RESEARCH PAPER

Radiological Distribution and Demographic Trends of Intracranial Aneurysms: A Tertiary Care Study.

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ABSTRACT

Background: Intracranial aneurysms are a major cause of subarachnoid haemorrhage and contribute significantly to neurological morbidity and mortality. Understanding their demographic and radiological distribution is essential for early diagnosis and risk stratification.

Aim: To evaluate the demographic profile, clinical presentation, and radiological distribution of intracranial aneurysms in a tertiary care hospital.

Materials and Methods: This hospital-based cross-sectional observational study included 91 patients diagnosed with intracranial aneurysms on CT angiography and/or digital subtraction angiography. Demographic details, clinical presentation, aneurysm location, number, and circulation involvement were analysed using descriptive statistics.

Results: Intracranial aneurysms were more frequently observed in females, with peak incidence in the fifth and sixth decades of life. The majority of patients presented with symptoms of subarachnoid haemorrhage. Anterior circulation aneurysms predominated, with the middle cerebral artery, internal carotid artery, and anterior communicating artery being the most commonly involved sites. Most patients harboured a single aneurysm, while multiple aneurysms were less common.

Conclusion: Intracranial aneurysms in this cohort showed a clear female predominance and anterior circulation dominance. Knowledge of demographic trends and anatomical distribution may aid in early recognition and optimized imaging evaluation.

Keywords: Intracranial aneurysm; Radiological profile; Demographic distribution; CT angiography; Cerebrovascular diseases

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INTRODUCTION

Intracranial aneurysms are pathological focal dilatations of the cerebral arterial wall that predispose individuals to aneurysmal rupture and subarachnoid haemorrhage (SAH), a neurological emergency associated with high mortality and long-term disability [1, 2]. The global prevalence of unruptured intracranial aneurysms is estimated to be around 5% in the general population, with noticeable differences across age, gender, and geographic regions [3 - 5].

The natural history of intracranial aneurysms is influenced by numerous factors, including aneurysm size, location, morphology, hemodynamic stress, and patient-related factors such as age, gender, hypertension, and smoking history [1, 3, 7-9]. Early detection and precise characterisation of aneurysms are essential for preventing catastrophic rupture and guiding appropriate therapeutic interventions [7, 10].

Radiodiagnosis and imaging form the foundation of aneurysm findings. The techniques, like non-invasive imaging in the form of computed tomography angiography (CTA) and magnetic resonance angiography (MRA), have gained widespread acceptance due to their high diagnostic accuracy and accessibility [11 -13]. However, digital subtraction angiography (DSA) remains the gold standard for comprehensive vascular assessment, especially in complex aneurysms and pre-interventional planning [14, 15]. Digital subtraction angiography (DSA), however, remains the reference standard for detailed vascular assessment owing to its superior spatial and temporal resolution [16-18].

In developing countries, there is limited published data on the detailed radiological profile of intracranial aneurysms, and such findings are lacking in our population. Therefore, the study aimed to link this gap by providing a comprehensive analysis of demographic, clinical, and radiological characteristics of intracranial aneurysms and by evaluating CTA–DSA correlation in a tertiary care setting.

MATERIALS AND METHODS

Study Design and Setting

This hospital-based, descriptive, cross-sectional study was conducted in the Department of Radiodiagnosis and Imaging at Sher-i-Kashmir Institute of Medical Sciences (SKIMS), Srinagar, a tertiary care referral institution. The primary objective of the study was to evaluate the

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demographic profile, clinical presentation, and radiological distribution of intracranial aneurysms in patients presenting to the institution. The study did not involve a comparative evaluation of imaging modalities and was designed to generate epidemiological and anatomical data.

Study Population

The study population comprised patients referred to the Department of Radiodiagnosis with clinical suspicion or radiological evidence of an intracranial aneurysm during the study period. The patients were mainly referred from the Department of Emergency Medicine, SKIMS, as well as the neurology and neurosurgery departments of the institute (SKIMS). Patients who were diagnosed with intracranial aneurysms on CT angiography and/or digital subtraction angiography were included. Both ruptured and unruptured aneurysms were considered for analysis. Patients with inadequate imaging quality, incomplete clinical records, or inconclusive imaging findings were excluded from the study.

Clinical Data Collection

Clinical information was obtained from hospital medical records and imaging requisition forms. Data collected included age, sex, and presenting symptoms. Clinical presentation was categorized into subarachnoid haemorrhage-related symptoms (such as sudden severe headache, vomiting, or altered sensorium) and non-haemorrhagic or incidental presentations. Laboratory parameters were recorded when available, but were not analysed as primary outcome variables.

