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Magnetic Resonance Angiography reveals Intracranial Berry Aneurysm in a Clinically Asymptomatic Patient: A Case Report on a 58-year-old Ghanaian Woman

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ABSTRACT

Headaches associated with intracranial aneurysms are often misdiagnosed and poorly understood in the Ghanaian population. The symptomatology of intracranial aneurysms ranges from asymptomatic to subarachnoid haemorrhage, depending on the size of a particular aneurysm. The objective of this case study was to use gadolinium-enhanced MRA to radiologically describe features of intracranial berry aneurysm (IBA) in a clinically asymptomatic patient. We present a case report on a 58-year-old woman who experienced constant right-sided headaches for about a year, managed by herbal medication until her referral to the diagnostic imaging unit for radiological investigation. She underwent a series of brain magnetic resonance (MR) imaging investigations, involving pre- and post- gadolinium contrast MR angiography (MRA). Axial, sagittal and coronal brain MRI and MR angiography were conducted with 50 mg/ml gadolinium contrast and radiologically evaluated. A right posterior communicating artery aneurysm was found, suggesting compression of the oculomotor nerve, which is characteristic of intracranial berry aneurysm (IBA) and associated with her constant headaches. The patient could not afford the cost of an aneurysm coiling to treat her condition, so she was placed on prescription medication and recommended lifestyle changes to manage her condition. The case report shows the accuracy of MRA in definitive diagnosis of IBA, which could be used to better characterize suspected aneurysm on particularly small vessel MRI of patients presenting with constant unexplained headaches.

Keywords: *Aneurysm, headache, internal carotid artery, intracranial berry aneurysm, magnetic resonance angiography, time-of-flight.*

INTRODUCTION

Berry or saccular aneurysms represent 90% of intracranial aneurysms (Brisman, Song, & Newell, 2006; Hacein-Bey, & Provenzale, 2011). They present as small, round dilations typically located at arterial bifurcations within the circle of Willis in the brain, resulting from localized arterial wall weaknesses possibly influenced by genetic, hemodynamic, and environmental factors. If left untreated, these aneurysms carry a significant risk of rupture, leading to subarachnoid hemorrhage. Larger or ruptured aneurysms can cause severe headaches, visual disturbances, or neurological deficits (Cianfoni *et al*., 2013).

The symptomatology of unruptured intracranial aneurysms ranges from asymptomatic to vague or non-specific symptoms like headache, dizziness, neck pain or photophobia, depending on the size of a particular aneurysm. Ruptured

aneurysms are commonly associated with non-traumatic subarachnoid hemorrhage and may lead to neurological emergency with potentially devastating consequences (Cianfoni *et al*., 2013). The earlier terminology used to describe this condition was berry aneurysm, but this has now been replaced by saccular aneurysm. Diagnosis can be made with time-of-flight (TOF) magnetic resonance imaging (MRI) or contrast-enhanced computed tomography angiography (CTA), and treatment options encompass surgical clipping or endovascular coiling, aiming to mitigate the risk of rupture (Gamal, 2015; Jiang *et al*., 2020).

MATERIALS AND METHODS

A patient with constant right-sided headaches and right oculomotor nerve palsy was referred to the Komfo Anokye Teaching Hospital (KATH), Kumasi-Ghana, for MRI of the brain. This case report presents the MRI findings about this patient.

Case Presentation

A 58-year-old woman weighing 80 kg was referred from the Outpatient Department (OPD) of KATH to the Radiology Department for brain MRI with a provisional diagnosis of right-sided headaches and right oculomotor nerve palsy. She had experienced constant headaches over a year, and has often relied on herbal medication for pain relief but this did not treat the condition. She had no family history of intracranial berry aneurysm, had a history of hypertension treated with herbal medications, occasionally consumed a unit of alcohol, and a non-smoker. She was referred for brain MRI to exclude microaneurysms as the cause of her third nerve palsy.

