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Thrombectomy for Large-Vessel Occlusion With Pretreatment Intracranial Hemorrhage

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ORIGINAL RESEARCH

Thrombectomy for Large-Vessel Occlusion With Pretreatment Intracranial Hemorrhage

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BACKGROUND: Many patients treated with endovascular thrombectomy (EVT) in clinical practice would not have qualified for inclusion in the initial clinical trials demonstrating benefit for EVT, yet likely will benefit from reperfusion. One such subset for which data are sparse is patients with emergent large-vessel occlusion and concomitant intracranial hemorrhage (ICH). The objective of this report is to document patients who underwent thrombectomy for large-vessel occlusion in the presence of concomitant ICH and evaluate their clinical characteristics and outcomes.

METHODS: We retrospectively reviewed prospectively collected patient records at 4 comprehensive stroke centers from 2012 to 2019. Patients were identified who had pre-EVT ICH. Data collected included baseline patient demographics and laboratory values, stroke characteristics, ICH radiographic variables, antiplatelet/anticoagulant/thrombolytic medication use, and procedural factors. The primary safety outcome was any worsening of ICH on neuroimaging obtained 24 hours after EVT.

RESULTS: Eight patients were identified who underwent thrombectomy with concomitant ICH. The mean age was 71.9 years (range, 37–90). Median National Institutes of Health Stroke Scale score was 25 (interquartile range, 16.5–28.8), and 5 (63%) received tissue plasminogen activator. All patients underwent EVT and had mTICI2B or greater reperfusion. In 7 patients (88%), the initial ICH remained stable on postprocedure imaging. In 1 patient who received intravenous antiplatelet agents during thrombectomy, the hemorrhagic transformation was radiographically increased but without clinical correlate or mass effect.

CONCLUSIONS: In a multi-institution evaluation of 8 patients with ICH at the time of thrombectomy, 1 patient had radiographic worsening of hemorrhage, and no patient experienced clinical worsening related to hemorrhage progression. These findings suggest that thrombectomy may be safe in this population.

Key Words: acute ischemic stroke ■ intracranial hemorrhage ■ thrombectomy

As a result of robust large randomized controlled clinical trials, current guidelines recommend endovascular thrombectomy (EVT) for a subset of patients with emergent large-vessel occlusion (LVO) with salvageable penumbra.[1] Many patients treated with EVT in clinical practice would not have qualified for inclusion in the initial clinical trials demonstrating benefit for EVT, yet likely will benefit from thrombectomy.[2,3] Consensus guidelines on the role of EVT in unique populations who fall outside of traditional clinical trial populations have been published.[4] However, data regarding the role of EVT inpatients with emergent LVO and concomitant intracranial hemorrhage (ICH) are lacking.

Patients with emergent LVO and concurrent ICH represent a unique population in whom the utility of EVT

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Nonstandard Abbreviations and Acronyms

ECASS European-Australasian Acute Stroke Study
EVT endovascular thrombectomy
ICH intracranial hemorrhage
LVO large-vessel occlusion
NIHSS National Institutes of Health Stroke Scale

Clinical Perspective

- In this multi-institutional retrospective analysis of patients with prethrombectomy intracranial hemorrhage, no patient had clinical worsening related to hemorrhage progression after mechanical thrombectomy.
- Mechanical thrombectomy for large-vessel occlusion may be safe in patients with prethrombectomy intracranial hemorrhage.

have not been studied but who may benefit from EVT. We hypothesized that these patients were unlikely to have worsening of their ICH after thrombectomy. The objective of this report is to document patients who underwent thrombectomy for LVO in the presence of concomitant ICH and evaluate their clinical characteristics and outcomes.

METHODS

We retrospectively reviewed prospectively collected patient records at 4 academic American comprehensive stroke centers from 2012 to 2019. Patients were identified who had pre-EVT ICH. Each center had institutional review board approval to collect and review data.

Data collected included baseline patient demographics and laboratory values, stroke characteristics, ICH radiographic variables, antiplatelet/anticoagulant/thrombolytic medication use, and procedural factors. Outcomes were evaluated including follow-up cranial imaging, hematoma stability, reperfusion grading, necessity for clot evacuation or decompressive craniectomy, National Institutes of Health Stroke Scale (NIHSS) score at discharge, and 90-day modified Rankin scale scores.

Outcome Measures

The primary safety outcomes were any worsening of ICH on neuroimaging obtained 24 hours after EVT and mortality. Additional radiographic outcome measures included number of passes, reperfusion grade, and procedural time; clinical outcome measures included 90-day modified Rankin scale score, NIHSS score at hospital discharge, and complications.

