



RESEARCH ARTICLE

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CLINICAL AND IMAGING CHARACTERISTICS OF INTRACRANIAL LARGE-ARTERY STENOSIS OR OCCLUSION IN PATIENTS WITH ISCHEMIC STROKE AT S.I.S CAN THO INTERNATIONAL HOSPITAL 2024–2026

Nguyen Tran Tran¹, Tran Chi Cuong², Nguyen Luu Giang², Le Minh Thang²,
Nguyen Dao Nhat Huy², Pham Thi Ngoc Nga^{1*}

¹Can Tho University of Medicine and Pharmacy, Can Tho city, Vietnam

²S.I.S Can Tho International Hospital, Can Tho city, Vietnam

* Corresponding Author

Pham Thi Ngoc Nga,
Can Tho University of
Medicine and Pharmacy

Corresponding Author
e-mail:
ptnnga@ctump.edu.vn



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ABSTRACT

Objective: To describe the clinical characteristics and intracranial large-artery stenosis or occlusion identified by 3-Tesla magnetic resonance imaging (MRI) and digital subtraction angiography (DSA) in patients with ischemic stroke at S.I.S Can Tho International Hospital. **Materials and Methods:** This descriptive cross-sectional study included 194 patients with ischemic stroke and intracranial large-artery stenosis or occlusion evaluated at S.I.S Can Tho International Hospital. All included patients underwent both 3-Tesla MRI/MRA and DSA as part of their clinical evaluation. The study was descriptive and was not designed to assess diagnostic accuracy or agreement between MRI and DSA. **Results:** The male-to-female ratio was approximately 2:1. Dysarthria, hemiparesis/hemiplegia, and central facial palsy were the most frequently recorded predominant neurological manifestations. Only 18.0% of patients arrived within 3 hours of symptom onset. A single intracranial vascular lesion was identified in 92.8% of patients. Among the predefined index lesions reported on DSA, the M1–M2 segments of the middle cerebral artery were most frequently involved (58.8%). Severe stenosis (70–99%) was recorded in 49 patients (25.3%) and complete arterial occlusion in 145 patients (74.7%). **Conclusion:** In this selected cohort from a specialized stroke and endovascular center, most patients had a single intracranial vascular lesion, the M1–M2 segments were the most frequent index-lesion location, and complete occlusion was more common than severe stenosis.

Key words: Intracranial arterial stenosis, 3T MRI, DSA, Ischemic stroke.

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1. Introduction

In 1970, the World Health Organization (WHO) defined stroke as a rapidly developing clinical condition characterized by focal neurological deficits lasting more than 24 hours or leading to death, with no apparent cause other than a vascular origin [1]. Ischemic stroke results from cerebral arterial occlusion and/or reduced cerebral blood flow due to hemodynamic compromise. According to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification, ischemic stroke is categorized into five etiological subtypes: large-artery atherosclerosis, small-vessel occlusion, cardioembolism, stroke of other determined etiology, and stroke of undetermined etiology. Intracranial atherosclerotic stenosis is an important cause of ischemic stroke and is associated with an increased risk of recurrent cerebrovascular events [2]. Patients with a recent transient ischemic attack or ischemic stroke and severe stenosis (70–99%) of a major intracranial artery are at particularly high risk of recurrent ischemic stroke in the territory of the affected artery, with a reported 1-year risk of approximately 23% despite antiplatelet therapy and standard management of vascular risk factors [3]. Recurrent events may be associated with greater disability, mortality, and healthcare burden than initial stroke events.

Accurate assessment of the location, degree of stenosis, and extent of intracranial vascular lesions is important for treatment planning and prognostic evaluation. Three-Tesla magnetic resonance imaging (3T MRI), including magnetic resonance angiography (MRA), provides a non-invasive assessment of brain parenchyma and the intracranial arterial lumen, whereas digital subtraction angiography (DSA) provides high-spatial-resolution luminal assessment and remains important in patients considered for endovascular treatment. High-resolution vessel-wall MRI can provide additional arterial-wall information when dedicated vessel-wall sequences are performed [4–6]; however, plaque characterization was not an outcome of the present study.

In Vietnam, data integrating clinical characteristics with intracranial vascular imaging findings in patients with ischemic stroke remain limited. Therefore, this study aimed to describe the clinical characteristics and imaging features of intracranial large-artery stenosis or occlusion assessed with 3-T MRI and DSA at S.I.S Can Tho International Hospital.

2. Materials and Methods

2.1. Materials

This study included patients diagnosed with ischemic stroke at S.I.S Can Tho International Hospital between March 2024 and August 2026.