MRI Acquisitions

After a satisfactory outcome of her renal function test, the following pre- and post-gadolinium (50 mg/ml) contrast-enhanced brain MRI acquisitions were carried out on a 1.5 T Toshiba Achieva MRI scanner (Philips, Amsterdam, The Netherlands):

Sagittal T2W, T1W, T1W(FSE), T1W(FSE) Gado.
Axial T1W, T2W, T2W*, FLAIR, DWI, T1W Gado, Gado MRA
Coronal T1W, T2W, T1W Gado
T1W FatSat acquisition (pre and post Gado) to visualize non-contrast enhanced images

Where T2W = spin-lattice relaxation time weighted contrast, T1W = spin-spin relaxation time weighted contrast, and T2W = susceptibility-weighted spin-lattice relaxation time contrast.*

Various pulse sequences were used with and without the contrast (gadolinium, Gado) to enhance visualization of all features for accurate radiological interpretation; the pulse sequences included Fast Spin Echo (FSE), Fluid Attenuated Inversion Recovery (FLAIR), Diffusion Weighted Imaging (DWI), Magnetic Resonance Angiography (MRA), and Fat Saturation (FatSat) sequences. Slice thickness of 2.0 mm was used for the image acquisitions, appropriate for the range of sizes of various aneurysms (< 5.0 mm to >25.0 mm), reported elsewhere (Merritt *et al*., 2021).

RESULTS AND DISCUSSION

Time-of-flight (TOF) magnetic resonance angiography is useful in the detection of berry aneurysms in patients with renal impairment. However turbulent flow within the aneurysm can make diagnosis difficult. To optimize the use of MRI in the clinical investigations, it became necessary to include contrast-enhanced MR

angiography in the acquisition protocol, which has shorter acquisition times compared to TOF and shows high signal intensity even in the presence of turbulent or slow flow or spin saturation in larger scan volumes (Gamal, 2015). Berry aneurysms yield hyperintense lesions on T1W MRI with gadolinium-based contrast agents, and so this acquisition was also performed.

The brain MRI revealed bulbous dilatation at the junction of the right internal carotid artery and the posterior cerebral artery measuring approximately 9 mm maximum, in diameter (Figure 1). In the axial view of the MR image, the lesion appeared to be originating from the right posterior communicating artery. The lesion retained contrast on T1W MRI with gadolinium, suggestive of an aneurysm. There was also a likely compression of the oculomotor nerve just before the cavernous sinus portion. The ventricles appeared normal in size and showed no signs of raised intracranial pressure.

The brain MRI showed an unruptured aneurysm with a thrombus that was enhanced on T1W MRI with gadolinium. The orbital contents were unremarkable. The impression on the findings confirmed a right posterior communicating artery aneurysm (Figure 1) with suggestion of compression of the oculomotor nerve as described above.

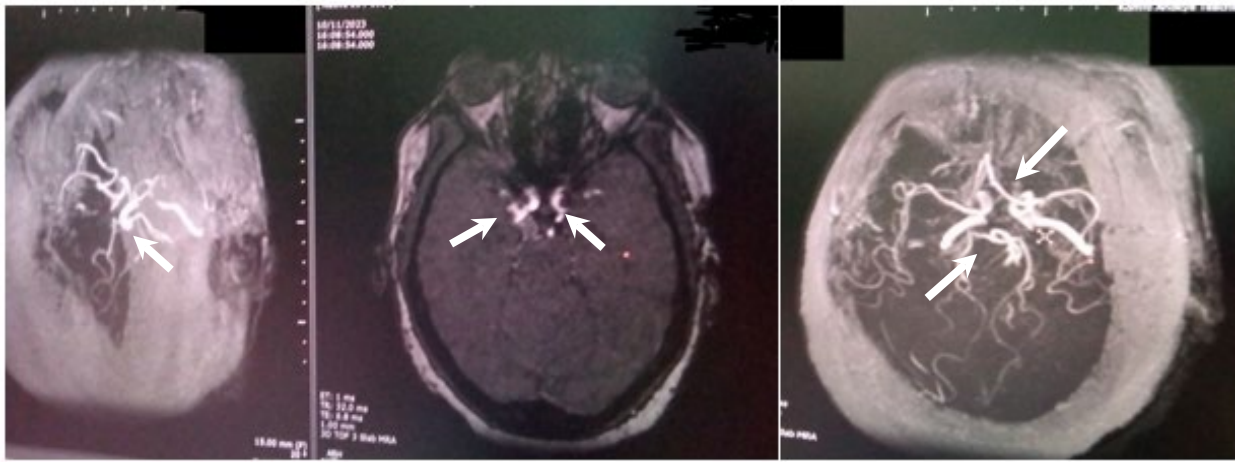

Figure 1: Axial MR angiogram of the patient with arrows pointing to the aneurysm

MR imaging can be used to confirm a suspected case of intracranial aneurysm. However, for smaller aneurysms, the sensitivity of MRI may be limited, which makes it impossible (without performing an angiogram) to specify how different they appear radiologically from infundibular dilations. Circle of Willis anomalies are often associated with ruptured as compared to unruptured cerebral aneurysms of the anterior and posterior communicating arteries (Lazzaro, Ouyang, & Chen, 2012). Our patient presented with unruptured aneurysm and did not show sign of circle of Willis anomaly.

