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An Overview on the Role of MRI in Diagnosis and Management of Berry Aneurysm

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ABSTRACT

Berry aneurysms are also known as saccular aneurysms are pathological dilatations of intracerebral arteries, that are typically located within the anterior circulation of the brain. the exact etiology of their formation is still enigmatic, but it's postulated to be multifactual, through an interplay between familiar disposition, environmental factors, and degenerative processes. They are approximately found in around 3% of the general population. But the majority of cases are asymptomatic and are only detected accidentally. We aimed to review the literature looking into the role of MRI in the diagnosis of berry aneurysms. PubMed database was used for articles selection, papers were obtained and reviewed. Rigors number of studies have looked into the efficacy of MRI in the diagnosis of berry aneurysm, which has shown that MRI is as highly sensitive and specific as other diagnostic modalities chiefly CTA and DSA. Moreover, the utilization of different techniques such as HRMRI can lead to its use as a risk assessment and prediction tool of future ruptures. Additionally, it is considered to be the safest method due to its lack of ionizing radiation, contrast administration, or catheterization, making it the ideal choice for screening in an asymptomatic patient.

Keywords: *MRI, Diagnosis, Screening, Berry aneurysm*

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INTRODUCTION

Berry aneurysms are also known as saccular aneurysms are pathological dilatation of intracerebral arteries, that arise due to weakness of the arterial wall and its inability to withstand hemodynamic pressure leading to its expansion (Frösen *et al.,* 2012). Typically located within the anterior circulation of the brain (around 90% of cases) (Seibert *et al.,* 2011), They are considered to be an acquired condition with the exact etiology behind them formation still being enigmatic, but it's postulated to be multifactual, through an interplay between familiar disposition, environmental factors and degenerative process (Williams & Brown, 2013).

They are the most prevalent form of intracranial aneurysms and are approximately found in around 3% of the general population, which translates into 168 million affected individuals worldwide (Hackenberg *et al*., 2018). Females and the elderly are more prone to develop aneurysms as the female to male ratio approaches 2 to 1 and the mean age of diagnosis is 50 years old (Vlak *et al*., 2011).

MThe majority of cases are unaware of their presence due to the silent and asymptomatic nature of the disease and are only detected accidentally when patients undergo cranial imaging (MRI/CT scan) for unrelated reasons (Ellis *et al.,* 2018). Berry aneurysms may lead to dire and series of consequences particularly the occurrence of Subarachnoid hemorrhages (SAH), a catastrophic complication with a mortality rate of 35%, and even high morbidity among the survivors (Hackenberg *et al.,* 2018). Fortunately, the risk of rupture is relatively low as the mean rupture risk within 1 and 5 years being merely 1.4% and 3.4% consecutively (Greving *et al.,* 2014), factors the could be utilized to predict such an unfortunate outcome are age, hypertension, history of prior hemorrhage, lastly the size and site of the aneurysm (Greving *et al.,* 2014). The most common

location of aneurysmal rupture is the anterior comminating artery (ACA) accounting for 40%, followed by the internal carotid artery in 25% (Inagawa, 2010).

MATERIALS AND METHODS

PubMed database was used for articles selection, and the following keys used in the mesh (((((berry aneurysm) AND (diagnosis)) OR (berry aneurysm)) AND (MRI)) OR (berry aneurysm)) AND (screening). In regards to the inclusion criteria, the articles were selected based on the inclusion of one of the following topics; optic neuritis; clinical features; management. Exclusion criteria were all other articles that did not have one of these topics as their primary endpoint.

Review

MRI / MRA in diagnosis and follow-up of symptomatic patients.

Multiple meta-analyses have looked into this topic with the most recent one being in 2014, where it has shown very promising results with a pooled sensitivity and specificity of 95% and 89% respectively, making MRA a viable option for the Diagnosis of berry aneurysms. In addition, it concluded that the use of the 3-Tesla time-of-flight MRA (3T -TOF) technique had similar outcomes to the traditional contrast-enhanced MRA (CE-MRA), which makes TOF-MRA a more favorable option as it avoids the use of contrast agents (Sailer *et al.,* 2014).

More recent researches have looked into other possible MRA sequences in the detection and evaluation of aneurysms aiming to identify the optimal diagnostic option. One group of researchers have compared the 3D non-contrast black-blood MRI technique (BB MRI) to the commonly used 3T – TOF, their result has shown that BB MRI has yielded more accurate measurements than 3T TOF, shedding light on the possible future utilization of such technique (Zhu *et al.,* 2019) .

With the emerge of the more novel MRI machines knowns as High-resolution MRI (HRMRI) new doors have opened up in follow-up of aneurysms, as one study has shown that detection of wall enhancement may reflect an undergoing inflammatory change which is a heralding sign of imminent rupture (Hu *et al.,* 2016). Another possible use of these devices is in patients presenting with SAH to determine whether it was aneurysmal in origin or not, this is due to the machine's ability to accurately detect ruptures in vessel walls (Matouk *et al.,* 2013). Another study had identified another possible method of rupture prediction through assessment of wall thickness by the new 7-tesla MRI technique (Kleinloog *et al.,* 2014) .