Imaging Acquisition

Imaging data were retrieved from the institutional Picture Archiving and Communication System (PACS). CT angiography studies were performed using a multidetector CT scanner with standard intracranial angiographic protocols. Digital subtraction angiography studies, when performed, were carried out using conventional angiographic techniques. For this study, imaging modalities were used to document aneurysm presence and anatomical characteristics, without undertaking direct modality-to-modality comparison.

Radiological Evaluation

Radiological assessment focused on aneurysm characteristics relevant to epidemiological profiling. Each aneurysm was evaluated for anatomical location, circulation involvement, and number per patient. Aneurysm locations were categorised according to standard cerebral arterial segments, including the internal carotid artery, middle cerebral artery, anterior communicating artery, anterior cerebral artery, posterior communicating artery, basilar artery, and vertebral artery. Circulation involvement was classified as anterior or posterior circulation.

Classification of Aneurysm Characteristics

The number of aneurysms per patient was recorded and categorised as single or multiple. In patients with multiple aneurysms, all identifiable aneurysms were included in the analysis. Morphological parameters such as aneurysm size or neck configuration were not included, as the study's emphasis was on distribution rather than detailed morphological assessment.

Data Management and Statistical Analysis

Collected data were entered into a structured spreadsheet and analysed using descriptive statistical methods. Continuous variables were expressed as ranges, while categorical variables were summarised using frequencies and percentages. No inferential statistical tests were applied, as the primary aim was descriptive profiling rather than hypothesis testing.

Ethical Considerations

The study was conducted in accordance with institutional ethical standards. Patient confidentiality was strictly maintained throughout data collection and analysis. As this was an observational study involving retrospective review of imaging and clinical records, no direct patient intervention was undertaken. The analysis represents a focused evaluation of a shared institutional dataset addressing distinct research objectives, separate from imaging modality comparison studies.

RESULTS

Demographic Characteristics

Among the 91 patients studied, the majority of the representation was from females with an overall percentage of 67.0% compared to 33.0% in males. The majority of patients were aged between 40 and 70 years, with a mean age of 50.8 ± 12.5 years. The maximum representation of cases was from rural areas with a percentage of 82.4% as compared to 17.6% from rural areas (Table 1)

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Table 1. Baseline Demographic Characteristics (n = 91)

Variable	Value
Age (years), mean ± SD	50.8 ± 12.5
Female, n (%)	61 (67.0%)
Male, n (%)	30 (33.0%)
Rural residence	75 (82.4%)
Urban residence	16 (17.6%)

Clinical Presentation

Most patients presented with symptoms suggestive of subarachnoid haemorrhage, including sudden severe headache in 50 (87.7%), and vomiting present in 68 (74.7%) of the subjects, while a subset of aneurysms were detected incidentally during imaging for unrelated neurological complaints. (Table 2)

Table 2. Clinical Presentation of subjects

Clinical feature	N (%)
Hypertension	74 (81.32%)
Headache	50 (87.7%)

Vomiting	68 (74.7%)
Limb weakness	27 (29.6%)

Location

The most common aneurysm locations were: - Middle cerebral artery (MCA) present in 42 (46.2%) - Internal carotid artery (ICA) in 22 (24.1%)- Anterior communicating artery (ACOM) 18 (19.8%) (Table 3)

Table 3. Radiological findings revealing the location of aneurysm

Parameter	N (%)
Middle cerebral artery	42 (46.2%)
Internal carotid artery	22 (24.1%)
Anterior communicating artery	18 (19.8%)

Number of Aneurysms

The angiographic findings are presented in Table 4. The findings revealed that the majority of patients had a single aneurysm 61(67.0%), while a smaller proportion had multiple aneurysms 16 (17.6%). (Table 4)

Table 4. CT Angiography Findings

Finding	N (%)
Single Aneurysm	70 (76.9%)
Multiple Aneurysms	21 (23.1%)

CTA–DSA Correlation

CTA demonstrated high sensitivity in detecting intracranial aneurysms. There was strong agreement between CTA and DSA regarding aneurysm location and number. DSA provided additional anatomical detail in select cases, particularly in small, complex, or cavernous segment aneurysms. Some aneurysms missed by CTA were located by DSA, with an overall higher detection rate of DSA as compared to CTA in picking up complex and doubtful aneurysms.

DISCUSSION

The present study provides a comprehensive overview of the demographic characteristics and radiological distribution of intracranial aneurysms in patients evaluated at a tertiary care centre [4,6,19]. Understanding these patterns is essential, as aneurysm location, number, and patient demographics significantly influence clinical presentation, management decisions, and risk of rupture [20, 21].

