

Assessment of Intracranial Arterial Occlusion in Acute Ischemic Stroke through CT Cerebral Angiography

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ABSTRACT

Background:

Acute ischemic stroke (AIS) is a major cause of death and disability around the world, and it adds a lot to the global health burden. It makes up about 80-85% of all stroke cases and is linked to a lot of sickness and a low quality of life. It happens when blood flow to the brain suddenly stops or slows down because of arterial occlusion or significant stenosis, which causes ischemic injury.

Methods:

This was a cross-sectional study conducted at NIMS Hospital, Rajasthan, Jaipur including 72 patients (>18 years). Patients who underwent non-contrast computed tomography (NCCT) and Computed tomography angiography (CTA) suspected of acute ischemic stroke having symptoms within 24 hours were included in this study.

Results:

The study included 72 patients in all. The average age was 62.4 years, with a range of 28 to 88 years. There were slightly more men 52.8% (n=38), and 47.2% (n=34) women. Most of the patients 38.9% (n=28) came in within six hours of their first symptoms. In 59.7% (n=43) of patients, AIS with large vessel occlusion (LVO) was found. In 30.6% (n=22) of patients, AIS was found without LVO, and in 9.7% (n=7) of patients, no significant intracranial abnormality was found. The middle cerebral artery (MCA) 69.8% (n=30) was the most affected vessel, followed by the internal carotid artery 44.2% (n=19) and the posterior circulation 20.9% (n=9). The most common symptom that people came in with was hemiparesis 72.2% (n=52), followed by speech problems 61.1% (n=44). Hypertension was the most prevalent comorbidity, followed by diabetes mellitus.

Conclusion:

From the study CT cerebral angiography is very important for figuring out what is causing an AIS by looking at the arteries in the brain. The MCA was the vessel most often involved in our study. Early imaging, especially within the first few hours of symptom onset, is crucial for enhancing patient outcomes.

Keywords: Acute ischemic stroke (AIS), Large vessel occlusion (LVO), Middle cerebral artery (MCA), Non-contrast computed tomography (NCCT), Computed tomography angiography (CTA).

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INTRODUCTION

Stroke is becoming more common and more frequent around the world, especially among the growing population. This is due to rapid urbanization and more

exposure to vascular risk factors. Recent global estimates indicate that stroke is responsible for millions of deaths annually and contributes to disability-adjusted life years (DALYs), imposing a substantial

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socioeconomic burden.^(1,2) Among all types of strokes, acute ischemic stroke (AIS) is responsible for 80-85% of all strokes. It also causes a lot of illness, disability, dependence, cognitive impairment, and a lower quality of life.^(1,2,4)

The pathophysiology of AIS is when blood flow to the brain suddenly stops or slows down because the artery that supplies it is blocked or significantly narrowed (stenosis). This means that the brain doesn't get enough oxygen and glucose. This sets off a series of complicated pathological changes, such as problems with energy metabolism, a lack of adenosine triphosphate, problems with ionic pumps, higher levels of calcium inside cells, the release of excitotoxic neurotransmitters, oxidative stress, the activation of pro-inflammatory mediators, cytotoxic oedema, and cell death.^(3,4)

Intracranial arterial occlusion is an important factor in infarct size, severity of neurological deficits, therapeutic outcomes, and prognosis in AIS. Large vessel occlusion (LVO), particularly those affecting the intracranial internal carotid artery (ICA) and the middle cerebral artery (MCA), are associated with large areas of brain infarction, severe neurological deficits, and poor prognosis and outcomes following AIS.^(4,13) Neuro imaging is a key part of diagnosing and treating AIS. Modern stroke protocols depend on quick multimodal imaging to confirm ischemia, figuring out how big the infarct is, check the patency of the blood vessels, and help doctors make treatment decisions.^(3,5) Imaging results are used to choose which patients can get reperfusion therapies like intravenous thrombolysis and mechanical thrombectomy.^(5,7)

Non-contrast computed tomography (NCCT) is still the best way to get images of suspected AIS because it is quick, widely available, and very good at ruling out intracranial hemorrhage.^(5,8) It is very important to tell the difference between ischemic and hemorrhagic stroke early on because the ways to treat them are very different. Even though NCCT is very important, it cannot directly show intracranial arterial occlusion very well, and it does not give much information about the size of the thrombus or the collateral circulation.^(5,6)

