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Review Article

Anaesthesia Section

Optimising Anaesthesia for Endovascular Thrombectomy in Acute Ischaemic Stroke: A Narrative Review on the use of General Anaesthesia versus Conscious Sedation

ANGAN GHOSH[1], SANJOT NINAVE[2]

ABSTRACT

Acute Ischaemic Stroke (AIS) due to Large Vessel Occlusion (LVO) remains a leading cause of mortality and long-term disability worldwide, with Endovascular Thrombectomy (EVT) established as the gold standard of treatment when performed rapidly. Anaesthetic management is pivotal in influencing procedural success, safety, and neurological outcomes, yet the choice between General Anaesthesia (GA) and Conscious Sedation (CS) remains controversial. GA offers advantages of airway protection, patient immobility, and optimal procedural conditions; however, it is often associated with haemodynamic instability, potential delays in treatment initiation, and risks of prolonged recovery. In contrast, CS allows for continuous neurological assessment and may reduce treatment times, but carries the risk of patient agitation, airway compromise, and the need for conversion to GA, which can adversely affect outcomes. Recent randomised controlled trials, meta-analyses, and large-scale observational studies have attempted to clarify this debate, with many reporting broadly comparable rates of functional independence, recanalisation success, and mortality between GA and CS. However, subtle differences persist regarding haemodynamic stability and complication profiles. Evidence also suggests that protocol-driven approaches, hybrid strategies, and institutional preparedness significantly influence outcomes, highlighting that anaesthetic technique cannot be considered in isolation. The evolving literature supports a balanced, patient-centred approach in which anaesthetic choice is guided by clinical condition, airway safety, operator preference, and institutional expertise rather than a rigid protocol. Ultimately, tailored anaesthetic management remains critical to maximising neurological recovery, minimising peri-procedural risks, and optimising workflow efficiency in patients undergoing EVT for AIS. This review introduces a novel, patient-centred framework for anaesthetic management in EVT, focussing on individual clinical and institutional factors to optimise outcomes and workflow efficiency.

Keywords: Cerebral revascularisation, Haemodynamic monitoring, Neurologic recovery, Patient-centred care

INTRODUCTION

The AIS is a leading cause of mortality and morbidity globally and represents an accurate medical emergency necessitating prompt diagnosis and treatment. Most AIS is due to the occlusion of an artery within the anterior circulation, most commonly within a principal cerebral artery. This occlusion produces a sudden stoppage of cerebral perfusion, with an ensuing cascade of metabolic derangements and cellular injury, which, if not reversed in the early stages, leads to permanent infarction of brain tissue. Due to the narrow therapeutic window, reperfusion as early as possible is the cornerstone of stroke treatment [1].

The course of reperfusion methods has transformed the prognosis of AIS. While intravenous thrombolysis with tissue Plasminogen Activator (tPA) was the initial advance, it is of limited value because it is time-sensitive, has contraindications, and has a low recanalisation rate with LVO. In recent years, EVT has emerged as a new revolution in specific subsets, namely those presenting with LVO in the anterior circulation [2].

Since EVT involves precise catheter-based catheterisation of the cerebral vasculature, the anaesthetic role becomes particularly vital. The best anaesthetic care must compromise the need for patient immobility and haemodynamic stability and the urgency for rapid intervention. Two predominant forms of anaesthetic usage are currently employed during EVT: GA and CS. Both methods have differing advantages and pose differing disadvantages. GA guarantees total immobility, best airway protection, and controlled ventilation, but can be linked with a delay in treatment and increased risk of intraprocedural hypotension. In contrast, CS allows for a more rapid onset of the procedure, allows direct monitoring of neurology in real-time, and prevents complications related to intubation. Still, it is patient-related and prone to unwarranted movement or compromise of respiration [3]. Recent randomised controlled trials, meta-analyses, and large-scale observational studies have attempted to clarify this debate, with many reporting broadly comparable rates of functional independence, recanalisation success, and mortality between GA and CS. However, subtle differences persist regarding haemodynamic stability and complication profiles [3-6].

