Available online www.ijpras.com

International Journal of Pharmaceutical Research & Allied Sciences, 2021, 10(1):38-41
https://doi.org/10.51847/yGJr_Ra

Review Article

ISSN : 2277-3657
CODEN(USA) : IJPRPM

Evaluation of the Role of Angiography in Diagnosis and Management of Brain Aneurysm: Literature Review

Mubarak Barrak Aldosari[1], Amjad Ali Alharbi[2], Khaled Abdullah T Alharbi[3], Ibrahim Mohammad Almutairi[4], Meshari Nawaf Bin Mutib Alharbi[3], Mohammad Abdulaziz A Altulaihi[3], Amal Mousa Shaybah[5], Lujain Said Bayazeed[6], Omar Dahman Alamoudi[2], Saud Abdulaziz Alyabis[7]*, Heba Jaffer Alrebh[8]

[1]*Faculty of Medicine, Najran University, Najran, KSA.*
[2]*Faculty of Medicine, Umm Al Qura University, Makkah, KSA.*
[3]*Faculty of Medicine, Qassim University, Qassim, KSA.*
[4]*Faculty of Medicine, Almajma'ah University, Riyadh, KSA.*
[5]*Faculty of Medicine, Jazan University, Jazan, KSA.*
[6]*Faculty of Medicine, King Abdulaziz University, Jeddah, KSA.*
[7]*Faculty of Medicine, Alfarabi Medical College, Riyadh, KSA.*
[8]*MBBS, King Faisal University, Al Ahsa, KSA.*

***Email:** *Saudalyabis@hotmail.com*

ABSTRACT

In the population, there is a notable prevalence of unruptured intracranial aneurysms. These can only be detected early using high-resolution imaging modalities. A discussion of the different imaging modalities is warranted, and an intracranial aneurysm can often be fatal if left undetected. PubMed database was used for article selection, and papers were obtained and reviewed. PubMed database was used for article selection, and the following keys terms: magnetic resonance angiography, computerized tomography angiography, digital subtraction angiography, aneurysms, imaging in cerebrovascular hemorrhage. Patients with subarachnoid hemorrhage should initially be investigated by CT angiography as it is quick and accurate for the diagnosis of early hemorrhage. Further imaging by magnetic resonance angiography and digital subtraction angiography could be useful in late presentations, or to have more detailed images of CT confirmed aneurysms. The physician should utilize their clinical judgment of intracranial aneurysms combined with specific case presentations to decide upon the best imaging choice. The imaging modality chosen should help in identifying the aneurysm, following up unruptured aneurysms, and alerting the radiologist to any recurrence of a previously treated ruptured aneurysm.

Key words: *Imaging in cerebrovascular hemorrhage, Magnetic resonance angiography, Aneurysms, Intracranial*

INTRODUCTION

When a cerebral aneurysm occurs, the underlying mechanism is seen to be an integral weakness within the vasculature [1-4]. This weakness manifests itself as dilation in the vessel wall, developing in time with pressure and continuous flow into an aneurysm. With fluctuations in blood pressure, the vessel would distribute the pressure equally across its circumference. However, when an aneurysmal defect is present, the pressure directed towards it would lead to a rupture at this weakest point. Also, patients with ischemic strokes have been found to have a potential risk of developing intracranial aneurysms [5]. Future research is focusing on finding associations between aneurysmal development in the presence of underlying vascular pathology such as coarctation of the aorta [6]. Risk factors for intracranial aneurysms include smoking, hypertension, diabetes, obesity, and high serum cholesterol [7]. Also, cerebral infections are commonly caused by Staphylococcus aureus and Streptococcus species, and bacterial endocarditis is also a potential source for cerebral infections and subsequent aneurysm development [8]. Furthermore, aneurysms may recur after the operative clipping of the aneurysm [9].

MATERIALS AND METHODS

PubMed database was used for article selection, and papers were obtained and reviewed. PubMed database was used for article selection, and the following keys terms: magnetic resonance, aneurysms, unruptured aneurysms, imaging in cerebrovascular hemorrhage.

Review

The issue of intracranial aneurysms is not uncommon, as many people spend their daily lives with unruptured and undetectable aneurysms. These patients are asymptomatic, and these aneurysms can only be detected incidentally on imaging. No screening tests are routinely done for the population, as only a negligible minority of these cases do eventually rupture. Furthermore, prediction models for unruptured aneurysms have not shown clinical benefit [10]. Another cause of not detecting these aneurysms is because of their variable locations as they could occur on the parts and branches of the circle of Willis. For instance, they could occur on the internal carotid artery directly, or on occasion on its branches.

Clinical features

Patients may present with a variety of symptoms and signs suggestive of intracranial bleeding. These include progressive headaches or sudden-onset severe ‘thunderclap ’headaches in cases of subarachnoid aneurysms. There is also evidence for ‘sentinel’ headache as an impending sign of aneurysmal rupture [11]. Other patients may also present later with unilateral body weakness or complete loss of sensation and motor functionality. These are pressure symptoms from the edematous inflammation occurring around the intracranial neural tissue.

