Section: Radiology

Original Research Article

ANGIOGRAPHIC SPECTRUM OF INTRACRANIAL VASCULAR PATHOLOGIES ON CEREBRAL DIGITAL SUBTRACTION ANGIOGRAPHY IN A TERTIARY CARE CENTRE

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ABSTRACT

Background: Cerebrovascular diseases remain a leading cause of morbidity and mortality worldwide. Accurate imaging of intracranial vasculature is essential for diagnosis and management of these conditions. Digital subtraction angiography (DSA) remains the gold standard for evaluating intracranial vascular pathology due to its superior spatial resolution and dynamic assessment of cerebral circulation. Objective: To evaluate the angiographic spectrum of intracranial vascular pathologies detected on cerebral digital subtraction angiography in patients presenting to a tertiary care centre.
Materials and Methods: This retrospective observational study included 34 patients who underwent cerebral digital subtraction angiography between January 2025 and June 2025 at a tertiary care centre. Demographic characteristics, clinical indications, and angiographic findings were obtained from archived angiography reports. Angiographic findings were categorized into intracranial arterial stenosis or occlusion, intracranial aneurysm, vertebrobasilar disease, arteriovenous malformation (AVM), and normal angiographic findings.
Results: A total of 34 patients were included, comprising 20 males (58.8%) and 14 females (41.2%), with a mean age of 58 years. The most common indication for cerebral DSA was evaluation of ischemic stroke (55.9%), followed by subarachnoid hemorrhage (20.6%). Intracranial arterial stenosis or occlusion was the most common angiographic finding (52.9%), predominantly involving the internal carotid artery and middle cerebral artery. Intracranial aneurysms were detected in 17.6% of cases, vertebrobasilar disease in 14.7%, and arteriovenous malformation in 2.9%. Normal angiographic findings were observed in 11.8% of cases.
Conclusion: Cerebral digital subtraction angiography remains an essential imaging modality for evaluation of intracranial vascular diseases. Intracranial arterial stenosis and occlusion were the most frequent angiographic findings in this study, highlighting the importance of DSA in the diagnosis and management of cerebrovascular disorders.
Keywords: Digital subtraction angiography, intracranial vascular disease, cerebral angiography, aneurysm, stroke.

INTRODUCTION

Cerebrovascular diseases are a major global health concern and represent one of the leading causes of mortality and long-term disability worldwide. Global epidemiological data show that stroke alone is responsible for a significant amount of neurological morbidity, especially in developing nations where the burden is continuously rising as a result of aging populations and the increased prevalence of risk factors like atherosclerosis, diabetes mellitus, and hypertension.[1] The diagnosis, risk assessment, and treatment of these disorders depend heavily on the timely and precise assessment of cerebral vasculature, which ultimately affects patient outcomes and prognosis.

The evaluation of cerebrovascular disorders has been transformed by developments in neuroimaging. Due to their quick acquisition, accessibility, and lower procedure risks, non-invasive modalities like computed tomography angiography (CTA) and magnetic resonance angiography (MRA) have become widely accessible and are frequently employed as initial screening techniques.[2] Nevertheless, cerebral digital subtraction angiography (DSA) remains the gold standard imaging technique for thorough assessment of intracranial vascular diseases in spite of these technical advancements.[3]

The improved spatial and temporal resolution of digital subtraction angiography allows for accurate imaging of the cerebral artery architecture, including intricate vascular networks and tiny distal arteries. In order to comprehend disease processes such arterial stenosis, occlusion, and vascular abnormalities, it also enables dynamic evaluation of blood flow, collateral circulation, and hemodynamic alterations.[4] Accurate clinical decision-making is made possible by DSA's ability to identify small vascular anomalies that could otherwise go undetected, unlike CTA and MRA.

Aneurysms, vertebrobasilar insufficiency, intracranial artery stenosis or occlusion, and arteriovenous malformations (AVMs) are among the many conditions that fall under the broad category of intracranial vascular diseases. Among the most frequent causes of ischemic stroke are intracranial artery stenosis and occlusion, especially in Asian cultures where intracranial atherosclerosis is more common than extracranial disease.[5] Since prompt management can greatly lower the risk of recurrent stroke and related problems, early diagnosis of these lesions is essential.