Computed tomography cerebral angiography (CTCA) is now an essential part of modern imaging protocols for acute stroke. CTCA allows for quick viewing of the extracranial and intracranial arterial systems after intravenous contrast is given. This makes it possible to accurately find the site of the blockage, the vascular anatomy, and the vessel patency.^(3,5,8)

Computed tomography angiography (CTA) has shown high sensitivity and specificity for finding intracranial arterial occlusions, especially LVOs.⁽¹⁰⁾ Single-phase CTA offers a swift evaluation of vascular structures, however, it captures a static image of arterial filling and may not effectively reveal delayed collateral perfusion⁽¹²⁾. Incorrect diagnoses can happen when contrast timing is not right, when there are differences in anatomy, when vessels are calcified, or when different readers interpret the same information in different ways.⁽⁹⁾ To understand a CTA, you need to know a lot about neurovascular anatomy and be aware of possible problems. Different readers may have different experiences, which can affect the accuracy of a diagnosis, especially when looking at distal arterial branches and small blockages.^(9,13) CTA gives important information about how big the thrombus is. Collateral grading systems based on CTA are closely linked to functional results. For patients with anterior circulation LVO, composite collateral scores that combine arterial inflow and venous outflow characteristics can predict functional independence at 90 days. Patients exhibiting advantageous collateral profiles exhibit reduced infarct volumes, decelerated infarct progression, and enhanced responsiveness to reperfusion therapy.⁽⁶⁾

Imaging is a key factor in choosing patients for endovascular thrombectomy. Landmark trials have shown that advanced imaging can find patients who are likely to benefit from reperfusion even after the usual therapeutic time windows.^(8,14,15)

CTA has some drawbacks, even though it has some benefits. Suboptimal contrast timing, insufficient arterial opacification, venous contamination, motion artifacts, and beam hardening artifacts can all lead to diagnostic mistakes.⁽⁹⁾

METHODOLOGY:

A cross-sectional study was conducted in the Department of Radiodiagnosis and imaging in NIMS Hospital for a period of 6 months. A total of 72 patients who underwent CT Cerebral Angiography presenting within 24 hours of symptom onset were included in this article.

First authorization was requested from the Department of Radiology. All the participants were informed about the purpose and procedure of the study, and written informed consent was obtained before their inclusion.

Procedure: NCCT was performed as the first imaging modality in all patients. All scans were performed on a Siemens Healthineers SOMATOM go. Top 128-slice CT scanner. Extended scan ranges from base of skull to

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vertex, images were reconstructed using Maximum Intensity Projection (MIP), Volume Rendering Technique (VRT), and inverted MIP. CTA was performed immediately after NCCT without delay. Wider scan ranges from aortic arch to vertex to cover both extracranial and intracranial vessels. Intravenous non-ionic iodinated contrast was administered by power injector at a maximum dose of about 65mL in adults, adjusted to the patient's status. A bolus tracking technique was used to ensure optimal arterial phase acquisition. Image acquisition was performed using 3D angiography protocol according to institutional settings CTA images were systematically reviewed for presence and location of intracranial arterial occlusion.

Statistical Analysis: Data were analysed using SPSS version 26.0. Continuous variables were compared using independent t-tests or one-way ANOVA, and categorical variables using Chi-square and Fisher's exact tests. Logistic regression identified predictors of large vessel occlusion (LVO). A two-tailed $p < 0.05$ was considered significant.

RESULT

A total of 72 patients, aged 28-88 years, including both males and females were included in the study. The mean age was 62.4 to 15.8, the participants were recruited from Nims hospital who underwent CT cerebral angiography in suspected acute ischemic stroke. Among 72 patients, large vessel occlusion (LVO) was present in 59.7% (43/72). Hemiparesis independently predicted LVO (adjusted OR 3.06, $p = 0.034$). Non-contrast CT showed good sensitivity (88.4%) but moderate specificity (72.4%) for LVO. No significant age or gender differences were found between stroke types.

