

## CASE REPORT

# Complex decision-making in stroke: preoperative mechanical thrombectomy of septic embolus for emergency cardiac valve surgery

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## SUMMARY

Stroke is a common and devastating embolic manifestation of infective endocarditis. We report a case of cardioembolic stroke in a patient with enterococcal endocarditis, with National Institutes of Health Stroke Scale score of 3. A middle-aged patient with bacterial endocarditis exhibited mild intermittent left hemiparesis and dysarthria in the setting of severe aortic insufficiency requiring urgent aortic valve replacement.

Cerebrovascular imaging revealed a partially occlusive thrombus in the M1 segment of the right middle cerebral artery, which became symptomatic during relative hypotension. Given the expected hypotension during the urgently needed aortic valve replacement, there was a significant risk of infarction of most of the right hemisphere. Thus, mechanical thrombectomy was performed immediately prior to thoracotomy, and the patient awoke neurologically intact. This case demonstrates avoidance of a large stroke due to a subocclusive thrombus and anticipated intraoperative hypotension with preoperative mechanical thrombectomy.

## BACKGROUND

Stroke is a common and devastating embolic manifestation of infective endocarditis (IE).<sup>1</sup> Cardiac surgery for IE requires induced hypotension, placing hypoperfused cerebral tissue at risk for infarction. Patients presenting with large vessel occlusion without severe neurological deficit (National Institutes of Health Stroke Scale (NIHSS) score <7) are frequently felt to be inappropriate for neurointervention due to relatively good neurologic status. However, with known induced hypotension, preoperative mechanical thrombectomy (MT) of embolized vegetations may make early cardiac surgery safer by restoring normal cerebral hemodynamic physiology. We report a case of preoperative MT followed by immediate cardiac valve surgery in a patient with recent cardioembolism from enterococcal endocarditis.

## CASE PRESENTATION

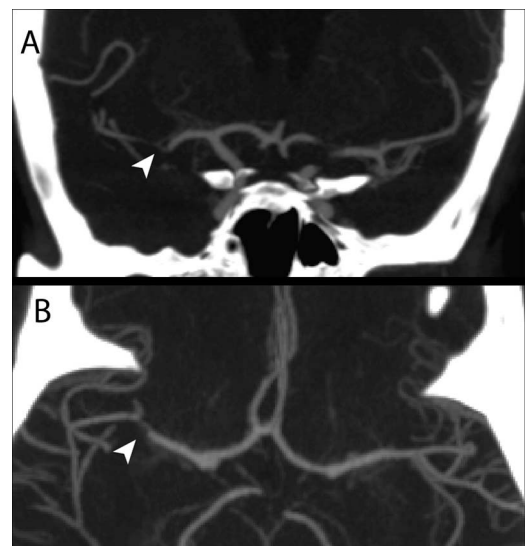
A patient (age in the 40s) with a history of intravenous opiate use and a new diagnosis of *Enterococcus faecalis* endocarditis presented with severe dyspnea prompting a transthoracic echocardiogram which confirmed aortic insufficiency with extensive aortic valve vegetations. Overnight the patient had three intermittent 30 min episodes of

left hand weakness, left facial droop, and slurred speech. The NIHSS score was 3. Identical episodes were reported during the previous 3 days.

## INVESTIGATIONS

CT angiography demonstrated partial occlusion of the distal right M1 segment (figure 1), with prolonged mean transit time throughout most of the right middle cerebral artery (MCA) territory on CT perfusion (figure 2), placing extensive MCA territory at risk. MRI demonstrated multiple small areas of infarction of various ages scattered predominantly throughout the right cerebral hemisphere in the MCA territory and watershed areas (figure 3). These findings were thought to be due to both embolic events from cardiac vegetations, but with a partially occlusive thrombus in the MCA resulting in hypoperfusion whenever the patient's blood pressure dropped.