Another serious vascular disease is intracranial aneurysms, which frequently manifest as subarachnoid hemorrhage and have significant rates of morbidity and death. In order to design therapeutic procedures like endovascular coiling or surgical clipping, DSA is crucial in determining aneurysm shape, size, location, and connection with surrounding vessels.[6] In a similar vein, posterior circulation strokes are significantly influenced by vertebrobasilar circulation anomalies, which necessitate accurate angiographic assessment for proper treatment.

Complex vascular lesions known as arteriovenous malformations are defined by aberrant connections between veins and arteries without a capillary bed in between. Despite being less frequent, they provide a serious danger of cerebral bleeding, especially in younger people. Because it offers comprehensive information on nidus architecture, feeding arteries, and draining veins—all of which are crucial for treatment planning—DSA continues to be essential in the assessment of AVMs.[7] Cerebral DSA is the foundation of contemporary neurointerventional radiology and has developed into a therapeutic technique in addition to its diagnostic capabilities. It provides less invasive therapy alternatives with better clinical results by enabling a variety of endovascular operations, such as mechanical thrombectomy, angioplasty, stent implantation, and embolization approaches.[8]

In some clinical situations, the diagnostic precision and therapeutic potential of DSA continue to surpass its drawbacks, despite its invasive nature and related dangers such contrast-induced nephropathy and procedural problems. Therefore, in order to optimize patient care and direct future research, it is crucial to comprehend the angiographic spectrum of cerebral vascular diseases observed in ordinary clinical practice. In order to shed light on the distribution and patterns of cerebrovascular diseases in this context, the current study attempts to assess the angiographic spectrum of intracranial vascular pathologies found on cerebral digital subtraction angiography in patients who present to a tertiary care facility.

Aim

To evaluate the angiographic spectrum of intracranial vascular pathologies on cerebral digital subtraction angiography in patients presenting to a tertiary care centre.

Objectives

1. To analyze the demographic profile of patients undergoing cerebral digital subtraction angiography.
2. To identify the common clinical indications for performing cerebral DSA.
3. To evaluate the distribution of various intracranial vascular pathologies detected on angiography.
4. To determine the frequency of specific angiographic findings such as arterial stenosis, occlusion, aneurysms, vertebrobasilar disease, and arteriovenous malformations.
5. To assess the proportion of normal versus abnormal angiographic findings.

MATERIALS AND METHODS

Study Design

This study was a retrospective observational study conducted to evaluate the angiographic spectrum of intracranial vascular pathologies detected on cerebral digital subtraction angiography (DSA).

Study Setting

The study was carried out in the Department of Interventional Radiology at a tertiary care centre, equipped with advanced neuroimaging and endovascular facilities.

Study Population

A total of 34 patients who underwent diagnostic cerebral digital subtraction angiography between

January 2025 and June 2025 were included in the study.

Inclusion Criteria

- Patients undergoing cerebral DSA for evaluation of cerebrovascular disease
- Patients presenting with ischemic stroke or intracranial hemorrhage
- Patients with suspected intracranial vascular pathology

Exclusion Criteria

- Patients with incomplete clinical or angiographic records
- Patients undergoing purely therapeutic procedures without diagnostic angiography

Angiographic Procedure

All procedures were performed under strict aseptic precautions using either transfemoral or transradial arterial access. Selective catheterization of the common carotid arteries, internal carotid arteries, and vertebral arteries was performed using standard angiographic catheters.

Digital subtraction angiographic images were obtained in multiple projections, allowing comprehensive evaluation of both anterior and posterior cerebral circulation.

Data Collection

Data were retrieved from archived angiography reports and included:

- Age
- Gender
- Clinical indication
- Angiographic findings

Angiographic findings were classified into:

1. Intracranial arterial stenosis or occlusion
2. Intracranial aneurysm
3. Vertebrobasilar disease
4. Arteriovenous malformation (AVM)
5. Normal angiographic findings

Statistical Analysis

Data analysis was performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA).