In the current cohort, intracranial aneurysms were more frequently observed in females than in males. This finding is consistent with previously published literature reporting a higher prevalence of aneurysms among women, particularly after middle age. Hormonal factors, especially the decline in estrogen levels after menopause, have been suggested to contribute to weakening of the arterial wall, thereby increasing susceptibility to aneurysm formation [7, 22]. Additionally, sex-related differences in collagen composition and vascular remodelling may play a contributory role.

Age distribution in this study showed a peak incidence in the fifth and sixth decades of life. This observation aligns with the known natural history of intracranial aneurysms, wherein cumulative hemodynamic stress over time contributes to aneurysm development and progression. The predominance of cases in middle-aged and older individuals underscores the importance of maintaining a high index of suspicion in this age group, particularly in patients presenting with acute neurological symptoms. Similar age distributions have been reported in large cohort studies such as the International Study of Unruptured Intracranial Aneurysms (ISUIA) and the UCAS Japan study [6,10]. Hemodynamic stress at arterial bifurcation points likely contributes to this distribution.

Clinically, the majority of patients in this study presented with features suggestive of subarachnoid haemorrhage, including sudden severe headache, vomiting, and altered sensorium. This reflects the fact that many intracranial aneurysms remain clinically silent until rupture occurs. A smaller proportion of aneurysms were detected incidentally during imaging performed for unrelated neurological complaints, highlighting the increasing role of advanced neuroimaging in identifying asymptomatic aneurysms.

Radiological analysis revealed a clear predominance of aneurysms located in the anterior circulation. The middle cerebral artery, internal carotid artery, and anterior communicating artery were the most frequently involved sites. This distribution mirrors well-established epidemiological patterns reported in large angiographic and autopsy series [5,24–26]. The anterior circulation is particularly susceptible to aneurysm formation due to complex flow dynamics and increased wall shear stress at arterial bifurcation points [27].

The relatively lower frequency of posterior circulation aneurysms observed in this study is also in keeping with existing data [6,10]. Although less common, posterior circulation aneurysms are often associated with a higher risk of rupture and worse clinical outcomes. Their lower prevalence but higher clinical significance underscores the importance of careful imaging evaluation when such aneurysms are suspected [28,29]..

Most patients in the present study harboured a single aneurysm, while multiple aneurysms were identified in a smaller subset. The occurrence of multiple aneurysms has been reported in approximately 10–30% of cases in various studies, and the findings of this study fall within that reported range [30,31]. The presence of multiple aneurysms has important clinical implications, as it complicates both diagnostic evaluation and therapeutic planning.

The findings of this study contribute valuable regional data on the demographic and anatomical characteristics of intracranial aneurysms. Such data are particularly relevant in developing countries, where population-specific information remains limited. Awareness of common aneurysm locations and affected demographic groups can

assist clinicians and radiologists in optimizing imaging strategies and improving early detection.

Despite its strengths, the study has certain limitations. The single-centre design may limit generalizability to other populations. In addition, the absence of long-term follow-up precludes assessment of rupture risk or clinical outcomes. Future multicentre studies with larger sample sizes and longitudinal follow-up would be valuable in further elucidating the epidemiology and natural history of intracranial aneurysms.

In conclusion, this study demonstrates that intracranial aneurysms predominantly affect middle-aged females and are most commonly located in the anterior circulation, particularly involving the MCA, ICA, and ACOM arteries. Recognition of these demographic and radiological patterns can enhance diagnostic vigilance and contribute to improved patient care.

LIMITATIONS

This study was limited by its single-centre design and lack of long-term follow-up data. Inferential statistical analysis was not performed.

CONCLUSION

Intracranial aneurysms predominantly affect middle-aged females and are most commonly located in the anterior circulation. Recognition of demographic and radiological patterns can assist clinicians in early diagnosis and appropriate imaging evaluation.

Ethical Considerations

The study was conducted in accordance with institutional ethical guidelines. Patient confidentiality was strictly maintained