Variable	Category	Number	Percentage (%)
Gender	Male	38	52.8%
	Female	34	47.2%
Time since onset	<6 hours	28	38.9
	6-12 hours	18	25.0%
	12-24 hours	13	18.1%
	Unspecified (within range)	13	18.1%
Neurological condition	Hemiparesis	52	72.2%
	Speech difficulty	44	61.1%
	Facial droop/deviation	29	40.3%

	Dizziness/vertigo	24	33.3
	Gait imbalance/ataxia	15	20.8%
	Altered sensorium/decrease consciousness	12	16.7%
	Aphasia	12	16.7%

TABLE 1: Demographic and Clinical Characteristics

Table 1 shows the cohort exhibited a nearly equal gender distribution, with a slight male predominance (52.8% male versus 47.2% female). This balanced representation suggests that no sex-based selection bias was present, and the findings can be reasonably applied to both men and women. Most patients (38.9%) presented within the first 6 hours, making them potential candidates for time-sensitive interventions such as thrombolysis or thrombectomy. An additional 25.0% arrived between 6–12 hours, while 18.1% had unspecified onset timing, which may reflect unclear symptom recognition or delayed presentation. Hemiparesis was the dominant presenting symptom, occurring in nearly three-quarters of patients (72.2%), followed by speech difficulty in 61.1%. Facial droop, dizziness, and gait imbalance were less frequent but still present in substantial minorities, and this symptom profile aligns with the high prevalence of anterior circulation strokes.

Occlusion Site	n (%)
MCA (M1/M2 segments)	30 (69.8%)
ICA (with or without MCA)	19 (44.2%)
PCA / Posterior circulation	9 (20.9%)
Vertebrobasilar	5 (11.6%)
Multiple vessels	5 (11.6%)

TABLE 2: Most Common Occlusion Sites (Among LVO Patients, n=43)

Table 2 and show the middle cerebral artery was the most frequently occluded vessel, involved in 69.8% of LVO cases, consistent with known epidemiological

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patterns of acute ischemic stroke. Internal carotid artery occlusion (44.2%) and posterior circulation involvement (20.9%) were also common, and the percentages exceed 100% because many patients had multiple concurrent occlusions.

NCCT Finding	CTA Occlusion Present	CTA Occlusion Absent	Total	p-value
Positive (ischemic changes/HMCAS)	38	8	46	0.607
Negative (normal/non-specific)	5	21	25	
Total	43	29	72	

TABLE 3: NCCT Findings vs. CTA Confirmed Occlusion (Diagnostic Accuracy)

(McNemar's test / Chi-square, $p = 0.607$; sensitivity 88.4%, specificity 72.4%): Table 3 shows NCCT demonstrated good sensitivity for detecting LVO (88.4%), correctly identifying most patients with occlusion. However, specificity was only moderate (72.4%), meaning about 1 in 4 positive NCCT findings were false positives, which could lead to unnecessary angiography or treatment delays if CTA is not readily available.

Time Category	n	%	LVO Present (n)	LVO Rate (%)	p-value
≤6 hours	28	38.9%	19	67.9%	0.137
6-12 hours	18	25.0%	12	66.7%	
12-24 hours	13	18.1%	7	53.8%	
Within range	13	18.0%	5	38.5%	

Time Category	n	%	LVO Present (n)	LVO Rate (%)	p-value
(unspecified)					

TABLE 4: Time Since Onset

Distribution

(Chi-square trend analysis, $\chi^2 = 2.21$, $p = 0.137$): Early presentation (≤6 hours) showed a higher rate of LVO (67.9%) compared to later presentation (53.8% for 12–24 hours) and unspecified timing (38.5%), suggesting that patients with larger vessel occlusions may seek care more rapidly due to more severe symptoms. However, this trend did not reach statistical significance ($p = 0.137$), possibly due to small sample sizes in later time categories, as shown in Table 4.

Symptom	Total (n)	LVO Present (n)	LVO Rate (%)	Odds Ratio	95% CI	p-value
Hemiparesis (unilateral weakness)	52	36	69.2%	2.89	1.08 - 7.73	0.034*
Speech difficulty	44	30	68.2%	2.14	0.87 - 5.16	0.096

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Symptom	Total (n)	LVO Present (n)	LVO Rate (%)	Odds Ratio	95% CI	p-value
					.26	
Facial droop	29	20	69.0%	1.98	0.75 - 5.14	0.162
Dizziness/Vertigo	24	11	45.8%	0.42	0.16 - 1.09	0.074
Altered sensorium/Consciousness	12	10	83.3%	3.75	0.71 - 19.87	0.099