TABLE 1. Baseline Characteristics

	All patients
N	8
Age, y, mean (range)	71.9 (37–90)
Female, n (%)	5 (63)
NIHSS score, median (IQR)	25 (16.5–28.8)
Antiplatelet use, n (%)	2 (25)
Anticoagulant use, n (%)	0 (0)
tPA, n (%)	5 (63)
Time from symptom onset to tPA (median)	90 min (90–126)
Time from symptom onset to EVT (median)	340 min (256–411)
Platelet count, thousands/μL (mean)	187±68
INR, mean	1.1±0.2
Comorbid conditions, n (%)	
Hypertension	5 (63)
Prior TIA/stroke	4 (50)
Prior hemorrhagic stroke	1 (13)
Tobacco user	1 (13)
Atrial fibrillation	2 (25)
Diabetes	1 (13)
Coronary artery disease	3 (38%)
Alcohol abuse	0 (0)
Hyperlipidemia	1 (13)
Occlusion location, n (%)	
ICA	2 (25)
MCA-M1	3 (38)
MCA-M2	1 (13)
Basilar	2 (25)

EVT indicates endovascular thrombectomy; ICA, internal carotid artery; INR, international normalized ratio; IQR, interquartile range; MCA, middle cerebral artery; NIHSS, National Institutes of Health Stroke Scale; TIA, transient ischemic attack; and tPA, tissue plasminogen activator.

RESULTS

Eight patients who underwent thrombectomy with concomitant ICH constituted the study cohort. The mean age was 71.9 years (range, 37–90) and 63% (n=5) were women. Six patients had anterior circulation LVO with median Alberta Stroke Program Early CT Score of 8 (interquartile range, 7.25–8.75) and 2 had basilar artery occlusion (Table 1). Median NIHSS score was 25 (interquartile range, 16.5–28.8), and 5 (63%) received

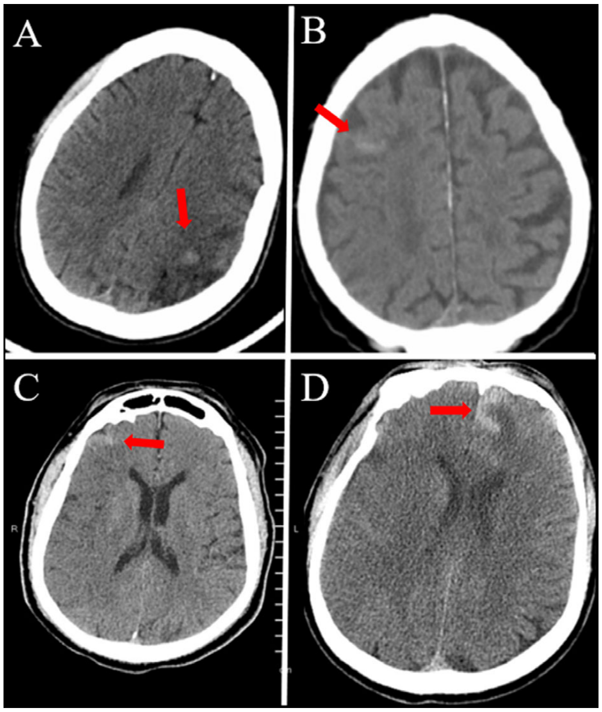

FIGURE 1. Example images of prethrombectomy intracranial hemorrhage. **A** through **C** demonstrate patients with hemorrhage within the affected vascular territory. The patient in **D** had a right M1 occlusion and had received intravenous tissue plasminogen activator.

tissue plasminogen activator (tPA) at a median of 90 minutes from symptom onset.

In 6 patients, the location of intraparenchymal hemorrhage was within the infarcted parenchyma (Figure 1). Per ECASS (European-Australasian Acute Stroke Study) classification,[5] 3 of these patients were classified as meeting criteria for parenchymal hematoma type 1, and 1 patient each met criteria for hemorrhage infarction type 1, hemorrhage infarction type 2, and parenchymal hematoma type 2. In 2 patients (25%), the ICH present on hospital admission was contralateral to the LVO.

All patients underwent EVT at a median of 340 minutes (5.7 hours) after symptoms onset with mTICI 2b (>50% of the affected vascular territory) reperfusion. The median number of passes was 2.5 (interquartile range, 1.8–3.3). All patients received heparinized saline flushes during EVT per institutional protocols. One patient required deployment of an intracranial stent during EVT, requiring an intraprocedural loading dose of intravenous P2Y12 inhibitor.