This review uniquely synthesises the most recent evidence and evolving perspectives comparing GA with CS in EVT, emphasising practical insights, emerging trends, and gaps in current knowledge to guide tailored, patient-centred anaesthetic strategies. The review explores hybrid or protocol-based approaches, institutional preparedness, and operator familiarity, underscoring that a balanced, individualised anaesthetic plan remains critical to maximising neurological recovery and minimising peri-procedural risks in patients undergoing EVT for AIS.

Goals of Anaesthesia in Endovascular Thrombectomy (EVT)

The key goals of anaesthesia in EVT are the preservation of cerebral perfusion, physiological stability, and a simple and expeditious procedure. Patient immobilisation is essential because it enables skilled catheter manipulation in fragile cerebral arteries and avoids procedural complications. Proper oxygenation and ventilation should be ensured during the procedure to prevent hypoxia or hypercapnia, both of which exacerbate ischemic brain injury. Maintenance of cerebral perfusion pressure is another critical aim; it avoids hypotension, exacerbating ischemia in susceptible brain areas with impaired autoregulation. Preventing aspiration and protecting the airway is essential in patients with bulbar dysfunction or decreased consciousness. CS demands meticulous patient respiration monitoring, while GA ensures a protected airway. In addition, CS permits ongoing monitoring of the neurological status, allowing for early recognition of deteriorating deficits, reperfusion injury, or intraoperative complications. The selected anaesthetic method must be consistent with these objectives and balanced against the patient's neurological status, comorbidities, and need for immediate intervention [7,8].

General Anaesthesia (GA): Advantages and Disadvantages

The GA offers a controlled and secure environment for neuro-interventional treatment. GA generally includes induction with intravenous agents like propofol, etomidate, or thiopentone, followed by control of airways by endotracheal intubation and maintenance on intravenous or volatile anaesthetics. Patient movement elimination is one of the key benefits of GA and represents utmost importance regarding the technical success of EVT. Second, GA allows for controlled ventilation, allowing for the optimisation of oxygen and carbon dioxide, the latter exerting an essential effect on cerebral blood flow. Airway protection with GA is critical for decreased consciousness, vomiting, or bulbar impairment. GA removes the necessity of patient cooperation, too, and thus favours those patients who are restless or unresponsive. GA also provides more precise control of systemic haemodynamics and minimises intraprocedural risk due to the acute movement of the patient [9].

All these advantages aside, GA does have some astounding shortcomings. Induction and airway control are often the causes of delay in commencing the procedure, and this is not desirable in the time-sensitive context of stroke. Hypotension is similarly problematic since many induction drugs lower blood pressure and thereby worsen cerebral ischaemia. Delayed neurological examination due to prolonged sedation and monitoring of postoperative patients under GA, typically in an Intensive Care Unit (ICU), is also required. Ventilator-associated pneumonia and other complications of intubation are also more common in GA groups, especially among elderly or comorbid patients [3,8]. [Table/Fig-1] shows the drugs used for GA [10-17].

Conscious Sedation (CS): Advantages and Limitations

The CS or moderate sedation allows the patient to undergo the procedure with spontaneous respiration and verbal responsiveness. Sedatives such as dexmedetomidine, midazolam, and fentanyl are commonly employed, titrated to the degree that the patient is sedated but arousable. One of the primary benefits of CS is the immediate triggering of EVT with little delay seen with intubation or induction, thereby reducing door-to-groin puncture time- a critical parameter in stroke outcome [18].

The CS also permits ongoing neurological monitoring during the procedure, which can provide real-time feedback regarding the patient's neurological status. This can be useful in identifying re-occlusion signs, haemorrhagic transformation, or worsening infarct. Additionally, airway manipulation risks are avoided, leading to fewer respiratory complications and often obviating the need for post-procedure ICU admission [19].