Inclusion criteria: Patients were eligible if they had ischemic stroke with an intracranial large-artery stenosis or occlusion identified on vascular imaging and recorded in the study database. The term “intracranial large-artery stenosis or occlusion” was used because the available variables did not uniformly establish an atherosclerotic mechanism for every lesion.

Exclusion criteria: Patients were excluded if they had a potential cardiac source of embolism, including atrial fibrillation or valvular heart disease; lacunar ischemic stroke; no identifiable intracranial arterial lesion on neuroimaging; isolated thrombotic occlusion with complete recanalization and no residual intracranial arterial stenosis; or severe stroke with a high risk of death and a Glasgow Coma Scale (GCS) score <8 at admission, precluding adequate follow-up. Because the original dataset did not provide sufficiently uniform etiologic adjudication for dissection, vasculitis, moyamoya disease, and other non-atherosclerotic arteriopathies, the study does not classify all included lesions as intracranial atherosclerotic disease.

2.2. Methods

A descriptive cross-sectional study was conducted. All patients who met the eligibility criteria during the study period were included, yielding 194 patients in the final analysis. The patient was the primary unit of analysis. For patients with lesions at two or more vascular sites, the source study dataset contained one predefined index lesion per patient for lesion-location and severity summaries. The available source documentation did not provide a separate retrospective adjudication rule for selecting the index lesion; therefore, the index lesion recorded in the original dataset was used without re-selection.

All 194 included patients underwent both 3-T MRI/MRA and DSA during their clinical evaluation. Three-Tesla MRI/MRA was used for non-invasive assessment of cerebral parenchyma and intracranial arterial abnormalities, whereas DSA provided detailed luminal information and was particularly relevant to endovascular evaluation. The purpose of the present study was descriptive rather than comparative; no paired diagnostic-accuracy,

agreement, sensitivity, specificity, or equivalence analyses were performed. Demographic and clinical variables included age, sex, time from symptom onset to hospital admission, the predominant neurological manifestation recorded for the study analysis, and National Institutes of Health Stroke Scale (NIHSS) score. One predominant manifestation was coded per patient. Imaging variables included the number of intracranial arterial lesions and, for the predefined index lesion, arterial location and degree of stenosis or occlusion. Clinical information was obtained through patient assessment and review of medical records.

Brain MRI was performed using a 3-Tesla Siemens MAGNETOM Lumina MRI system. The MRI protocol included diffusion-weighted imaging (DWI), apparent diffusion coefficient (ADC) mapping, fluid-attenuated inversion recovery (FLAIR), and three-dimensional time-of-flight magnetic resonance angiography (3D TOF-MRA). DSA was performed according to clinical indications. For the present analysis, lesion severity was reported using the categories preserved in the source study database: severe stenosis (70–99%) and complete occlusion (100%). The original records did not include a uniform measurement method that would allow retrospective recalculation of percentage stenosis; therefore, the recorded categories were reported without re-adjudication. The study protocol did not define MRI–DSA agreement or diagnostic accuracy as an outcome, and no retrospective sensitivity, specificity, kappa, correlation, or equivalence analysis was undertaken.

2.3. Statistic

Data were entered and analyzed using SPSS version 20.0. Categorical variables were summarized as frequencies and percentages. Continuous variables were presented as mean $\pm$ standard deviation (SD) and range, as appropriate.

2.4. Research Ethics

The study was conducted as part of a research project approved by the Ethics Committee for Biomedical Research of S.I.S Can Tho International Hospital (Approval No. 2113/QĐ-S.I.S, September 25, 2023). All study procedures were conducted in accordance with the approved research protocol. Participant information was kept confidential and used solely for research purposes.

3. Results

3.1. General Characteristics

Table 1. Age and sex characteristics of patients with ischemic stroke

Sex	n	%
Male	130	67.0
Female	64	33.0
Total	194	100.0
Age, years, mean $\pm$ SD (range)	62.06 $\pm$ 11.50 (24–95)	

The study included 194 patients with ischemic stroke, comprising 130 men (67.0%) and 64 women (33.0%), with a male-to-female ratio of approximately 2:1. The mean age was 62.06 $\pm$ 11.50 years, ranging from 24 to 95 years.

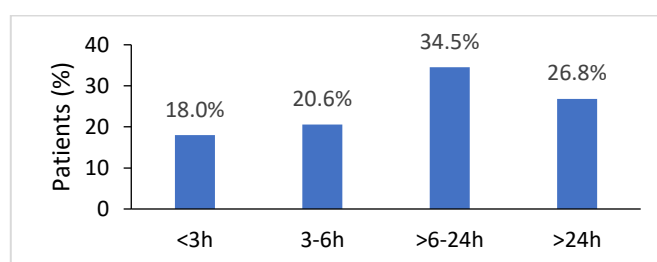


Figure 1. Time from symptom onset to hospital admission among patients with ischemic stroke.