- Continuous variables were expressed as mean ± standard deviation (SD)
- Categorical variables were expressed as frequency and percentage
- Chi-square test/Fisher's exact test was used to assess associations between categorical variables
- A p-value < 0.05 was considered statistically significant

RESULTS

The study population demonstrated a male predominance (58.8%), with a male-to-female ratio of 1.4:1. Most patients belonged to the fifth to seventh decade of life, indicating a higher burden of cerebrovascular disease in older individuals.

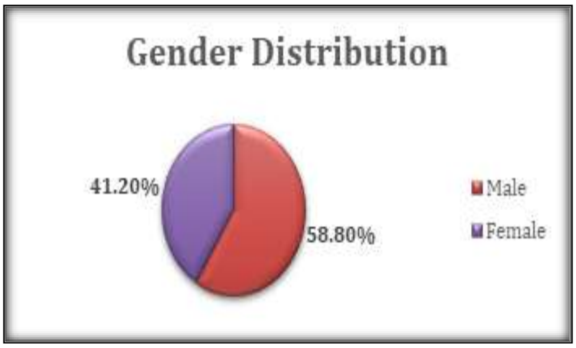

Figure 1: Gender Distribution

Table 1: Demographic Characteristics

Variable	Value
Total patients	34
Male	20 (58.8%)
Female	14 (41.2%)
Mean age	58 ± 12.4 years

Table 2: Clinical Indications for Cerebral DSA

Indication	Cases	Percentage
Ischemic stroke	19	55.9%
Subarachnoid hemorrhage	7	20.6%
Intracranial hemorrhage	4	11.8%
Suspected vascular malformation	4	11.8%

The most common indication for cerebral DSA was ischemic stroke (55.9%), followed by subarachnoid hemorrhage (20.6%). This reflects the primary role of DSA in evaluating both ischemic and hemorrhagic cerebrovascular events.

Table 3: Angiographic Findings

Finding	Cases	Percentage
Intracranial arterial stenosis/occlusion	18	52.9%
Intracranial aneurysm	6	17.6%
Vertebrobasilar disease	5	14.7%
Arteriovenous malformation (AVM)	1	2.9%
Normal angiogram	4	11.8%

The most common angiographic finding was intracranial arterial stenosis or occlusion (52.9%), predominantly involving the internal carotid artery and middle cerebral artery.

Intracranial aneurysms were detected in 17.6% of patients, mainly in those presenting with subarachnoid hemorrhage. Vertebrobasilar disease accounted for 14.7%, highlighting the significance of posterior circulation involvement.

Only one case (2.9%) of AVM was identified, while 11.8% of patients had normal angiographic findings, suggesting either early disease or non-vascular causes of symptoms.

Table 4: Association Between Clinical Indication and Angiographic Findings

Clinical Indication	Abnormal DSA	Normal DSA	p-value
Ischemic stroke (n=19)	17	2	
Hemorrhagic stroke (SAH + ICH) (n=11)	10	1	
Suspected malformation (n=4)	3	1	
Total	30	4	0.041*

There was a statistically significant association between clinical indication and angiographic findings (p = 0.041). Patients presenting with ischemic and hemorrhagic stroke were more likely to demonstrate abnormal angiographic findings compared to those evaluated for suspected vascular malformations.

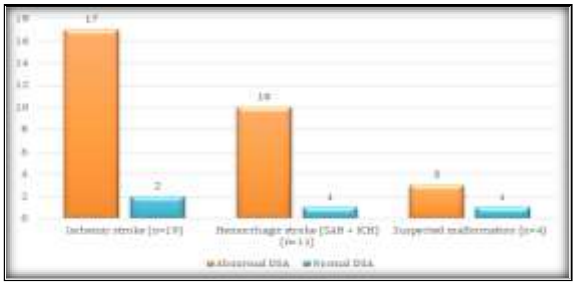

Figure 2: Association Between Clinical Indication and Angiographic.

Although males showed a slightly higher prevalence of intracranial stenosis and aneurysms, the difference between genders was not statistically significant (p = 0.32).