Pathology

The pathology of the aneurysm is important, as they vary in shape according to etiology. The physician must distinguish between a true and false aneurysm, as true aneurysms are characterized by the involvement of all parts of the vascular wall, intima, media, and adventitia. These true aneurysms are commonly caused by atherosclerosis. Furthermore, several factors are associated with an aneurysm’s growth and eventual rupture. These factors include sac size above 1cm, T1 signal in aneurysm rim, thrombus formation, and type of aneurysm. Particular types associated with a high risk of rupture are vertebrobasilar, non-saccular, and dolicoectatic aneurysms [12]. Rarely, patients develop mycotic aneurysms and these typically occur in the elderly age group [13].

Common locations for saccular types of aneurysms include bifurcations of the cerebral vasculature, such as the carotid bifurcation or other branching points of the circle of Willis. These locations are screened during imaging of berry aneurysms. Most commonly these aneurysms occur at the bifurcations of the anterior communicating artery, middle cerebral artery, and posterior communicating artery [14]. With recent advances in imaging modalities, several options are available for screening and follow-up of aneurysms. These imaging modalities include magnetic resonance imaging, computed tomographic angiography, and digital subtraction angiography. There are advantages and disadvantages to each imaging technique with each gaining favorability according to the clinical scenario **(Table 1)**.

Diagnostic imaging

In patients presenting with ‘thunderclap’ headache, often described as the worst headache of their lifetime, the radiologist should begin with a non-contrast computerized tomography scan of the head for subarachnoid hemorrhage. As mentioned previously **(Table 1)**, this latter modality is best for quick confirmatory results in emergencies. Non-contrast magnetic resonance is as useful as computerized tomography and could be used in late presenting cases of suspected subarachnoid hemorrhage. Furthermore, evidence has shown that 3D proton density magnetic resonance angiography improves diagnostic accuracy for lesions not readily diagnosed by other magnetic resonance imaging [15].

Table 1. Imaging Choice Comparison

Modality	Advantage	Disadvantage
Magnetic Resonance Angiography	No radiation exposure, highly detailed soft tissue	Contraindicated in certain groups of patients, low detail of bony structures, higher cost than CT
Digital subtraction angiography	Gold standard for diagnosis	More expensive than the other two modalities,
Computed tomographic angiography	Results appear within minutes, highly detailed bony structures	Moderate radiation exposure, low detail of soft tissue

Magnetic resonance imaging is excellent with detailing soft tissue structures, however, some patients are contraindicated for this imaging modality. These include patients with medical implants like pacemakers or metals, or even those with claustrophobia, but the latter group can always receive anesthesia and undergo the procedure. Recent advances in rendering have shown promising evidence of 4D magnetic resonance imaging and 3D contrast-MRI in the diagnostic accuracy and subsequent follow-up of management of cerebral aneurysms and vascular abnormalities [16].

While CT angiography is the initial test for ruptured aneurysms, MR angiography can be used to confirm the diagnosis in late presentations. While CT angiography is suitable as initial imaging for ruptured aneurysms, it would not be as useful in patients who developed diffuse subarachnoid hemorrhage. CT angiography also loses its accuracy in certain scenarios where the patient is severely anemic, or the bleeding was minimal that it was readily absorbed into the cerebrospinal fluid Furthermore, digital subtraction angiography (DSA) is considered the gold standard in detecting intracranial aneurysms [17]. The downside to the high accuracy offered by the latter modality is it is not cost-effective as an initial test.

The radiologist would have relative feasibility in identifying the location of a ruptured aneurysm, as time passes and the bleeding diffuses across the intracranial cavity, this becomes more difficult. The site collection of blood within the intracranial cavity may give an inclination of the original site of injury. For example, rupture of middle cerebral artery aneurysms would have blood collecting in proximal fissures such as the Sylvian fissure. Moreover, digital subtraction angiography is an invasive test, that could aid the radiologist in identifying the disease and guiding necessary treatment [18]. It is the combination of CT angiography with DSA that would provide the best image possible for an intracranial aneurysm, including flow pattern and detailed characteristics.

Follow-up

During the follow-up of patients treated for coiled aneurysms, contrast-enhanced magnetic resonance angiography would be beneficial as it would be able to detect newly developing aneurysms with high accuracy [19]. Accordingly, contrast-enhanced MRA is similar in diagnostic accuracy to digital subtraction angiography in the follow-up of patients treated with coil embolization. In the follow-up, contrast-enhanced MRA would be better suited as the primary imaging modality, however, DSA could still be used to evaluate recurrence of aneurysmal growth detected by the former modality [19].

CONCLUSION

The radiologist should attempt to identify any anatomical abnormalities and anomalies within the images provided, as this will aid the physician in making accurate management choices for the patient. Moreover, these anatomical areas that require detailed reporting include the size of the neck of an aneurysm, neck-dome ratio, and dimensional measurement of the aneurysms in conjunction with the affected and branching vessels. Establishing a baseline for diagnosis is important, as it could be used later on follow up of the disease.