Only 18.0% of patients were admitted within 3 hours of symptom onset, whereas 61.3% presented after more than 6 hours. As S.I.S Can Tho International Hospital is a specialized stroke referral and endovascular-intervention center receiving patients from several Mekong Delta provinces, interhospital referral and transport may contribute to delayed presentation and may also enrich the cohort for patients requiring advanced vascular imaging. These explanations are plausible but could not be verified, because referral and transport times were not recorded.

Table 2. Predominant neurological manifestation at presentation

Predominant clinical manifestation at presentation	n	%
Central facial palsy	38	19.6
Hemisensory disturbance	2	1.0
Altered level of consciousness	17	8.8
Headache	5	2.6
Dizziness	7	3.6
Dysarthria	70	36.1
Hemiparesis/hemiplegia	51	26.3
Syncope	0	0.0
Other symptoms	4	2.1
Total	194	100.0

Dysarthria was the most frequently recorded predominant clinical manifestation (36.1%), followed by hemiparesis/hemiplegia (26.3%) and central facial palsy (19.6%). Because one predominant manifestation was coded per patient for this analysis, the percentages sum to 100% and do not represent the prevalence of all potentially coexisting neurological signs.

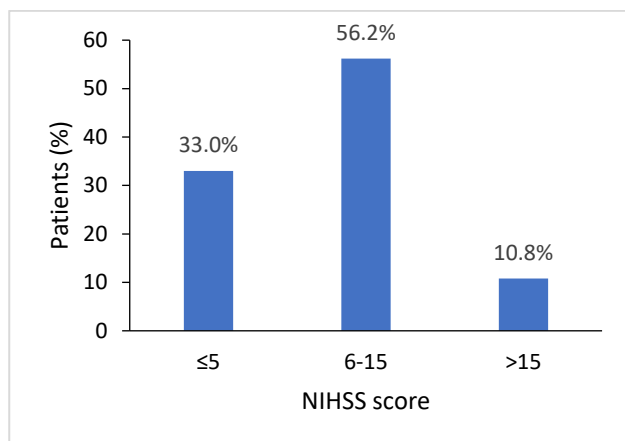


Figure 2. Distribution of NIHSS scores in patients with ischemic stroke

Most patients had NIHSS scores of 6–15 (56.2%), followed by those with scores ≤5 (33.0%). Patients with NIHSS scores >15 accounted for 10.8% of the study population.

3.2. Imaging characteristics of intracranial arterial stenosis and occlusion

Among the 194 patients, 180 (92.8%) had one intracranial vascular lesion and 14 (7.2%) had lesions at two or more vascular sites. Subsequent lesion–location and severity summaries use the single predefined index lesion recorded in the source study dataset for each patient (n= 194).

Table 3. Segmental distribution of the index intracranial arterial lesions on DSA (n= 194)

Index intracranial arterial location	DSA	
	n	%
ICA, cavernous–ophthalmic segment	3	1.5
ICA, ophthalmic segment to terminus	43	22.2
Middle cerebral artery (M1–M2 segments)	114	58.8
Vertebral artery (V4 segment)	19	9.8
Basilar artery	15	7.7
Other	0	0.0
Total	194	100.0

Among the 194 index lesions analyzed on DSA, the middle cerebral artery M1–M2 segments were the most frequently affected arterial segments, accounting for 114 cases (58.8%). The internal

carotid artery from the ophthalmic segment to the carotid terminus was involved in 43 cases (22.2%), followed by the vertebral artery V4 segment in 19 cases (9.8%) and the basilar artery in 15 cases (7.7%). Lesions involving the intracranial internal carotid artery from the cavernous to ophthalmic segment were identified in 3 cases (1.5%). No lesions were classified as “other.”

Table 4. Severity of the predefined index intracranial arterial lesion on DSA (n= 194)

Index-lesion severity	n	%
Severe stenosis (70–99%)	49	25.3
Complete occlusion (100%)	145	74.7

Regarding index-lesion severity, severe stenosis (70–99%) was recorded in 49 patients (25.3%), whereas complete arterial occlusion (100%) was recorded in 145 patients (74.7%).

3.3. Illustrative clinical case

A 54-year-old man presented with acute dysarthria and facial asymmetry, followed several hours later by right-sided hemiparesis and a decreased level of consciousness.