However, CS is not without its drawbacks. Agitation or non-compliance by the patient may develop during the procedure, with its attendant risk of movement that can jeopardise catheterisation by the device or lead to injury of the vessels. Compromission of access to the airway is a potential risk, particularly for borderline-conscious individuals or those at risk of being over-sedated. Emergency conversion to GA is also rare, leading to procedural delay and risk of adverse outcomes. Effective CS requires well-trained personnel who can monitor and manage different levels of sedation and respond promptly if the patient deteriorates [20]. Drugs used in CS are listed in [Table/Fig-2] [10,12,14,21-23].

Comparative Evidence from Clinical Trials

Comparative evidence from clinical trials is mentioned in [Table/Fig-3] [4-6].

Category	Drugs	Purpose/Role	Advantages	Considerations
Induction agents	Propofol [10]	Rapid induction of anaesthesia. Provides sedation and amnesia.	Fast onset and offset. Minimal cardiovascular effects in stable patients.	May cause hypotension, especially in patients with compromised perfusion.
	Etomidate [11]	An induction agent that causes minimal haemodynamic changes.	Preferred for haemodynamically unstable patients. Rapid onset and short half-life.	It can cause adrenal suppression with prolonged use.
	Ketamine [12]	Induces sedation while maintaining sympathetic tone and hemodynamic stability.	Useful in patients with hypotension. Provides analgesia and mild sedation.	Increases intracranial pressure; not ideal for patients with high ICP.
Maintenance agents	Sevoflurane [13]	Volatile anaesthetic used to maintain General Anaesthesia (GA).	Quick onset, easy titration. Less airway irritation compared to other volatile agents.	Requires a controlled environment for use (e.g., ventilator).
	Desflurane [13]	Volatile anaesthetic used for maintenance.	Rapid onset and offset, allowing for quicker recovery.	May cause airway irritation and requires special equipment.
Analgesia and muscle relaxants	Fentanyl, Remifentanil [14,15]	Potent opioids are used for pain management and to blunt the sympathetic response to noxious stimuli.	Potent analgesia with fast onset. Remifentanil offers an ultra-short duration for shorter procedures.	Respiratory depression, requires careful titration.
	Rocuronium, Vecuronium [16]	Non-depolarising muscle relaxants induce muscle paralysis for intubation and immobility during the procedure.	Ensures complete muscle relaxation for procedural precision.	Prolonged action may occur in patients with renal or hepatic dysfunction.
Adjuvants	Dexmedetomidine [17]	A sedative and analgesic that does not cause significant respiratory depression.	Provides haemodynamic stability, light sedation, and analgesia.	May cause bradycardia and hypotension if not monitored closely.

[Table/Fig-1]: Summarises commonly used anaesthetic agents for General Anaesthesia (GA) during Endovascular Thrombectomy (EVT) [10-17].

Category	Drugs	Purpose/Role	Advantages	Considerations
Sedative agents	Midazolam [21]	Short-acting benzodiazepine for sedation, anxiolysis, and amnesia.	Rapid onset and offset. Provides mild to moderate sedation with amnesia.	May cause respiratory depression if not carefully titrated.
	Propofol (Low-dose infusion) [10]	A short-acting sedative agent used in low doses to maintain light sedation.	Allows for rapid onset and fast recovery. Easily titratable to balance sedation.	Requires careful monitoring of respiratory function.
Analgesic agents	Fentanyl [14]	An opioid analgesic is used for pain control during the procedure.	Provides potent analgesia with a fast onset and short duration.	May cause respiratory depression and hypotension if not monitored.
	Local anaesthetics (e.g., Lidocaine, Mepivacaine) [22]	Used for local anaesthesia at the vascular access site.	Minimises discomfort at the procedure site.	Risk of toxicity if used excessively or in patients with impaired metabolism.
Adjuvants	Dexmedetomidine [23]	A sedative and analgesic that provides a calming effect without significant respiratory depression.	Ideal for maintaining light sedation while preserving neurological monitoring.	May cause bradycardia and hypotension.
	Ketamine (Low-dose) [12]	Provides analgesia and mild sedation while maintaining sympathetic tone.	Helps prevent hypotension. Suitable for patients at risk of cardiovascular instability.	May cause emergence reactions and should be titrated carefully.