At initial evaluation by the stroke and interventional services, the patient was felt to be neither a candidate for tissue plasminogen activator nor MT, given the low NIHSS score. Furthermore, the symptoms subsequently resolved when the patient was consistently autoperfusing to maintain a systolic blood pressure of 170 mm Hg. Cardiac surgery was undertaken to evaluate the patient and emergency

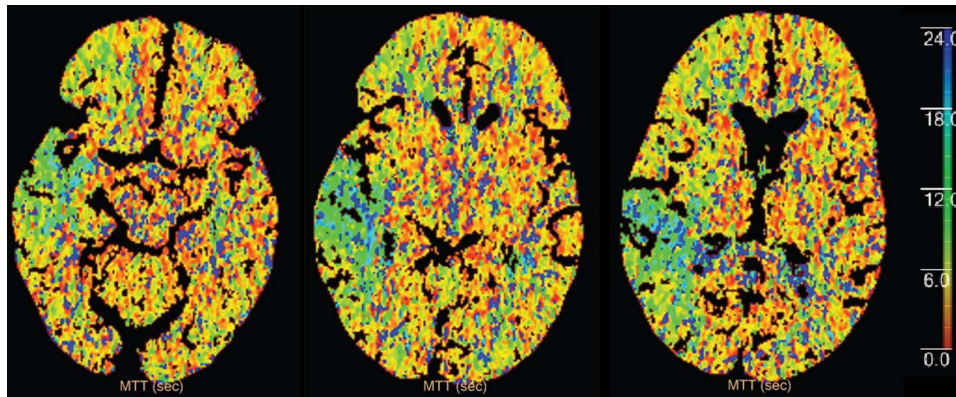


**Figure 1** CT angiography showing segmental occlusion of the right M1 segment just proximal to its trifurcation (arrowheads) in (A) coronal and (B) axial planes.



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**Figure 2** CT perfusion maps showing prolonged mean transit time with tissue at risk throughout the greater part of the right middle cerebral artery territory.

aortic valve replacement and mitral valve repair were recommended due to the high risk of a recurrent thromboembolic event or stroke progression. The procedure would require a significant decrease in blood pressure while on-pump during bypass. Therefore, after direct personal consultation among the cardiac surgery, vascular neurology, and endovascular neurosurgery attendings, the decision was made to offer MT followed by cardiac valve surgery immediately after stroke intervention.

#### TREATMENT

Upon consultation among the surgical services and anesthesiology, general endotracheal anesthesia was preferred as the patient was planned for immediate cardiac surgery following neurointervention. It was desired to use the same anesthesia to reduce the complications of reversal and induction, including intubation risks and potential volatile hemodynamic changes in a patient with a blood pressure-dependent neurological status. Under general endotracheal anesthesia, angiography confirmed right MCA occlusion with a Thrombolysis in Cerebral Infarction (TICI) 2 flow into the superior division and TICI 0 flow into the posterior inferior division (figure 4). A 5Max ACE (Penumbra, Alameda, California, USA) was advanced over a Penumbra 3Max, which was advanced over a Fathom-16 micro-wire (Boston Scientific, Boston, Massachusetts, USA) to selectively catheterize the right MCA. Once the clot was reached, the

