneous subarachnoid haemorrhage: Comparison with digital subtraction angiography (DSA) and surgical findings. Br J Neurosurg, 2008; 22: 71-78.

9 Kouskouras C., Charitanti A., Giavroglou C., Foroglou N., Selviaridis P., Kontopoulos V., et al. Intracranial aneurysms: Evaluation using CTA and MRA Correlation with DSA and intra-operative findings. Neuroradiology, 2004; 46: 842-850.

10 McKinney A.M., Palmer C.S., Truwit C.L., Karagulle A., Teksam M. Detection of aneurysms by 64-section multidetector CT angiography in patients acutely suspected of having an intracranial aneurysm and comparison with digital subtraction and 3D rotational angiography. Am J Neuroradiol, 2008; 29: 594-602.

11 Pechlivanis I., Schmieder K., Scholz M., König M., Heuser L., Harders A. 3-Dimensional computed tomographic angiography for use of surgery planning in patients with intracranial aneurysms. Acta Neurochir (Wien), 2005; 147: 1045-1053.

12 Hiratsuka Y., Miki H., Kiriyama I., Kikuchi K., Takahashi S., Matsubara I., et al. Diagnosis of unruptured intracranial aneurysms: 3T MR angiography versus 64-channel multi-detector row CT angiography. Magn Reson Sci, 2008; 7: 169-178.

13 Gauvrit J.Y., Leclerc X., Ferré J.C., Taschner C.A., Carsin-Nicol B., Auffray-Calvier E., et al. Imagerie de l'hémorragie sous-arachnoïdienne. J Neuroradiol, 2009; 36: 65-73.

Source of support: Nil
Conflict of interest: None declared.