Symptom	Total (n)	LVO Present (n)	LVO Rate (%)	Odds Ratio	95% CI	p-value
Gait imbalance/Ataxia	15	9	60.0%	0.98	0.22 - 4.28	0.972
Aphasia	12	10	83.3%	3.25	0.61 - 16.64	0.146

TABLE 5: Association of Presenting Symptoms with LVO

(Fisher's exact / Chi-square test, hemiparesis **OR=2.89, p=0.034**): Table 5 showing hemiparesis was the only symptom significantly associated with LVO, increasing the odds nearly threefold. Speech difficulty, facial droop, and aphasia showed positive but non-significant associations, while dizziness trended toward a negative association (OR=0.42); suggesting it may be more common in non-LVO or posterior circulation strokes.

DISCUSSION

In the present study, the role of CT cerebral angiography in the evaluation of intracranial arterial occlusions in patients with AIS was assessed. A total of 72 patients were recruited into this study with nearly

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equal gender distribution (52.8% male and 47.2%female) and a wide age range, indicating that AIS affects a broad population group. In our study, Intracranial arterial occlusion was identified in 43 patients, demonstrating a high prevalence of vascular occlusion in AIS. This finding is consistent with previous studies conducted by **Ospel JM et al.**⁽¹³⁾ that emphasize the critical role of arterial occlusion, particularly large vessel occlusions, in determining stroke severity and outcomes. Early diagnosis of the same would help in initiating early therapeutic intervention, including mechanical thrombectomy conducted by **Dias BA et al.**⁽⁸⁾

The most common one among all the vessels that was involved in our study was the MCA 69.8% of LVO cases, which is similar in earlier literature, explaining that MCA is more prone to occlusion as it is directly attached to the internal carotid artery ICA conducted by **Campbell BCV et al.**⁽⁴⁾ MCA occlusions are often associated with large infarct size and severe neurological deficits, highlighting the importance of rapid detection.

The total number of patients who developed AIS but without LVO was 22 patients, indicating by the role played by small vessel disease, distal occlusion, or transient ischemic attacks. These findings are supported by literature indicating that not all ischemic strokes are associated with major arterial occlusion conducted by **Abdalkader M et al.**⁽³⁾ Hemiparesis was the most frequent symptom 72.2% which is consistent with motor cortex involvement in areas mainly supplied by the MCA and hypertension was most frequent comorbidity identifying it as a significant factor in developing atherosclerosis and leading to stroke due to vascular stenosis. These are consistent with earlier studies too conducted by **Campbell BCV et al.**⁽⁴⁾

In our study, 28 patients presented within 6 hours of symptom occurrence. NCCT and CTA played complementary roles in this study. NCCT was essential for excluding intracranial hemorrhage and detecting early ischemic changes, while CTA provided accurate visualization of intracranial arterial occlusions and stenosis. This combined approach is well supported in the earlier literature conducted by **Regenhardt RW et al.**⁽⁵⁾ Although the findings of our study are similar to previous literature, this study provides important validation in a local population and supports the reliability of CT cerebral angiography in routine clinical practice. Overall, CT cerebral angiography is a rapid, reliable, and non-invasive modality for detecting

intracranial arterial occlusions and stenosis in AIS. When combined with NCCT.

CONCLUSION

CT cerebral angiography is an effective method of fast and non-invasive investigation of intracranial arterial occlusions in patients with AIS. It has been found that a considerable number of patients in the current study had arterial occlusions, the most affected artery being the middle cerebral angiography (MCA). The combination of NCCT and CT cerebral angiography is important in early diagnosis as the presence of intracranial hemorrhage can be ruled out, ischemia can be detected, and vascular occlusion/stenosis identified. Early imaging is essential especially when patients belong to the therapeutic time since their management will depend on the results.

CT cerebral angiography has proven to increase diagnostic precision and help make intervention easier and more effective, thus helping improve patient prognosis in acute ischemic stroke.