[Table/Fig-2]: Summarises commonly used anaesthetic agents for Conscious Sedation (CS) during Endovascular Thrombectomy (EVT) [10,12,14,21-23].

Trial (year)	Country	Design and focus	Sample size and key findings	Conclusion/ implication
SIESTA, 2015, Schönenberger S et al., [4]	Germany	Single-centre randomised trial comparing Conscious Sedation (CS) vs General Anaesthesia (GA) for EVT; primary outcome = early neurological improvement (ΔNIHSS at 24 h); multiple peri-procedural safety/feasibility secondary outcomes.	n = 150 (GA n=73; CS n=77). No significant difference in 24-hour NIHSS change. GA had fewer patient movements but higher post-procedural pneumonia and delayed extubation; an unadjusted higher proportion of mRS 0-2 at 3 months was seen in GA. However, the trial was not powered for long-term functional outcome.	With protocolised management, CS was not superior to GA for early neurological improvement; both regimens were feasible - attention to procedure timing, airway strategy, and post-op complications (e.g., pneumonia) is essential.
GOLIATH, 2018, Simonsen CZ et al., [6]	Denmark	Single-centre, randomised, open-label with blinded endpoint evaluation; primary outcome = infarct growth on MRI (pre-EVT vs 48–72 h post). Also reported 90-day mRS and reperfusion rates.	n = 128 (GA n=65; CS n=63). No statistically significant difference in infarct growth. The GA arm had higher successful reperfusion (76.9% vs 60.3%) and a shift toward better mRS distribution; when hypotension was avoided, GA was associated with smaller infarct volumes. Four CS patients (6.3%) required conversion to GA.	GA did not increase infarct growth, and when haemodynamics were well maintained, it may improve procedural conditions and reperfusion success. It emphasises the importance of haemodynamic management during GA.
AnStroke / ANSTROKE, 2017, Hendén PL et al., [5]	Sweden	Prospective randomised single-centre trial comparing GA vs CS for EVT; primary outcome = functional outcome at 3 months (mRS ≤2); also assessed early NIHSS, infarct volume, and intra-operative physiological parameters.	n = 90 (GA n=45; CS n=45). mRS ≤2 at 3 months: 19/45 (42.2%) GA vs 18/45 (40.0%) CS. No significant differences in intraoperative BP decline, $PaCO_2$, infarct volume, recanalisation rates, or mortality.	No difference in 3-month functional outcome between GA and CS in this cohort; highlights that with standardised peri-procedural care, GA can be non-inferior, and the need to limit GA-related delays and maintain haemodynamic targets.

[Table/Fig-3]: Clinical evidence comparing General Anaesthesia (GA) and Conscious Sedation (CS) in Endovascular Thrombectomy (EVT) [4-6].

Conversion from Conscious Sedation (CS) to General Anaesthesia (GA)

Emergency conversion to GA occurs in approximately 10-15% of cases and typically cannot be prevented due to an obstructed airway, restlessness, vomiting, or sudden clinical deterioration. Emergency conversions are risky and usually result in procedural delay, wastage of time, and more complications. Therefore, while choosing CS, one must have all devices for airway management at arm's length and ensure that qualified anesthesiologists are at hand to allow instant intubation if needed. Pre-procedural assessment must identify high-risk patients requiring GA in advance to avoid hazardous intra-procedural conversions [24].

Reported conversion rates from CS to GA during EVT vary across studies. Zhao J et al., observed conversion rates of 8% in anterior circulation and 29.5% in posterior circulation strokes [25]. Campbell D et al., reported an overall conversion rate of 12.7%, suggesting that the true treatment effect may be higher than in intention-to-treat analyses [26]. Similarly, Hendén PL et al., found a conversion rate of 15.5%, Schönenberger S et al., reported 14.3%, and Simonsen CZ et al., observed the lowest rate at 6.3%, reflecting variability influenced by patient selection, procedural complexity, and institutional protocols [4-6].