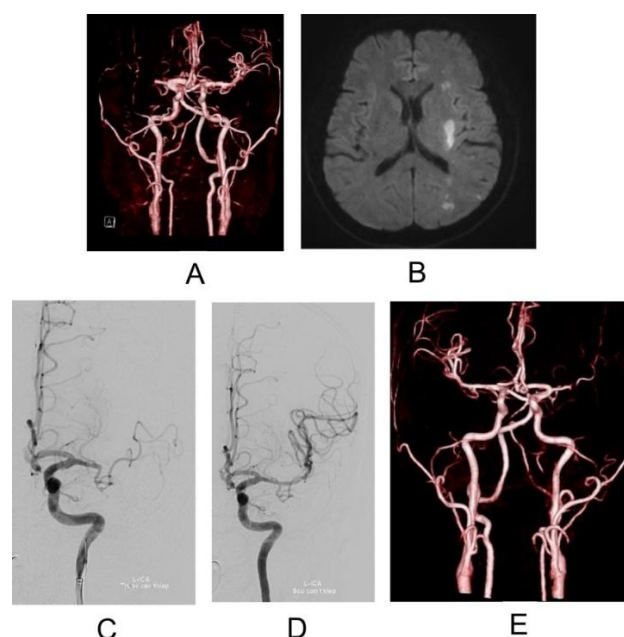


Figure 3. Illustrative clinical case. (A) Pre-procedural MRA shows left MCA occlusion; (B) DWI shows acute infarction in the left cerebral hemisphere; (C) DSA confirms left M1-segment occlusion before stenting; (D) DSA after intracranial stent placement; and (E) follow-up MRA on June 24, 2026 demonstrated in-stent occlusion.

Pre-procedural MRA and DWI on February 2, 2025 demonstrated left middle cerebral artery occlusion with acute ischemic infarction in the left cerebral hemisphere. DSA confirmed left M1-segment occlusion, and intracranial stent placement was subsequently performed. Follow-up MRA on June 24, 2026 demonstrated in-stent occlusion. This de-identified case is presented only as an imaging illustration of the vascular findings and endovascular course and was not used for a separate outcome analysis.

4. Discussion

This single-center descriptive study included 194 patients with ischemic stroke and intracranial large-artery stenosis or occlusion evaluated at a specialized cerebrovascular referral and endovascular center. The predominance of older adults and men is broadly compatible with contemporary epidemiologic observations of ischemic stroke [7,9], although the wide age range and incomplete etiologic adjudication mean that the included mean that not all included lesions can be assumed to be atherosclerotic.

Only 18.0% of patients arrived within 3 hours of symptom onset, and 61.3% arrived after more than 6 hours. Because S.I.S Can Tho International Hospital receives referrals from several Mekong Delta provinces, interhospital transfer and transport may contribute to delayed presentation. More importantly, this referral pattern introduces potential selection and referral bias and may enrich the cohort for patients requiring advanced vascular imaging or endovascular evaluation; these proportions should therefore not be generalized to an unselected ischemic-stroke population.

Most patients had NIHSS scores of 6–15 (56.2%), while 33.0% had scores ≤ 5 and 10.8% had scores > 15 . This distribution should be interpreted in light of the eligibility criteria, because patients with GCS < 8 at admission were excluded. Other vascular risk factors were not uniformly recorded and are therefore not reported.

A single intracranial vascular lesion was recorded in 92.8% of patients. The M1–M2 segments of the middle cerebral artery were the most frequent predefined index-lesion location (58.8%). Three-Tesla MRI/MRA provides non-invasive assessment of brain parenchyma and intracranial arterial abnormalities, while DSA provides high-spatial-resolution luminal information and is commonly used in endovascular evaluation [4-6]. However, the

present study was not designed to compare the diagnostic performance of these modalities.

Severe stenosis (70–99%) accounted for 25.3% of index lesions and complete occlusion for 74.7%. The high proportion of complete occlusion likely reflects the selected population of a specialized stroke referral and endovascular center and the study eligibility process. Previous Vietnamese experience has also described intracranial stenting in selected patients with acute ischemic stroke [8], while other studies have emphasized the importance of follow-up for restenosis or re-occlusion after intracranial stenting [10,11]. The illustrative case in Figure 3 demonstrates this type of longitudinal imaging course but is not intended to estimate the frequency or predictors of in-stent occlusion in the study cohort.

The study should be interpreted as a descriptive characterization of a selected hospital cohort rather than a diagnostic-comparison study.