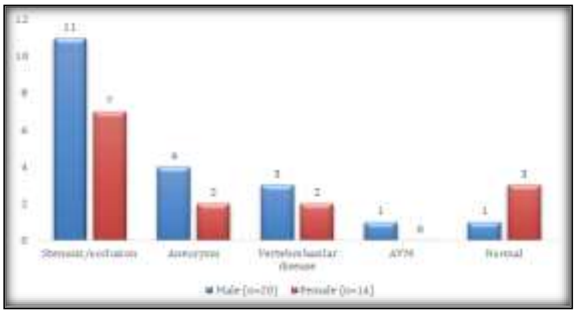

Figure 3: Gender-wise Distribution of Angiographi

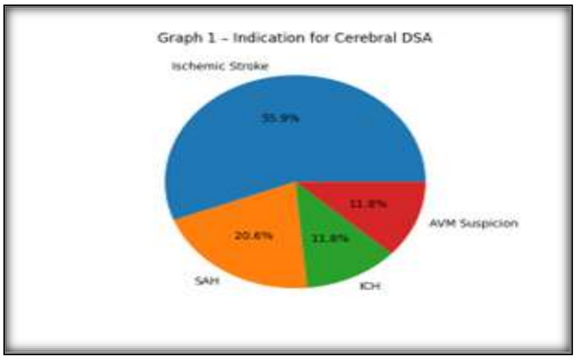

Figure 4: Indication for cerebral DSA

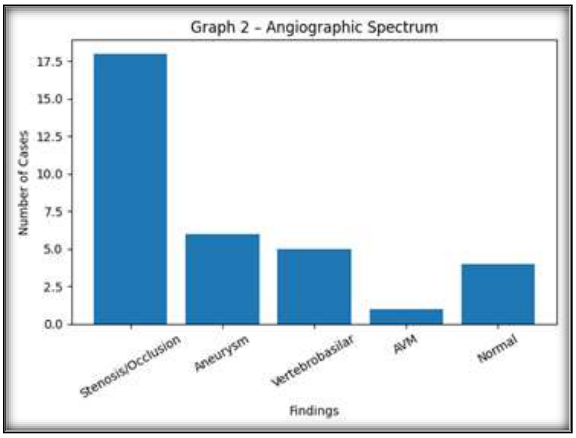

Figure 5: Angiographic Spectrum

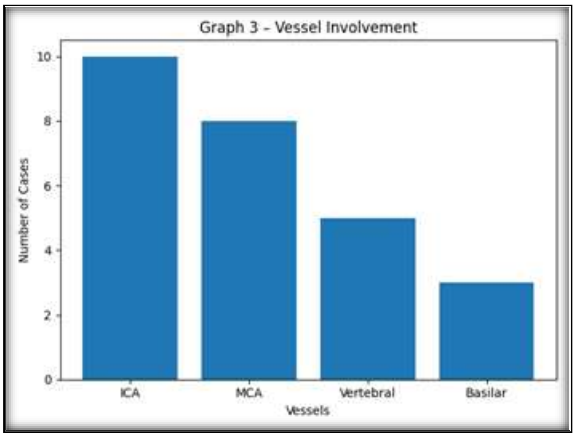

Figure 6: Vessel involvement


Image 1: CT scan post ACOM aneurysm coiling

Image 2: Non filling of left ACA and left MCA with diffuse narrowing of left ICA

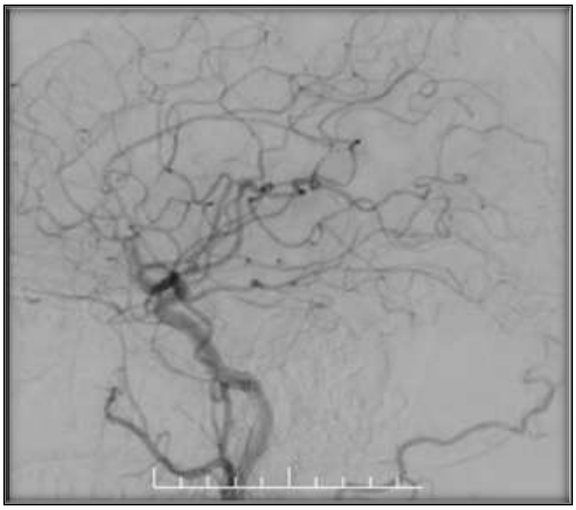

Image 3: Normal cerebral angiography

Image 4: High grade 99% stenosis of right ICA at origin with slow distal flow in right ACA