Postoperative Outcomes and Recovery

The EVT patients undergoing GA often require admission to the ICU post-procedure. This is mainly due to the need for continued ventilatory support, management of residual anaesthetic effects, and stringent haemodynamic monitoring. Sometimes, prolonged awakening, hypotension, or sedation can necessitate extended mechanical ventilation, delaying extubation and neurological assessment. These complications can contribute to increased length of stay, critical care service use, and total healthcare costs. In contrast, CS is typically associated with a more favourable immediate post-procedure recovery profile. Patients frequently avoid ICU admission, particularly if the procedure is benign and the patient is haemodynamically and neurologically stable. Avoidance of intubation, more rapid recovery of consciousness, and earlier onset of neurological assessment under CS could allow for more rapid transfer to stroke units or step-down units. This could shorten hospital stays and decrease utilisation of resources, consistent with optimal goals of cost-effective and efficient stroke care [5,27]. Lee CW et al., reported no significant difference between GA and CS in neurological improvement within 24 to 48 hours, incidence of pneumonia, symptomatic intracerebral haemorrhage, or mortality at three months. However, GA was associated with a higher incidence of intraoperative hypotension than CS [28]. Simonsen CZ et al., also observed that a greater proportion of patients under GA experienced a reduction in mean arterial pressure exceeding 20% compared with those under CS [6]. However, the duration of mean arterial pressure below 70 mmHg was not significantly different between the two groups. Liang F et al., found no significant difference in mortality at discharge, 30 days, or 90 days between GA and CS. Still, they noted that hypotension occurred more frequently in GA, while dysphoria and motion were more common in CS [3].

The success and safety of both anaesthetic techniques are incredibly reliant on institutional practice, team organisation, and experience of both neuro-interventional and anaesthesia teams. Both approaches have been shown to have successful outcomes in high-volume centres with established workflow and trained staff using either method. An adaptable individualised anaesthetic plan, considering patient-specific risk, procedural complexity, and accessible resources, is thus needed to maximise clinical outcomes and system efficiency [6,18].

Future Perspectives

With accumulating evidence, the choice between CS and GA must be tailored to individual circumstances. Technological developments, such as high-flow nasal oxygen and Transnasal Humidified Rapid-Insufflation Ventilatory Exchange (THRIVE), promise to render CS safer through enhanced oxygenation. Furthermore, integrating multimodal monitoring and machine learning- based predictive models allows clinicians to continuously assess patient physiology, anticipate changes during the procedure, and adjust anaesthetic management in real time, leading to more stable intraoperative conditions and improved patient outcomes in EVT. Future studies should aim to establish standardised anaesthetic protocols for EVT to avoid delays, provide haemodynamic stability, and create optimal conditions for reperfusion. Large multicentre trials comparing protocolised GA with CS should also be conducted with the aim of optimising selection criteria for patients [3,29].

CONCLUSION(S)

Both CS and GA play significant roles in the anaesthetic care of patients who are undergoing EVT for AIS. Although GA provides airway protection and control of the procedure, CS provides quicker initiation and real-time monitoring of neurological status. Evidence indicates that both methods can provide similar results when administered adequately by experienced teams. The decision should be based on patient-specific considerations, procedural needs, and institutional capabilities, aiming to reduce delays and maximise cerebral perfusion and recovery.

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PARTICULARS OF CONTRIBUTORS:

1. Junior Resident, Department of Anaesthesia, Jawaharlal Nehru Medical College, Datta Meghe Institute of Higher Education and Research, Wardha, Maharashtra, India.
2. Professor, Department of Anaesthesia, Jawaharlal Nehru Medical College, Datta Meghe Institute of Higher Education and Research, Wardha, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Angan Ghosh,
Laxmi Hostel, Jawaharlal Nehru Medical College, Datta Meghe Institute of Higher Education and Research, Wardha-442107, Maharashtra, India.
E-mail: angan.ghosh05@gmail.com

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