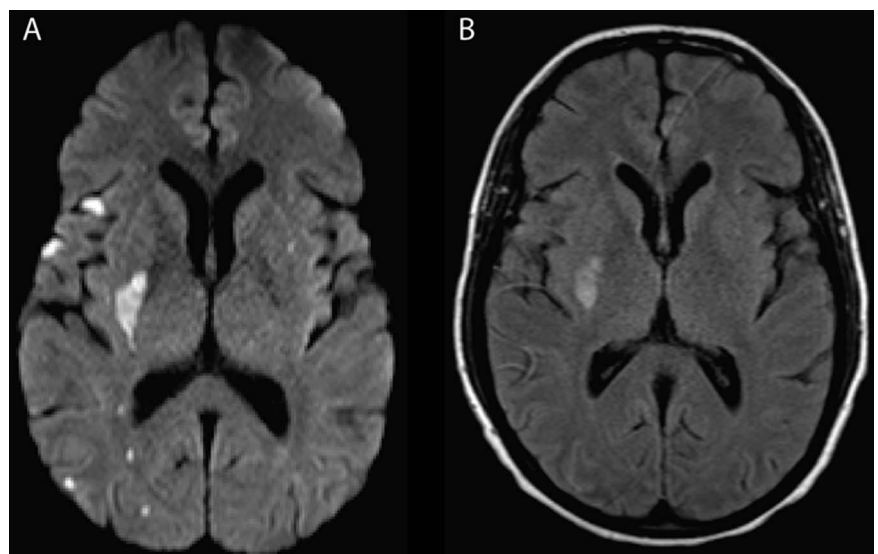
3Max and Fathom-16 were withdrawn and aspiration was undertaken at the site of occlusion for 3 min using the 5Max ACE, which was then withdrawn on aspiration to remove the  $2 \times 10$  mm clot (figure 5). Immediate angiographic run demonstrated complete TICI 3 reperfusion of the right MCA territory with robust recanalization without complication (figure 4). Some spasm of the supraclinoid internal carotid artery was observed (figure 4B/D), which had resolved on the final angiographic run without need for further intervention (not shown).

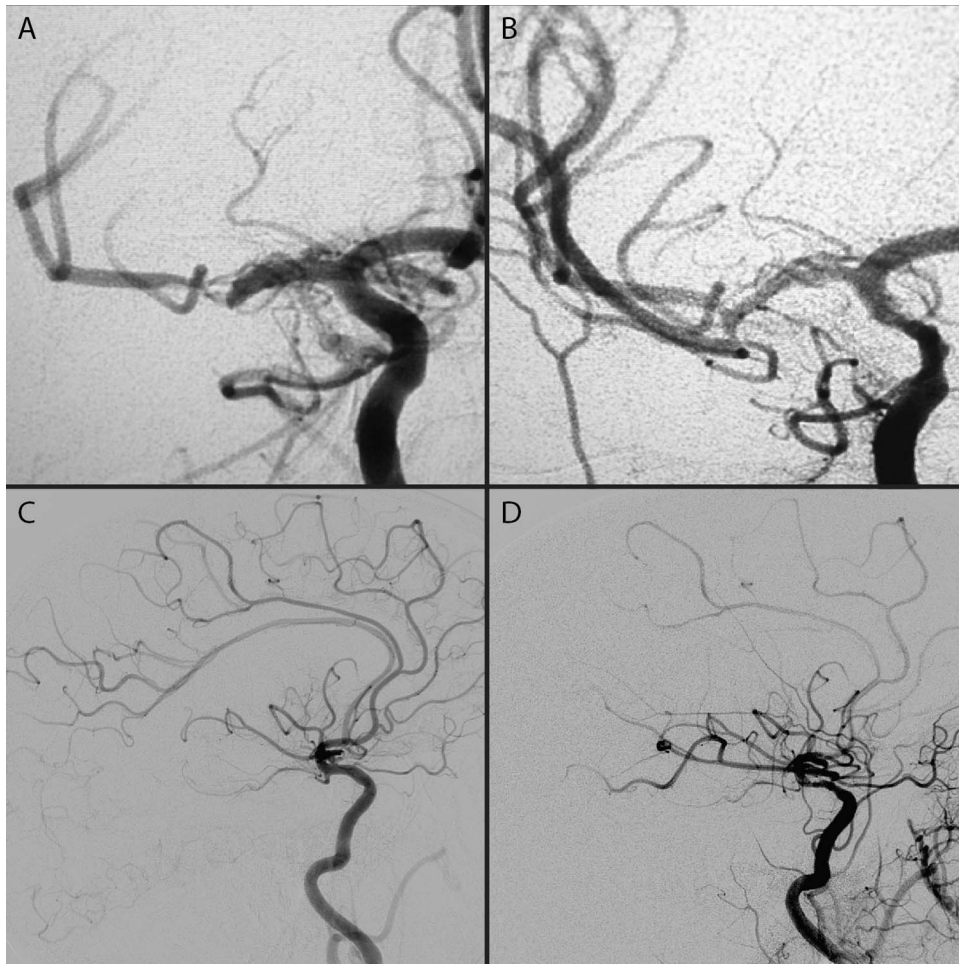
Given the excellent angiographic result, without flow limitation or evidence of hemorrhage, and the well-controlled hemodynamics of the patient, the decision was made to proceed under the same general anesthesia for the cardiac procedure without wake-up neurologic examination or repeat head imaging. The patient was transferred from the angiography suite to the cardiac surgery suite under the same anesthesia and underwent a median sternotomy with aortic valve replacement and mitral valve repair. The procedures were tolerated well and the patient was transferred to the cardiac intensive care unit in a stable condition.