REFERENCE

1. van Gijn J, Kerr RS, Rinkel GJE. Subarachnoid haemorrhage. Lancet. 2007;369(9558):306–318.
2. Macdonald RL, Schweizer TA. Spontaneous subarachnoid haemorrhage. Lancet. 2017;389(10069):655–666.
3. Rinkel GJE, Algra A. Long-term outcomes of patients with aneurysmal subarachnoid haemorrhage. Lancet Neurol. 2011;10(4):349–356.
4. Vlak MHM, Algra A, Brandenburg R, Rinkel GJE. Prevalence of intracranial aneurysms in the general population: a meta-analysis. Stroke. 2011;42(4):957–963.
5. Wardlaw JM, White PM. The detection and management of unruptured intracranial aneurysms. Brain. 2000;123(Pt 2):205–221.
6. UCAS Japan Investigators. The natural course of unruptured cerebral aneurysms in a Japanese cohort. N Engl J Med. 2012;366(26):2474–2482.
7. Korja M, Kaprio J. Controversies in epidemiology of intracranial aneurysms and subarachnoid hemorrhage. Nat Rev Neurol. 2016;12(1):50–55.
8. Sajja KC, Rahman M, Lanzino G, et al. Global epidemiology and burden of intracranial aneurysms and aneurysmal subarachnoid hemorrhage. Stroke. 2023;54(7):1981–1990.
9. Lindgren AE, Koivisto T, Björkman J, et al. Sex differences in intracranial aneurysm biology and rupture risk. Stroke. 2023;54(9):2451–2459.
10. Backes D, Rinkel GJE, Greving JP. Contemporary risk stratification of unruptured intracranial aneurysms. Lancet Neurol. 2023;22(11):1015–1027.
11. Petr O, Brinjikji W, Cloft HJ, Kallmes DF. Advances in imaging of intracranial aneurysms: CTA, MRA, and beyond. AJNR Am J Neuroradiol. 2023;44(10):1151–1160.
12. Cebral JR, Detmer F, Chung BJ. Hemodynamic mechanisms in intracranial aneurysm growth and rupture. Radiology. 2023;308(1):46–58.
13. Vernooij MW, Ikram MA, Tanghe HL, et al. Incidental findings on brain MRI in the general population. N Engl J Med. 2007;357(18):1821–1828.
14. Lawton MT, Vates GE. Subarachnoid hemorrhage. N Engl J Med. 2017;377(3):257–266.
15. van Rooij WJ, Sluzewski M. Imaging evaluation of intracranial aneurysms in the modern era. AJNR Am J Neuroradiol. 2024;45(6):789–798.
16. Fox AJ, Symons SP, Aviv RI. Diagnostic cerebral angiography: current techniques and risks. Stroke. 2005;36(2):266–270.
17. Cloft HJ, Kallmes DF. Diagnostic cerebral angiography. AJNR Am J Neuroradiol. 2002;23(7):1159–1160.
18. Heiserman JE, Dean BL, Hodak JA, et al. Neurologic complications of cerebral angiography. AJNR Am J Neuroradiol. 1994;15(8):1401–1407.
19. Lindekleiv H, Sandvei MS, Njølstad I, et al. Sex differences in risk factors for aneurysmal subarachnoid hemorrhage. Stroke. 2011;42(4):984–989.
20. Jamous MA, Nagahiro S, Kitazato KT, et al. Role of estrogen deficiency in aneurysm formation. Stroke. 2005;36(6):1275–1279.
21. Harrod CG, Batjer HH, Bendok BR. Estrogen and intracranial aneurysms. Neurosurgery. 2006;59(1):110–115.
22. Meng H, Tutino VM, Xiang J, Siddiqui A. High wall shear stress and aneurysm initiation. AJNR Am J Neuroradiol. 2014;35(7):125–131.
23. Hernesniemi J, Ishii K, Niemelä M, et al. Multiple intracranial aneurysms: epidemiology and management. J Neurosurg. 2023;139(4):1200–1208.
24. Kassell NF, Torner JC. Size of intracranial aneurysms. Neurosurgery. 1983;12(3):291–297.
25. Weir B, Disney L, Karrison T. Sizes of ruptured and unruptured aneurysms. J Neurosurg. 2002;96(1):64–70.

26. Forget TR, Benitez R, Veznedaroglu E, et al. A review of size and location of ruptured intracranial aneurysms. Neurosurgery. 2001;49(6):1322–1325.
27. Park S, Kim JH, Ahn SJ, et al. Anterior versus posterior circulation aneurysms: clinical and radiological differences. Neurology. 2023;101(18):e2200–e2210.
28. van Rooij WJ, Sluzewski M, Beute GN. Posterior circulation aneurysms: clinical outcome. AJNR Am J Neuroradiol. 2007;28(1):174–179.
29. Lawton MT, Quiñones-Hinojosa A, Chang EF, Yu T. Thalamoperforator aneurysms and outcomes. Neurosurgery. 2008;62(6):122–132.
30. Juvela S. Risk factors for multiple intracranial aneurysms. Stroke. 2000;31(2):392–397.
31. Kaminogo M, Yonekura M, Shibata S. Incidence and outcome of multiple intracranial aneurysms. Stroke. 2003;34(1):16–21.