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NEUROSCIENCES AND NEUROANAESTHESIA

Anaesthetic management of the patient with acute ischaemic stroke

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Editor's key points

- Anaesthetic management for endovascular treatment of acute ischaemic stroke has been shown to affect outcome.
- General anaesthesia can result in worse outcomes compared with local anaesthesia, although technique must be tailored to patient-specific variables.
- Time to reperfusion and arterial pressure are critical in maximizing survival of the ischaemic penumbra.

Summary. Anaesthetic management of the acute stroke patient demands consideration of the penumbra as the central focus. Recent studies have shown that patients who receive general anaesthesia for endovascular therapy for acute ischaemic stroke have worse outcomes than those who receive local anaesthesia. Although baseline condition of the patients in these studies differed, we should heed the warnings evident in the results. 'Time is brain': therapy should be quickly provided. Arterial pressure should be monitored carefully upon induction, avoiding a drastic reduction, and allowing for a reduction in arterial pressure upon recanalization. Keeping these factors in mind, anaesthetic technique (general, monitored anaesthesia care, or local) must be selected considering the individual patient's risks and benefits. Unfortunately, there are no proven neuroprotective strategies to date for use in acute ischaemic stroke.

Keywords: anaesthetics; brain, ischaemia; safety

Acute stroke is the second leading cause of death worldwide and the leading cause of long-term disability.[1] Ischaemic stroke is responsible for 87% of strokes.[2] In acute ischaemic strokes, an embolus, thrombus, or stenosis can decrease brain perfusion. The goal of early therapy for acute ischaemic stroke is to restore perfusion. I.V. thrombolysis with recombinant tissue plasminogen activator (rtPA) is the only proven medical therapy shown to improve patient outcomes in acute ischaemic stroke, with better outcomes achieved with earlier administration.[3 4] Patients who present within 4.5 h of stroke symptom onset and have no contraindications to therapy should be treated with i.v. rtPA.[5] However, only 3–8.5% of all stroke patients are treated with i.v. rtPA.[6] In addition, treatment with i.v. rtPA is unsuccessful in achieving recanalization in over half of patients with large-artery occlusions.[7] Patients who are not eligible for i.v. rtPA due to delayed time to presentation, contraindications to i.v. rtPA therapy (recent surgery or coagulopathy), or failed i.v. rtPA can be considered for endovascular therapy. Although recent data from randomized clinical trials suggest that endovascular therapy was not superior to i.v. rtPA,[8 9] studies show intra-arterial thrombolysis or mechanical clot-removing devices to be efficacious for recanalization and restoration of cerebral blood flow.[10–12]

This article reviews the current body of literature on the anaesthetic management of the acute ischaemic stroke patient, with a focus on the recent literature comparing outcomes after endovascular therapy performed with general compared with local anaesthesia, the importance of avoiding a time delay in treatment, the recent literature involving haemodynamic management of the acute stroke patient, and potentially neuroprotective strategies.

Anaesthetic technique and outcomes

There has recently been an increased interest in evaluating the relationship between type of anaesthesia a patient receives during endovascular therapy for stroke and outcomes. General anaesthesia can offer the benefits of immobility, pain control, and airway protection. The major disadvantages of general anaesthesia include haemodynamic changes with intubation, the possibility of delaying time to recanalization, pulmonary aspiration, and the requirement for additional workforce. Local anaesthesia or sedation (including monitored anaesthesia care) can maintain smoother haemodynamics due to the decreased administration of pharmacological vasodilators, and allow intra-procedural clinical neurological evaluation. But these approaches have the disadvantages of the lack of airway protection, continued patient movement, uncontrolled pain and agitation, and a prolonged procedure time. While the choice of anaesthetic technique can be individualized based on the needs of each patient, the anaesthesiologist monitors and provides airway support to assure proper

oxygenation, haemodynamic support to assure proper perfusion of the penumbra, and potentially immobility in the confused and agitated patient to provide better working conditions for revascularization (Table 1).