#### OUTCOME AND FOLLOW-UP

The patient returned to neurological baseline immediately after the surgeries and was extubated the following day. The patient remained hemodynamically and neurologically stable

**Figure 3** MRI showing multiple foci of infarction scattered throughout primarily the right cerebral hemisphere, although some evidence of left-sided disease is present. Multiple areas with restricted diffusion (A) were hyperintense on FLAIR imaging (B). The right basal ganglia in particular was hyperintense on FLAIR, suggesting an older infarct as well. No areas were hemorrhagic. There is also a remote right cerebellar hemisphere infarct (not shown).





**Figure 4** Diagnostic angiography demonstrating an occluding thrombus in the distal right M1 segment which is partially occlusive of the superior division of the middle cerebral artery (MCA) with Thrombolysis in Cerebral Infarction score (TICI) 2 flow through that branch, but is completely occlusive of the inferior division with a TICI 0 perfusion of the posterior and inferior branches in (A) anteroposterior and (C) lateral views. Follow-up angiogram through the existing catheter after mechanical thrombectomy showing complete restoration of flow through the MCA branches in (B) anteroposterior and (D) lateral views. The images show no evidence of thrombus formation or any other untoward occurrence and excellent TICI 3 perfusion of the MCA territory.

throughout the postoperative period with no new stroke episodes. On postoperative day 6 the patient developed a right leg deep vein thrombosis and was started on heparin and warfarin.

The patient was discharged to home on postoperative day 13 in an excellent neurological condition (NIHSS score 0; modified Rankin Scale score 0).

## DISCUSSION

Cerebral embolization is a common occurrence in IE, with ischemic stroke present in 18% of all IE cases.<sup>1</sup> Antibiotics are standard, but early surgery is indicated in cases of heart failure, uncontrolled infection, or high thromboembolic risk.<sup>2</sup>

While anecdotal, our case suggests that preoperative mechanical removal of large vessel embolic vegetations may be beneficial in situations where patients have a 'pressure-dependent' neurologic examination. Several other case reports suggest that this paradigm is both safe and effective in the setting of septic cardiac emboli (table 1). This case is unique in that the NIHSS score was below typical thresholds for MT, and symptomatology was subacute with MRI evidence of established small infarcts. Intervention was undertaken in a semi-elective manner because of the emergency need for cardiac surgery. Optimal cardiac surgery timing is driven by the risk of further neurological sequelae and the urgency of valve replacement. Early surgery is generally regarded as safe, although opinions differ.<sup>1,3</sup> The rate of neurological deterioration is 15–35% for cardiac surgery



**Figure 5** Extracted M1 segment embolus beside 5Max ACE clot extraction device. This embolus appeared to morphologically retain the shape of the middle cerebral artery bifurcation it was occluding.