ACKNOWLEDGMENTS : None

CONFLICT OF INTEREST : None

FINANCIAL SUPPORT : None

ETHICS STATEMENT : None

REFERENCES

1. Khorasanizadeh S, Behnaz F, Faresani HA, Dehkordy ME, Kouzekanani H, Moradi A, et al. The Effect of Premedication Dexamethasone on Exacerbation of Acute Hypoxic Brain Injury in Adult Mice. Arch Pharma Pract. 2019;10(3):112-8.
2. Zakaria FH, Bakar NH, Mohamad N, Abdul AZ. The Effects of MDMA on Brain: An in Vivo Study in Rats. Int J Pharm Res Allied Sci. 2018;7(3):126-37.
3. Moayeri A, Niazi H, Darvishi M. Effect of biocanin A in the acute phase of diffuse traumatic brain injury. Int J Pharm Phytopharmacol Res. 2020;10(1):77-86.
4. Sangi SMA, Bawadekji A, Alotaibi NM, Aljameeli AM, Soomro S. Protective effects of vitamin E on mobile phone induced injury in the brain of rats. Int J Pharm Phytopharmacol Res. 2020;10(1):97-104.
5. Jiranukool J, Thiarawat P, Galassi W. Prevalence of intracranial aneurysms among acute ischemic stroke patients. Surg Neurol Int. 2020;11:341.
6. Andrade L, Hoskoppal A, Hunt Martin M, Whitehead K, Ou Z, Kuang J, et al. Intracranial aneurysm and coarctation of the aorta: prevalence in the current era. Cardiol Young. 2021;31(2):229-32.
7. Tanji F, Nanbu H, Fushimi S, Shibata K, Kondo R. Smoking status and unruptured intracranial aneurysm among brain health check-up examinees: a cross-sectional study in Japan. J Rural Med. 2020;15(4):183-8.
8. Kazuhiro AN, Hasegawa H, Kikuchi B, Saito S, Jotaro ON, Shibuya K, et al. Treatment Strategies for Infectious Intracranial Aneurysms: Report of Three Cases and Review of the Literature. Neurol Med Chir. 2019;59(9):344.
9. Obermueller K, Hostettler I, Wagner A, Boeckh-Behrens T, Zimmer C, Gempt J, et al. Frequency and risk factors for postoperative aneurysm residual after microsurgical clipping. Acta Neurochir. 2021;163(1):131-8. doi:10.1007/s00701-020-04639-5.
10. Molenberg R, Aalbers MW, Mazuri A, Luijckx GJ, Metzemaekers JDM, Groen RJM, et al. The unruptured intracranial aneurysm treatment score as a predictor of aneurysm growth or rupture. Eur J Neurol. 2021;28(3):837-43. doi:10.1111/ene.14636.
11. Molenberg R, Aalbers MW, Mazuri A, Luijckx GJ, Metzemaekers JDM, Groen RJM, et al. Uiats as a predictor of aneurysm growth or rupture. Eur J Neurol. 2020;9(1):20-30. doi:10.1111/ene.14636
12. Nasr DM, Brinjikji W, Rouchaud A, Kadirvel R, Flemming KD, Kallmes DF. Imaging characteristics of growing and ruptured vertebrobasilar non-saccular and dolichoectatic aneurysms. Stroke. 2016;47(1):106-12.
13. Ryu J, Lee KM. Intracranial mycotic aneurysm in a patient with abdominal actinomycosis. World Neurosurg. 2021;147:161-3. doi:10.1016/j.wneu.2020.11.069
14. Orz Y, AlYamany M. The impact of size and location on rupture of intracranial aneurysms. Asian J Neurosurg. 2015;10(1):26-31.
15. Yim Y, Jung SC, Kim JY, Kim SO, Kim BJ, Lee DH, et al. Added diagnostic values of three-dimensional high-resolution proton density-weighted magnetic resonance imaging for unruptured intracranial aneurysms in the circle-of-Willis: Comparison with time-of-flight magnetic resonance angiography. Plos one. 2020;15(12):e0243235.
16. Youn SW, Lee J. From 2D to 4D Phase-Contrast MRI in the Neurovascular System: Will It Be a Quantum Jump or a Fancy Decoration?. J Magn Reson Imaging. 2022;55(2):347-72. doi:10.1002/jmri.27430.
17. Weinreich M, Litwok Y, Mui LW, Lau JF. Advanced vascular imaging. Vasc Med. 2017;22(1):73-6. doi:10.1177/1358863X16681666.
18. Chen J, Feng X, Peng F, Tong X, Niu H, Liu A. Cost-Effective analysis of different diagnostic strategies in screening for aneurysms after spontaneous subarachnoid hemorrhage. Acad Radiol. 2022;29(3):S36-S43. doi:10.1016/j.acra.2020.11.021.
19. Patzig M, Forbrig R, Gruber M, Liebig T, Dorn F. The clinical value of ceMRA versus DSA for follow-up of intracranial aneurysms treated by coil embolization: an assessment of occlusion classifications and impact on treatment decisions. Eur Radiol. 2021;31(6):4104-13. doi:10.1007/s00330-020-07492-3.