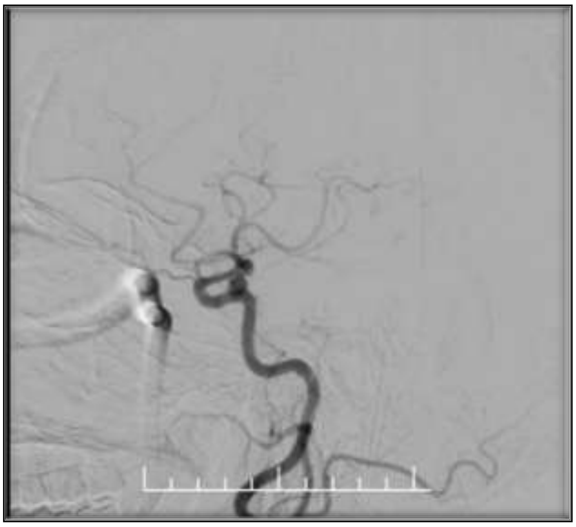

Image 5: Wide neck saccular aneurysm at left supraclinoid ICA/ PCOM territory

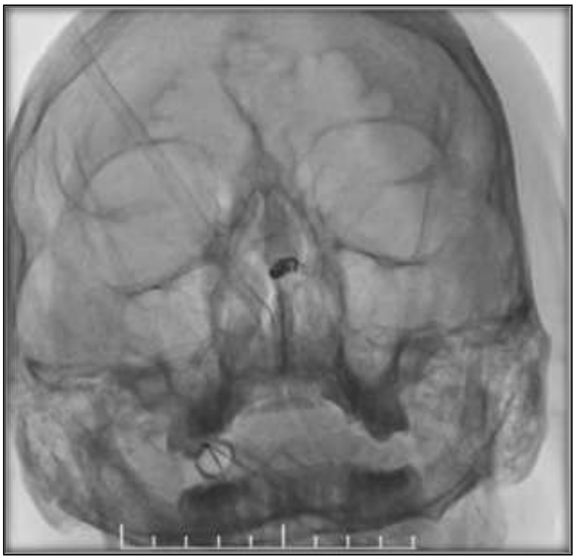

Image 6: Post stent placement in saccular aneurysm of left supraclinoid ICA / PCOM territory

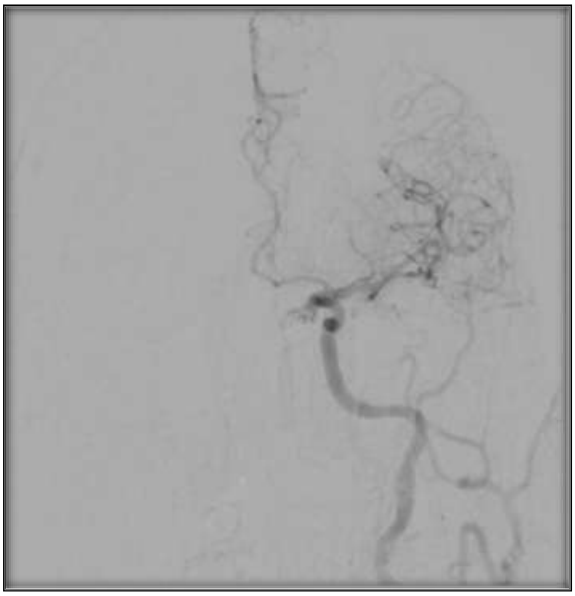

Image 7: Post stent placement in saccular aneurysm of left supraclinoid ICA / PCOM territory