In 2010, three studies[13–15] and multiple editorials[16–18] were published, evaluating outcomes and anaesthetic technique. Jumaa and colleagues performed a retrospective, single-centre study of 126 patients undergoing endovascular procedures for acute ischaemic stroke. They reported that intubated patients had longer intensive care unit stays, increased in-hospital mortality, worse clinical outcome, and larger final infarct volume size. However, the clinical conditions of the intubated patients differed from those not intubated before endovascular therapy in having significantly higher baseline National Institutes of Health Stroke Scale (NIHSS) scores.[13] Nichols and colleagues reviewed the anaesthetic management of 75 patients in the Interventional Management of Stroke (IMS) II trial with anterior circulation stroke who underwent angiography with or without intra-arterial treatment. They categorized the anaesthetic management into four levels (no sedation, mild sedation, heavy sedation, and pharmacological paralysis). They found that the group of patients who received no sedation had relatively good outcome (modified Rankin score of 0–2), lower death rates, and higher reperfusion rates. Patients who received more sedation also had higher baseline NIHSS scores.[14] Abou-Chebl and colleagues performed a large (980 patients) retrospective multicentre (12 centres) study, which found that general anaesthesia during an endovascular procedure for anterior circulation ischaemic stroke was an independent predictor for poor outcome. Similarly, patients who received a general anaesthetic had higher baseline NIHSS scores and were more likely to have carotid terminus occlusions.[15]

More recently, studies have included arterial pressure measurements in evaluating the relationship between general anaesthesia and poor outcomes after endovascular therapy for acute ischaemic stroke. Davis and colleagues performed a retrospective single-centre study of 96 patients undergoing endovascular therapy for acute ischaemic stroke and also found an association between general anaesthesia and poor outcomes (15% probability of good outcomes compared with 60% in the local anaesthesia group). Patients who underwent general anaesthesia had higher baseline NIHSS scores than those given local anaesthesia. However, the investigators also found an association of good outcomes with systolic arterial pressure (SAP) >140 mm Hg. There was a correlation between low arterial pressure (defined as the minimum pressure recorded) and general anaesthesia.[19] Abou-Chebl and colleagues reviewed the North American SOLITAIRE Stent-Retriever Acute Stroke (NASA) Registry to compare the outcomes of patients receiving general anaesthesia with those receiving sedation.[20] They included data from 281 patients from 18 sites that described anaesthesia type, and grouped patients into general anaesthesia (if they were intubated) or local anaesthesia (if they were not intubated, regardless of whether or not they received sedation). Patients who received general anaesthesia had higher baseline NIHSS score and lower baseline arterial pressures. In a multivariate analysis, hypertension, NIHSS score, unsuccessful revascularization, non-utilization of balloon guide catheter, and general anaesthesia were associated with mortality. The relationship between general anaesthesia and worse outcomes persisted when they excluded patients who arrived intubated (and were intubated emergently) and those who had posterior circulation strokes.[20] More recently, Rai and colleagues published an abstract that showed that although general anaesthesia was associated with higher patient mortality, it was not an independent predictor of outcome when baseline NIHSS score, age, and recanalization were taken into account. In addition, the interval between arrival and groin puncture was higher in patients with general anaesthesia. They also found a higher difference in pre- and post-SAP was associated with a worse outcome in patients with general anaesthesia[21] (Table 2).

Unfortunately, to date, there are no randomized controlled clinical trials and no prospectively collected data specific to anaesthetic management of endovascular treatment of acute ischaemic stroke. Studies that have been published include patients who have different baseline characteristics. In addition, in most studies, the types of anaesthesia often are classified as 'general anaesthesia' or 'intubated' *vs* 'local anaesthesia' or 'not intubated'. This binary stratification excludes haemodynamic management, depth of sedation, and the presence of anaesthesiologist.

The topic and study results are important and more data are necessary: the induction of general anaesthesia in each individual patient has individual risks and benefits, and as Molina and Selim[16] summarized can become a choice of general anaesthesia, 'sailing quietly in the darkness', or local anaesthesia, sailing 'fast under a daylight storm'.

The results of these studies and the differences between the groups that received general anaesthesia, sedation, or local anaesthesia suggest several hypotheses as to why patients who have general anaesthesia have worse outcomes. First, patients who have general anaesthesia in every study are 'sicker' at baseline by NIHSS scores. Even after correcting for this 'sicker' patient status, selection bias is inherent in any

Table 1 General anaesthesia or local anaesthesia for endovascular therapy after acute ischaemic stroke

General anaesthesia	Local anaesthesia
Pros	Pros
Immobility	Smoother haemodynamics
Pain control	Intra-procedural neurological evaluation
Airway protection	
Cons	Cons
Haemodynamic changes	Lack of airway protection
Additional workforce	Patient movement possible
Potential of time delay before start of procedure	Uncontrolled pain and agitation
	Prolonged procedure time