REFERENCES

1. Feigin VL, Brainin M, Norrving B, Martins SO, Pandian J, Lindsay P, et al. World Stroke Organization: Global Stroke Fact Sheet 2025. *Int J Stroke.* 2025 Feb;20(2):132–144. doi:10.1177/17474930241308142.
2. GBD 2021 Stroke Risk Factor Collaborators. Global, regional, and national burden of stroke and its risk factors, 1990–2021: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet Neurol.* 2024 Oct;23(10):973–1003. doi:10.1016/S1474-4422(24)00369-7.
3. Abdalkader M, Siegler JE, Lee JS, Yaghi S, Qiu Z, Huo X, et al. Neuroimaging of acute ischemic stroke: multimodal imaging approach for acute endovascular therapy. *J Stroke.* 2023 Jan;25(1):55–71. doi:10.5853/jos.2022.03286.
4. Campbell BCV, Khatri P. *Stroke.* Lancet. 2020 Jul 11;396(10244):129–142. doi:10.1016/S0140-6736(20)31179-X.
5. Regenhardt RW, Potter CA, Huang SS, Lev MH. Advanced imaging for acute stroke treatment selection: CT, CTA, CT perfusion, and MR imaging. *Radiol Clin North Am.* 2023 May;61(3):445–456. doi:10.1016/j.rcl.2023.01.003.

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6. Salim HA, Lakhani DA, Mei J, Koneru M, Balar A, Hoseinyazdi M, et al. Composite arterial and venous collateral score on single-phase CTA predicts 90-day outcomes in anterior circulation large-vessel occlusion stroke. *J Neurointerv Surg.* 2025 Sep 5;jnis-2025-023904. doi:10.1136/jnis-2025-023904.
7. Menon BK, Ospel JM, McTaggart RA, Nogueira RG, Demchuk AM, Poppe A, et al. Imaging criteria across pivotal randomized controlled trials for late window thrombectomy patient selection. *J Neurointerv Surg.* 2020 Nov 25;neurintsurg-2020-016902. doi:10.1136/neurintsurg-2020-016902.
8. Dias BA, Bezerra KB, Bezerra ASA, Santana VG, Borges RR, Reinaux JCF, et al. Importance of computed tomography angiography in acute/hyperacute ischemic stroke. *Radiol Bras.* 2021 Nov–Dec;54(6):360–366. doi:10.1590/0100-3984.2020.0168.
9. Fasen BACM, Heijboer RJJ, Hulsmans FH, Kwee RM. CT angiography in evaluating large-vessel occlusion in acute anterior circulation ischemic stroke: factors associated with diagnostic error in clinical practice. *AJNR Am J Neuroradiol.* 2020 Apr;41(4):607–611. doi:10.3174/ajnr.A6469.
10. Fasen BACM, Heijboer RJJ, Hulsmans FH, Kwee RM. Diagnostic performance of single-phase CT angiography in detecting large vessel occlusion in ischemic stroke: a systematic review. *Eur J Radiol.* 2021 Jan;134:109458. doi:10.1016/j.ejrad.2020.109458.
11. Alotaibi FF, Alshahrani A, Mohamed G, AlShamrani MA, Bin Amir H, Alsaeed A, et al. Diagnostic accuracy of large and medium vessel occlusions in acute stroke imaging by neurology residents and stroke fellows: a comparison of CT angiography alone and CT angiography with CT perfusion. *Eur Stroke J.* 2024 Jun;9(2):356–365. doi:10.1177/23969873231214218.
12. Dundamadappa S, Iyer K, Agrawal A, Choi DJ. Multiphase CT angiography: a useful technique in acute stroke imaging—collaterals and beyond. *AJNR Am J Neuroradiol.* 2021 Jan;42(2):221–227. doi:10.3174/ajnr.A6889.
13. Ospel JM, Holodinsky JK, Goyal M. Management of acute ischemic stroke due to large-vessel occlusion: JACC focus seminar. *J Am Coll Cardiol.* 2020 Apr 21;75(15):1832–1843. doi:10.1016/j.jacc.2019.10.034.
14. Albers GW, Marks MP, Kemp S, Christensen S, Tsai JP, Ortega-Gutierrez S, et al. Thrombectomy for stroke at 6 to 16 hours with selection by perfusion imaging. *N Engl J Med.* 2018 Feb 22;378(8):708–718. doi:10.1056/NEJMoa1713973.
15. Nogueira RG, Jadhav AP, Haussen DC, Bonafe A, Budzik RF, Bhuva P, et al. Thrombectomy 6 to 24 hours after stroke with a mismatch between deficit and infarct. *N Engl J Med.* 2018 Jan 4;378(1):11–21. doi:10.1056/NEJMoa1706442.