A definitive identification of an aneurysm is crucial for accurate diagnosis. Aneurysm rupture, or subarachnoid hemorrhage, is confirmed by lumbar puncture whereby cerebrospinal fluid is drawn and is evaluated for red blood cell count, as well as the presence or absence of xanthochromia (Amigo *et al*., 2021; Marco, 2021). However, computed tomography angiography (CTA) is reported to reveal blood in the basal cisterns within the first

12 hours after subarachnoid hemorrhage with approximately 95% sensitivity and specificity, and lumbar puncture is only required if no blood is seen on CT (Petridis *et al*., 2017).

In a retrospective cross-sectional study of 31 patients (with 37 lesions) diagnosed with intracranial aneurysm using digital subtraction angiography (DSA), Sarkodie *et al*. (2023) reported higher incidence of ruptured (n = 27) than unruptured (n = 10) aneurysms, and a majority of the lesions occurred in the posterior communicating artery. The MRI of our patient showed an unruptured aneurysm in this location. About 16.6% of aneurysm cases are reported to be among hypertensives, and these are the most common cases in the Ghanaian population, according to an autopsy study (Anim, 1985).

In a systematic review involving a patient population of 512 individuals who underwent CT angiogram (CTA) to characterize intracranial aneurysms, Han *et al*. (2013) found that 6.6 % of the 512 patients had intracranial vascular lesions on CTA and observed that aneurysms arose most commonly on the internal carotid artery ($n = 12$), followed by the anterior communicating artery ($n = 7$), and the middle cerebral artery ($n = 7$). Maximal diameters ranged from 2.0 to 13.1 mm (mean, 3.9 ± 2.6 mm). They noted that their estimated prevalence of 6.6% confirmed cases of aneurysms on CTA was higher than that predicted in the general population. They, therefore, concluded that CTA is a feasible tool for diagnosing intracranial vascular lesions in patients with acute severe headaches.

Nonetheless, a patient's clinical history is required to accurately diagnose the cause of their headache, which may point to many clinical abnormalities, including aneurysms. Such information may aid the radiologist in deciding on the necessity for imaging and the appropriate modality to choose (Guryildirim *et al*., 2019).

There are primarily two choices of non-invasive imaging modalities for the identification and characterization of subarachnoid hemorrhage and cerebral aneurysms. These are computed tomography (CTA) and magnetic resonance (MRA) angiography; in addition, the interventional technique, digital subtraction angiography (DSA), is also used in some cases (Yoon et al., 2016). Each of these techniques have unique strengths, weaknesses, and current advances. For example, while CTA exposes the patient to radiation, MRA is a non-radiation-based modality and both modalities could be performed without contrast to identify aneurysms. DSA is invasive in nature and mostly involves the use of contrast.

Currently, intracranial aneurysms are effectively treated by two available clinical procedures: *surgical clipping* or *endovascular coiling*. It is recommended that any of these two treatment options should be performed on the patient within the first 24 hours after bleeding to obstruct the ruptured aneurysm and reduce the possibility of recurrent hemorrhage. Meta-analyses results (Delgado, Andersson, & Delgado, 2017; Jiang *et al*., 2020; Ruan *et al*., 2015) have not found statistically significant differences in the outcomes and risks of the two procedures.

However, the International Subarachnoid Aneurysm Trial (Molyneux, 2002) reported a high rate (28.6 to 33.6%) of recurrence within a year associated with the endovascular coiling method. Furthermore, there is a 7% lower eight-year mortality rate with coiling, a 6.9 times greater rate of late retreatment for coiled aneurysms, and 8 times higher rebleeding risk than surgically clipped aneurysms.

The patient was referred to neurosurgery for aneurysm coiling, but financial constraints prevented her from pursuing the recommended treatment. Instead, she received prescription medication and was advised to make lifestyle adjustments to manage her condition.

CONCLUSION

Magnetic resonance imaging (MRI) is a powerful technique for the detection of berry or saccular aneurysm, an important cause of persistent headache. Prompt imaging is key in identifying such dangerous conditions to facilitate timely management to prevent complications. Cross-sectional imaging studies are recommended to characterize and estimate the incidence of intracranial berry aneurysms in the Ghanaian population.

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COMPETING INTERESTS

The authors have no competing interest to declare.

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