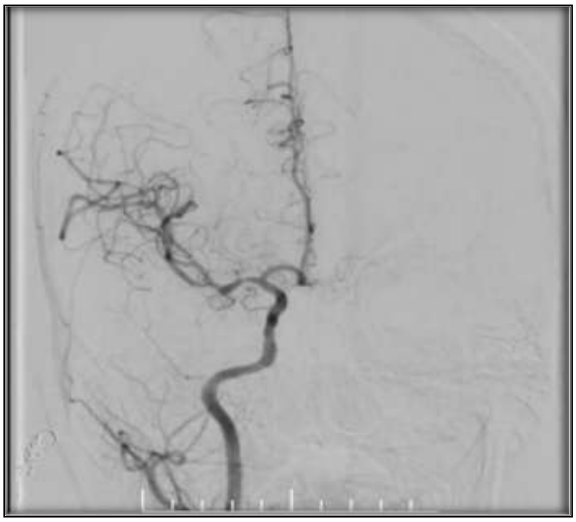

Image 8: 50% stenosis in M1 segment of right MCA

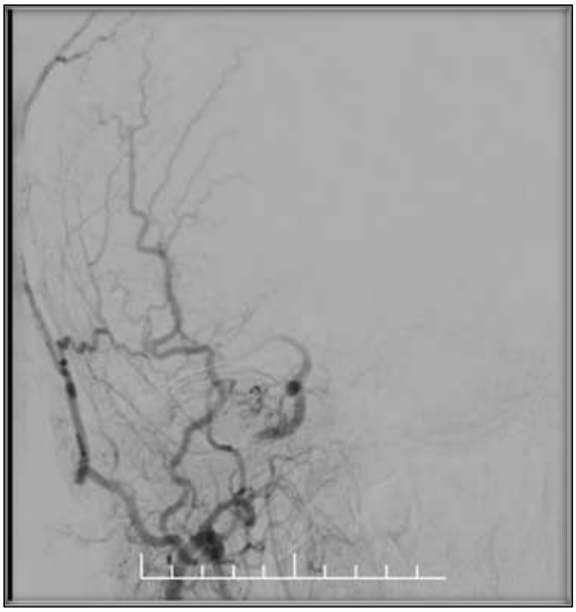

Image 9: Long segment complete occlusion of right ICA with 50% stenosis of left ICA

