Clinical Audit

Door-to-needle time in acute ischemic stroke: Impact of imaging pathway on thrombolysis workflow—A single-center audit

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Abstract

Background: Rapid reperfusion is the cornerstone of acute ischemic stroke (AIS) management. Door-to-needle time (DTN) is a key quality metric and is strongly time-dependent for benefit from intravenous thrombolysis. Imaging workflow can substantially influence DTN.

Objective: To evaluate DTN performance in AIS patients treated with intravenous thrombolysis and compare DTN between CT-based and MRI-based imaging pathways.

Methods: Retrospective audit of consecutive adult AIS patients who received intravenous thrombolysis at a tertiary stroke center. Demographics, vascular risk factors, stroke territory, imaging pathway (CT-first vs MRI-first), and DTN were recorded. Results are presented descriptively with comparison of mean DTN across pathways.

Results: Forty patients underwent thrombolysis; 23 (57.5%) were male. Anterior circulation strokes comprised 35/40 (87.5%). Major risk factors included hypertension 22/40 (55%), diabetes 16/40 (40%), smoking 17/40 (42.5%), and dyslipidemia 14/40 (35%). Mean DTN was 41 minutes in the CT-based pathway versus 66 minutes in the MRI-based pathway (absolute delay 25 minutes with MRI-first).

Conclusion: A CT-first workflow was associated with substantially shorter DTN compared with MRI-first imaging in our real-world audit. CT-first imaging should remain the default strategy for eligible hyperacute stroke patients, while MRI-first pathways should be reserved for selected indications (e.g., unclear onset) to avoid reperfusion delays.

Keywords: Acute ischemic stroke; Thrombolysis; Door-to-needle time; CT; MRI; Quality improvement.

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1. Introduction

Intravenous thrombolysis is an established therapy for AIS when delivered within the appropriate time window, improving functional outcomes despite an increased risk of symptomatic intracranial hemorrhage. Early randomized evidence (NINDS) demonstrated benefit when alteplase is administered within 3 hours, and later trials supported treatment up to 4.5 hours in selected patients.[1,2] Time-to-treatment strongly modifies benefit: pooled individual patient data analyses demonstrate that earlier treatment yields larger proportional and absolute benefits.[3] This has led major guidelines to emphasize rapid in-hospital evaluation and treatment, with DTN ≤60 minutes as a key benchmark.[4]

Imaging is essential to exclude intracranial hemorrhage and guide reperfusion decisions. Non-contrast CT (NCCT) is fast and widely available, making it the default modality in most systems of care. MRI offers improved early ischemia detection and advanced tissue selection, which is particularly useful in wake-up/unknown onset stroke and certain diagnostic dilemmas. However, MRI often introduces logistical delays (screening, transport, scanner availability, acquisition time), potentially eroding time-dependent thrombolysis benefit. This audit evaluates DTN at our center and examines how imaging pathway selection affects workflow.

2. Methods

Variables collected

- Demographics (age/sex — if available; currently sex only)
- Stroke territory (anterior vs posterior circulation)
- Vascular risk factors (hypertension, diabetes mellitus, smoking, dyslipidemia)
- Imaging pathway used prior to thrombolysis: CT-based (NCCT ± CTA) or MRI-based (DWI/FLAIR/GRE-SWI ± MRA)
- Door-to-needle time: time from ED arrival to thrombolytic bolus.
- Analysis: Descriptive statistics; DTN summarized as mean minutes in each imaging pathway (CT vs MRI). (If you want, once you share the per-patient DTN data, median/IQR and group comparison can be added.)

3. Results

Demographics	
Total thrombolysed AIS patients	40
Male	23 (57.5%)
Female	17 (42.5%)
Stroke territory	
Anterior circulation	35 (87.5%)
Posterior circulation	5 (12.5%)
Vascular risk factors	
Hypertension	22 (55%)
Diabetes mellitus	16 (40%)
Smoking	17 (42.5%)
Dyslipidemia	14 (35%)
Door-to-needle time by imaging pathway	
CT-based pathway	Mean DTN 41 min
MRI-based pathway	Mean DTN 66 min
Absolute difference	25 min longer with MRI-first imaging

4. Discussion

This audit demonstrates a clinically meaningful difference in DTN based on imaging pathway selection. Patients triaged through a CT-first pathway had substantially shorter DTN (41 minutes) compared with an MRI-first approach (66 minutes), producing an absolute delay of 25 minutes. This delay is not a minor operational detail, is biologically and clinically relevant. The time-dependent nature of thrombolysis benefit is firmly established. In pooled randomized trial data, alteplase improves functional outcomes when given within 4.5 hours, with progressively greater benefit the earlier treatment is delivered. [3] The mechanistic rationale is intuitive: as time elapses, infarct core expands, penumbral tissue shrinks, and reperfusion yields diminishing returns while hemorrhagic risks remain. Saver's quantitative "time is brain" model reinforces the scale of loss during untreated ischemia. [5]

International guideline frameworks for AIS care endorse NCCT as the default rapid imaging tool to exclude hemorrhage and enable treatment without unnecessary in-hospital delay. [4] MRI, although diagnostically powerful, introduces delays through additional screening (implants/foreign bodies), longer acquisition time, greater sensitivity to motion, and more complex logistics (transport, scheduling, staffing). Therefore, an MRI-first strategy—if applied broadly to standard-window thrombolysis—can inadvertently sacrifice time-dependent benefit.

Stroke systems of care emphasize streamlined CT-first pathways. The AHA/ASA "Target: Stroke" initiative established best practices focused on parallel processing, streamlined registration, rapid imaging, premixing thrombolytic, and feedback loops.[6] Highly optimized single-center workflows have demonstrated median in-hospital delays approaching 20 minutes when tasks are simplified and performed in parallel.[7] A key operational point is that imaging choice is a modifiable systems factor, and our findings support CT-first strategies in hyperacute stroke.

This does not imply MRI should be avoided in all acute stroke care. MRI-based selection is particularly valuable when onset is unknown (wake-up stroke) where mismatch paradigms can identify patients likely to benefit from thrombolysis. [9] Thus, MRI should be protocolized as a selective pathway, not the default for standard-window thrombolysis, unless local logistics allow MRI without DTN penalty.

Limitations: Single-center, retrospective design and absence of functional outcome measures.

5. Conclusion

In our single-center audit, a CT-first imaging pathway was associated with substantially shorter DTN compared with MRI-first imaging among thrombolysed AIS patients. CT-first protocols should be prioritized for standard-window thrombolysis, while MRI-first approaches should be reserved for selected scenarios where tissue-based selection outweighs time delay risk.

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