Another useful of MRI in the diagnosis of aneurysms is its ability to detect other possible differential diagnoses that may mimic the presentation of berry aneurysms or SAH such as meningitis, primary brain tumors, and Mets like leptomeningeal metastasis (Yoon *et al.,* 2016)

Comparing MRI/MRA to other diagnostic tools

Oher modalities that are utilized in the detection and evaluation of berry aneurysms are computed tomographic angiography (CTA) and digital subtraction angiography (DSA), with each one having its strengths and weakness.

When comparing MRA to CTA, MRA has the upper hand in regards to the safety profile, due to the high dose of ionizing radiation in CTA which doesn't exist in the former, additionally, MRA doesn't require contrast administration, unlike CTA which requires the use of a contrast agent that might lead to adverse effects chiefly contrast nephropathy and allergic reactions. Another advantage is the better detection rate of SAH in the acute or subacute period through the use of fluid-attenuated inversion recovery (FLAIR) sequences (MRA sensitivity 100% vs CTA sensitivity 66%). The main drawbacks of MRI are the higher price tag, prolonged time to obtain the results, and more susceptibility to motion artifacts, all of these obstacles hinder its use in an acute setting where CTA is the test of choice (Sailer *et al.,* 2014; Yoon *et al.,* 2016).

DAlthough MRA has a lower detection rate than Digital-subtraction angiography (DSA) which is considered as the gold standard tool in the diagnosis of berry aneurysms. In most cases we will not opt to use DSA due to the higher risk of its invasive nature and thus higher risk of adverse effects (Turan *et al.,* 2018), possible complications are similar to CTA with the added risk of vascular damage, neurological complication, or even strake and death. another key point to keep in mind is that the aforementioned risks get amplified greatly with each repeated procedure making it an unsuitable tool for follow-up (Ahmed *et al.,* 2019). Therefore, DSA is reserved only for pre-operative assessment as it can accurately detect even small aneurysms below 3 mm in size.

Screening and diagnosis of asymptomatic patients

As we have discussed above despite berry aneurysms being the most common type of intracranial aneurysms, they remain a relatively uncommon condition with the majority of cases being asymptomatic. In addition, although their rupture may lead to direful consequences only a small number of cases will ever develop such a complication. Moreover, surgical or radiological intervention for aneurysmal repair in its self carries a risk of postoperative morbidity and mortality, which may potentially lead to an even higher risk than rupture in some patients (Naggara *et al.,* 2012; Kotowski *et al*., 2013). Lastly delivering such diagnosis to some patients may have an impact on their mental health leading to the development of anxiety and constant stress, or can even create difficulties for patients in obtaining life or medical insurances. Due to all of these reasons widespread screening of the public is discouraged, except for some particular high-risk populations. In such cases where screening is deemed beneficial than MRI/MRA is the preferred method of screening, due to its high rate of detection and minimal side effects.

Current evidence supports the application of a screening program in Individuals with familial history, in particular patients with at least 2 first-degree relatives who had either an intracranial aneurysm or a subarachnoid hemorrhage (Bor *et al.,* 2014). As it was proven to be cost-effective. The recommended age of initiation and termination of screening is 20 and 80 respectively with the frequency of surveillance being once every 7 years (Bor *et al.,* 2010).

Polycystic kidney disease possesses the most substantial risk-increase of berry aneurysms second only to family history, as the percentage of aneurysmal formation in affected individuals ranges from 4-17%, in particular, if the patient is above 30 years old or with positive family history (Zhou *et al.,* 2017) other conditions with where screening is recommended are bicuspid aortic valve (Schievink *et al.,* 2010) or coarctation of the aorta (Williams & Brown, 2013).

Some other inherited diseases may also have a higher risk of berry aneurysms if compared to the general population, but their increase is not significant enough to justify generalized screening these include Marfan syndrome, Neurofibromatosis Type I, and Multiple Endocrine Neoplasia Type I (Hitchcock & Gibson, 2017).

CONCLUSION

Rigors number of studies have looked into the efficacy of MRI in the diagnosis of berry aneurysm, which has shown that MRI is as highly sensitive and specific as other diagnostic modalities chiefly CTA and DSA. Moreover, the utilization of different techniques such as HRMRI can lead to its use as a risk assessment and prediction tool of future ruptures. additionally, it is considered to be the safest method due to its lack of ionizing radiation, contrast administration, or catheterization, making it the ideal choice for screening in an asymptomatic patient. Its main drawbacks are high price tag, and prolonged time to obtain results. therefore, it's maybe an unsuitable option in an acute presentation in which CTA reign superior.

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