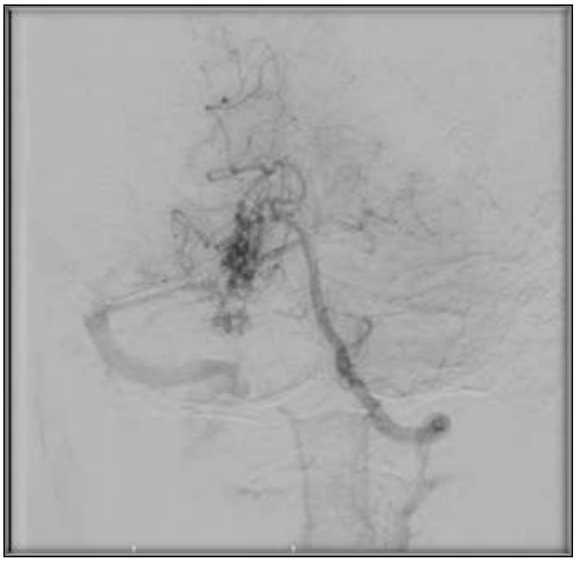

Image 10: Arterio-venous malformation in right cerebellum

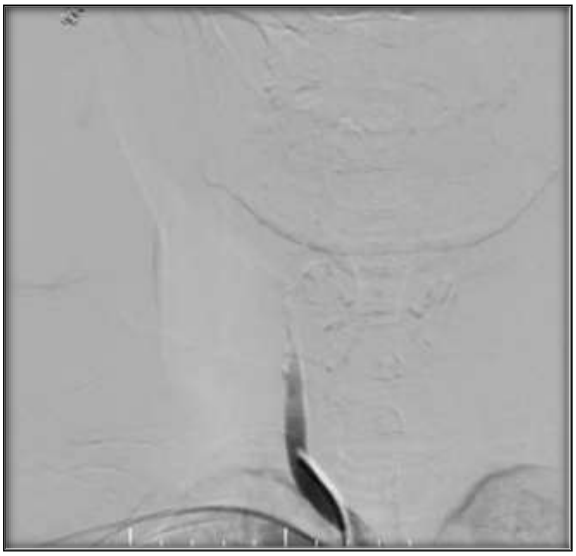

Image 11: Short segment complete occlusion of right distal CCA

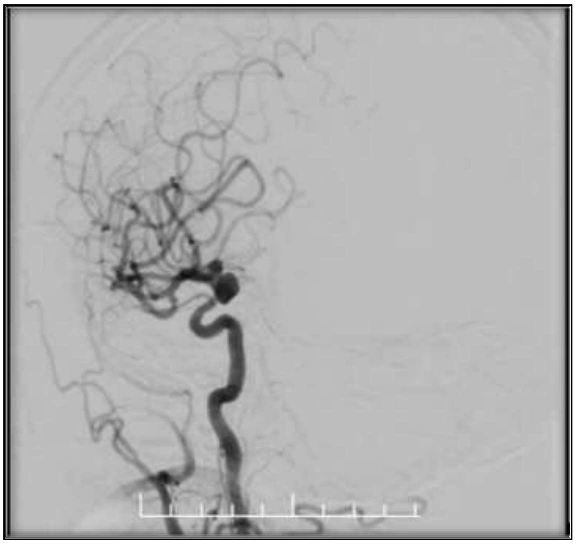

Image 12: Two aneurysm at right supraclinoid ICA, near carotid bifurcation with dysplastic proximal M1 segment of left MCA

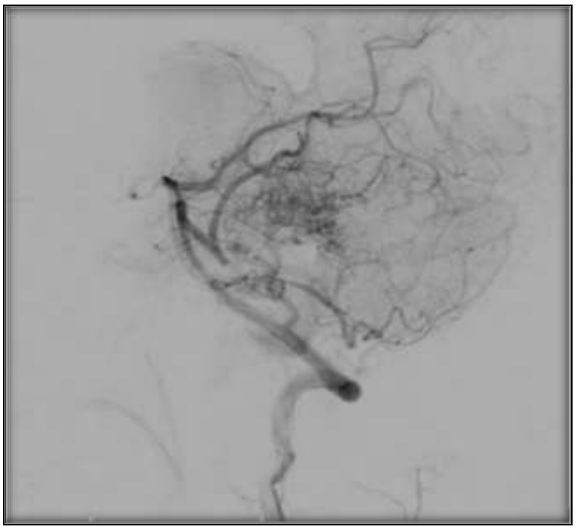

Image 13: Arteriovenous malformation in right cerebellum

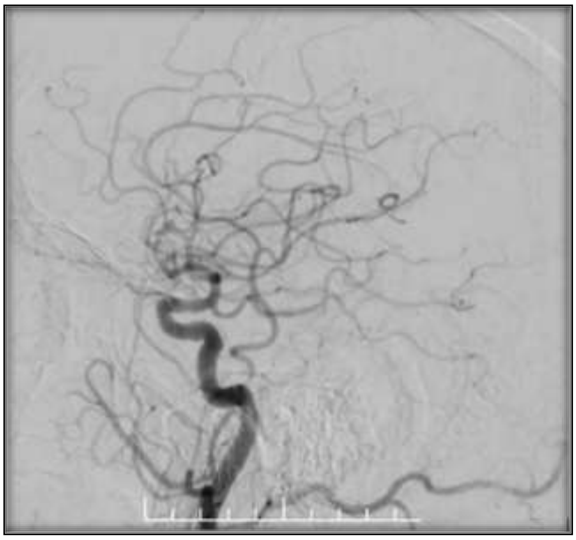

Image 14: Normal cerebral angiography

Image 15: Large left MCA bifurcation aneurysm

DISCUSSION

Digital subtraction angiography (DSA) remains the gold standard imaging modality for the evaluation of intracranial vascular diseases due to its superior spatial and temporal resolution and its ability to dynamically assess cerebral circulation.[2,3] DSA is still essential for accurately characterizing arterial lesions and directing endovascular procedures, despite major advancements in non-invasive imaging methods like computed tomography angiography (CTA) and magnetic resonance angiography (MRA).[10] A total of 34 individuals with a mean age of 58 ± 12.4 years and a male predominance (58.8%) were assessed in this research. According to the established epidemiology of cerebrovascular illnesses, which mostly affect older people due to accumulated vascular risk factors, the majority of patients were in their fifth or seventh decade of life.[1] Previous research has documented similar demographic patterns, emphasizing higher vulnerability in older and male groups.[11]