Study limitations fall into three main areas. First, regarding design and sampling, the single-center cross-sectional design and specialized referral patterns introduce potential selection bias, while excluding patients with GCS < 8 may underrepresent severe strokes. Second, data completeness was constrained by a lack of long-term clinical outcomes, incomplete etiologic adjudication of intracranial arteriopathies, and non-uniform availability of vascular risk-factor variables. Finally, regarding measurement, percentage stenosis could not be retrospectively recalculated due to limited source database documentation, and MRI–DSA diagnostic accuracy or agreement was not a prespecified objective and thus not assessed.

5. Conclusion

In this selected cohort of 194 patients with ischemic stroke and intracranial large-artery stenosis or occlusion at S.I.S Can Tho International Hospital, dysarthria, hemiparesis/hemiplegia, and central facial palsy were the most frequently recorded predominant neurological manifestations. Most patients had a single intracranial vascular lesion, the M1–M2 segments of the middle cerebral artery were the most frequent predefined index-lesion location, and complete occlusion (74.7%) was more frequent than severe stenosis (25.3%). These findings describe the clinical and imaging profile of patients evaluated at a specialized stroke and endovascular center.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Generative AI and AI-Assisted Technologies

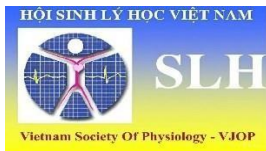
The authors declare that no artificial intelligence (AI) was used during the research process or in the writing of this manuscript.

Author Contributions

Nguyen Tran Tran: conceptualization and study design, patient recruitment and data collection, data analysis. Tran Chi Cuong, Nguyen Luu Giang: interpretation of results, preparing figures, drafting the manuscript. Le Minh Thang, Nguyen Dao Nhat Huy: editing and critical review of the manuscript. Pham Thi Ngoc Nga: final approval of the manuscript.

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ĐẶC ĐIỂM LÂM SÀNG VÀ HÌNH ẢNH HẸP HOẶC TẮC ĐỘNG MẠCH LỚN NỘI SỌ Ở BỆNH NHÂN ĐỘT QUY THIẾU MÁU NÃO TẠI BỆNH VIỆN ĐA KHOA QUỐC TẾ S.I.S CẦN THƠ 2024–2026

Nguyễn Trân Trân¹, Trần Chí Cường², Nguyễn Lưu Giang², Lê Minh Thắng², Nguyễn Đào Nhật Huy², Phạm Thị Ngọc Nga^{1*}

¹Trường Đại học Y Dược Cần Thơ

²Bệnh viện Đa khoa Quốc tế S.I.S Cần Thơ

TÓM TẮT

Mục tiêu: Mô tả đặc điểm lâm sàng và hình ảnh hẹp hoặc tắc động mạch lớn nội sọ trên MRI 3 Tesla và DSA ở bệnh nhân đột quy thiếu máu não tại Bệnh viện Đa khoa Quốc tế S.I.S Cần Thơ. **Đối tượng và phương pháp nghiên cứu:** Nghiên cứu mô tả cắt ngang trên 194 bệnh nhân đột quy thiếu máu não có hẹp hoặc tắc động mạch lớn nội sọ. Tất cả 194 bệnh nhân đều được đánh giá bằng MRI/MRA 3 Tesla và DSA trong quá trình thăm khám lâm sàng. Nghiên cứu mang tính mô tả và không được thiết kế để đánh giá độ chính xác hay độ tương hợp giữa MRI và DSA. **Kết quả:** Tỷ lệ nam:nữ xấp xỉ 2:1. Nói khó, liệt nửa người và liệt VII trung ương là các biểu hiện thần kinh trội thường gặp nhất. Chỉ 18,0% bệnh nhân đến viện trong 3 giờ đầu. Có 92,8% bệnh nhân chỉ có một vị trí tổn thương mạch nội sọ. Trong các tổn thương chỉ số được ghi nhận trên DSA, đoạn M1–M2 của động mạch não giữa thường gặp nhất (58,8%). Hẹp nặng 70–99% chiếm 25,3% và tắc hoàn toàn chiếm 74,7%. **Kết luận:** Trong nhóm bệnh nhân được chọn tại trung tâm đột quy và can thiệp nội mạch chuyên sâu, phần lớn bệnh nhân có một tổn thương mạch nội sọ; đoạn M1–M2 là vị trí tổn thương chỉ số thường gặp nhất và tắc hoàn toàn gặp nhiều hơn hẹp nặng.

Từ khóa: Hẹp động mạch nội sọ, MRI 3 Tesla, DSA, Đột quy thiếu máu não.