Primary Outcome

All patients underwent 24-hour post-EVT neuroimaging; in 7 patients (88%), the initial ICH remained stable. One patient (13%) met the primary radiographic outcome of worse ICH on 24-hour postprocedure neuroimaging. In this patient, who underwent intracranial stent placement and received antiplatelet medications during EVT, there was a slight increase in infarct-bed hemorrhagic conversion at 24 hours. There was no increased mass effect, no worsening neurologic deficit, and the blood remained stable on repeated imaging despite ongoing antiplatelet use.

TABLE 2. Procedural, Clinical, and Radiographic Outcomes

	All patients
N	8
No. of passes, median (IQR)	2.5 (1.8–3.3)
Intraprocedural antiplatelet use, n (%)	1 (13)
Procedure duration	49±31 min
Final TICI, n (%)	
0–2a	0 (0)
2b	6 (75)
3	2 (25)
Primary outcome, n (%)	
Worsening of ICH	1 (13)
ICH stability	7 (88)
NIHSS score at hospital discharge, median (IQR)	22.5 (10.8–42)
90-day modified Rankin scale, n (%)	
0–2	2 (25)
0–3	3 (38)
6	4 (50)

ICH indicates intracranial hemorrhage; IQR, interquartile range; NIHSS, National Institutes of Health Stroke Scale; and TICI, thrombolysis in cerebral infarction.

Secondary Outcomes and Complications

Median NIHSS score at hospital discharge was 22.5 (interquartile range, 10.8–42). Two patients (25%) achieved a modified Rankin scale score of 0 to 2 at follow-up, and 4 patients (50%) died (Table 2). One patient died of an ICH, remote from their initial hemorrhage, occurring after EVT. This 90-year-old patient with thrombocytopenia (78 000 platelets/μL) presented with a right M1 occlusion and NIHSS score of 17; he had a small right frontal intraparenchymal hemorrhage within the infarcted parenchyma. He did not receive intravenous tPA. Post-EVT neuroimaging revealed massive bilateral parieto-occipital intraparenchymal hemorrhages of unclear etiology, and the patient died.

DISCUSSION

In this analysis of patients undergoing EVT for LVO with pre-EVT ICH, 7 of 8 (88%) patients demonstrated stability of their hemorrhage after EVT. In the remaining patient, who required intracranial stenting, there was minimal worsening of petechial staining on 24-hour post-EVT neuroimaging, which did not result in significant mass effect or worse neurologic deficit. Overall, we believe that the cases reported here suggest that thrombectomy is technically safe and unlikely to independently worsen ICH in this population.

ICH after intravenous tPA occurs in 2% to 7% of patients, and risk factors have been well described.[6] Five patients in this series received intravenous tPA and most likely had tPA-related hemorrhage; of these, 3 had infarct-bed hemorrhages and 2 had hemorrhages contralateral to their site of vessel occlusion. None of these patients in this series who received intravenous tPA and then underwent EVT had worsening of their hemorrhage after thrombectomy; these cases suggest that tPA-related ICH should not alone provide rationale to withhold thrombectomy.

The median time to EVT reperfusion in this cohort was 5.7 hours (340 minutes). Although time from symptom onset to intravenous tPA administration is not associated with ICH risk,[7,8] the process of blood-brain barrier breakdown after ischemic injury is time dependent. Patients who undergo delayed thrombectomy may be more likely to be reimaged than their early-window counterparts, which may increase the sensitivity that a pre-EVT hemorrhage is detected and explain why some patients in this series had lengthy times between symptom onset and thrombectomy.

To the best of the authors' knowledge, only a single prior patient with ICH undergoing thrombectomy has been reported. Zivelonghi et al[9] report a quinquagenarian with small-volume subarachnoid hemorrhage who underwent EVT without subsequent hemorrhagic progression. Incorporating this patient, 8 of 9 patients with pre-EVT ICH did not experience worsening of ICH after EVT, and none of the patients reported had worsening neurologic deficit related to ICH. Reperfusion grade has been shown to be associated with symptomatic ICH after thrombectomy,[10] possibly by limiting core expansion, and may in turn reduce ICH expansion or contribute to ICH stability in these patients. Taken altogether, EVT may be safe in this population.

Limitations

The major limitations of this report are the small sample size and retrospective nature.

CONCLUSIONS

In a multi-institution evaluation of 8 patients with ICH at the time of thrombectomy, 1 patient had radiographic worsening of hemorrhage, and no patient experienced clinical worsening related to hemorrhage progression following thrombectomy. These findings suggest that thrombectomy may be safe in this population.

ARTICLE INFORMATION

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Conflicts of Interest

Dr Mokin is a consultant for Medtronic and Cerenovus), and has stock options with BrainQ, Endostream, Serenity Medical, and Synchron. The other authors have no conflicts of interest to disclose.

Data Availability Statement

Data is available upon reasonable request.

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