In terms of clinical indications, cerebral DSA was most frequently performed for ischemic stroke (55.9%), followed by subarachnoid hemorrhage (20.6%) and intracranial hemorrhage (11.8%). This illustrates how crucial DSA is to the assessment of both ischemic and hemorrhagic strokes. Similar results have been reported in earlier research, where ischemic stroke continues to be the most common reason for angiographic assessment, especially in those with suspected intracranial stenosis or major vascular occlusion.[12] Our study's most important discovery was that intracranial artery stenosis or occlusion was the most prevalent angiographic abnormality, accounting for 52.9% of cases. This finding is consistent with earlier research that found intracranial atherosclerotic disease to be a significant cause of ischemic stroke, particularly in Asian populations.[5,12]

The significance of early identification and management is highlighted by Chimowitz et al.'s demonstration that intracranial artery stenosis is linked to a high risk of recurrent stroke.[12] Our study's predominant involvement of the middle cerebral artery and internal carotid artery confirms established patterns of anterior circulation sensitivity. 17.6% of patients had intracranial aneurysms, mostly those who had subarachnoid hemorrhage. This is in line with research by Brinjikji et al,[14] who found that patients receiving DSA for hemorrhagic presentations had a high frequency of aneurysms. Since prompt endovascular therapy greatly lowers the risk of rupture and related morbidity and death, early detection of aneurysms is essential.

14.7% of individuals had vertebrobasilar illness, underscoring the clinical significance of posterior circulation involvement. The importance of DSA in such circumstances is further supported by the fact that posterior circulation strokes are frequently linked to significant neurological impairments and might be difficult to identify with non-invasive imaging techniques.[5] While 11.8% of patients had normal angiographic results, only 2.9% of patients were identified with arteriovenous malformations (AVMs). According to similar findings in earlier research, the existence of normal angiograms may be explained by brief ischemia episodes, early-stage illness, or non-vascular sources of symptoms.[3]

Significantly, our study showed a statistically significant correlation ($p = 0.041$) between angiographic results and clinical indication, suggesting that patients who report with hemorrhagic or ischemic stroke are more likely to have identifiable vascular abnormalities on DSA. However, gender-wise differences were not statistically significant ($p = 0.32$), indicating that in this cohort, angiographic patterns are mostly gender-neutral. Overall, DSA continues to offer unparalleled diagnostic accuracy and is essential for the thorough assessment of cerebral vascular diseases, especially in complicated and high-risk situations, even with the availability of non-invasive imaging techniques.[3,10]

CONCLUSION

This study highlights the pivotal role of cerebral digital subtraction angiography (DSA) in the evaluation of intracranial vascular pathologies in a tertiary care setting. The most frequent angiographic results, especially in patients with ischemic stroke, were intracranial artery stenosis and occlusion, highlighting the increasing prevalence of intracranial atherosclerotic disease. Vertebrobasilar diseases and aneurysms also made up a sizable fraction, highlighting the significance of DSA in the evaluation of both anterior and posterior circulation. The diagnostic use of DSA in cerebrovascular illnesses is further supported by the statistically substantial correlation between clinical presentation and angiographic results. Even with improvements in non-invasive imaging techniques, DSA still offers better vision and is essential for precise diagnosis and treatment planning. By enabling prompt management, early diagnosis of vascular anomalies by DSA can improve clinical outcomes and lower the morbidity and mortality linked to cerebrovascular disorders.

Limitations of the Study

1. The study had a small sample size (n = 34), which may limit the generalizability of the findings.
2. Being a retrospective study, it is subject to inherent biases such as incomplete data and selection bias.
3. The study was conducted at a single tertiary care centre, which may not reflect the broader population.
4. Lack of long-term follow-up data prevented assessment of clinical outcomes and prognostic implications.
5. Detailed vessel-wise quantitative analysis was limited due to incomplete documentation in some cases

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