**Table 1** Outcomes of mechanical thrombectomy in stroke-associated infectious endocarditis

Author	Cardiac disease	NIHSS	Location	NIS	Thrombolysis	Angio outcome	Clinical outcome
Bain <i>et al</i> <sup>5</sup>	18 months s/p LVAD c/b sepsis	18	L ICA terminus	MT+IBAS	IA tPA	M1: TIC1 3 A1: TIC1 0	Post-op NIHSS 7 NIHSS 2 @ 2 months
Sukumaran <i>et al</i> <sup>6</sup>	Rheumatic mitral stenosis	14	L M1	MT	None	TIC1 2a	Post-op NIHSS 4 NIHSS 0 @ 4 days
Dababneh <i>et al</i> <sup>7</sup>	6 months s/p MVR c/b line infection	Unknown	L M2	MT	None	TIC1 2–3	PE w/DNR Elected for hospice
Kan <i>et al</i> <sup>8</sup>	MVP	16	R M2	MT	None	TIC1 3	Post-op NIHSS 12
Kang <i>et al</i> <sup>9</sup>	None	16	L M1	MT	IA urokinase and tirofiban	TIC1 2b	Post-op NIHSS 7 NIHSS 3 @ 4 weeks
Toeg <i>et al</i> <sup>10</sup>	s/p AVR	20	R ICA terminus	MT	IV tPA	TIC1 3	Post-op NIHSS 2 Re-AVR for abscess NIHSS 0 @ 8 weeks

AVR, aortic valve replacement; c/b, complicated by; DNR, do not resuscitate; IA, intra-arterial; IBAS, intracranial balloon angioplasty and stenting; IV, intravenous; LVAD, left ventricular assist device; MT, mechanical thrombectomy; MVP, mitral valve prolapse; MVR, mitral valve repair; NIHSS, National Institutes of Health Stroke Scale; NIS, neurointerventional surgery intervention; PE, pulmonary embolism; s/p, status post; TIC1, Thrombolysis in Cerebral Infarction score; tPA, tissue plasminogen activator.

within 72 h of stroke.<sup>4</sup> Previous reports of early versus late cardiac surgery are limited because it is unclear how preoperative factors (especially vegetation size, hemodynamic instability, and infarct size) and postoperative outcome (especially intracerebral hemorrhage and reinfarction) varied between groups. There is little information reported on how neurointervention modifies the risks of cardiac surgery, although we expect this could improve outcomes for selected patients. Certainly the management paradigm presented here is unproven; however, we hope this report provides a reference for others who find themselves in this challenging scenario.

In general, the performance of MT for embolic vegetations without urgent cardiac surgery is rarely reported. Our review yielded six previous reports (table 1).<sup>5–10</sup> Including the current case, the proximal MCA was the most common thrombus location (3/7, 42.9%). Three cases (42.9%) have reported using MT with thrombolytics whereas four (57.1%) have reported MT alone. In a single case, MT failed due to adherence of the vegetation to the endothelium, requiring a balloon-assisted stent.<sup>5</sup> No cases reported postoperative hemorrhage. Postoperative revascularization has been exceptional in all cases (between

TIC1 2 and 3). All patients had a decrease in NIHSS score and 5/7 (71.4%) had an NIHSS score <4 at follow-up.

For our patient, MT was a favorable option to avoid a large stroke during emergency cardiac valve surgery. MT might be considered in the rare circumstance of partially occlusive thrombus prior to anticipated hypotension, even in the setting of minimal deficits (NIHSS <7).

**Competing interests** JM is a consultant for Lazarus Effect, Medina Medical, Pulsar Vascular, Reverse Medical, Edge Therapeutics; an investor in Blockade Medical, Medina Medical; and serves on the advisory board for Codman Neurovascular.

**Patient consent** None.

**Provenance and peer review** Not commissioned; externally peer reviewed.

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## Learning points

- ▶ The cerebral vasculature is a common distal embolic site in infective endocarditis.
- ▶ Early cardiac surgery is generally regarded as safe in the setting of endocarditis-related stroke, although optimal cardiac surgery timing is driven by the risk of further neurological sequelae and urgency of valve replacement.
- ▶ Mechanical thrombectomy might be considered in the rare circumstance of partially occlusive thrombus prior to anticipated hypotension, even in the setting of minimal deficits.

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