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Review Paper

Anesthetic Management of Mechanical Thrombectomy (MT) for Acute Ischemic Stroke (AIS): A current Evidence Review

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ABSTRACT:
The anesthetic management of mechanical thrombectomy (MT) for acute ischemic stroke (AIS) is a critical factor influencing procedural success and patient outcomes. Anesthetic strategies, including general anesthesia (GA), monitored anesthesia care (MAC), and conscious sedation (CS), are tailored to patient-specific factors such as hemodynamic stability, neurological status, and procedural requirements. GA is often preferred for its ability to secure the airway and ensure procedural immobility, while MAC and CS facilitate real-time neurological monitoring. The anesthesiologist's role encompasses hemodynamic optimization, airway management, and rapid decision-making to ensure patient safety and maximize treatment efficacy.

***Keyword:* anesthetic management, Mechanical thrombectomy, Rapid sequence induction and itubation ,Acute Ischemic stroke.**

INTRODUCTION:

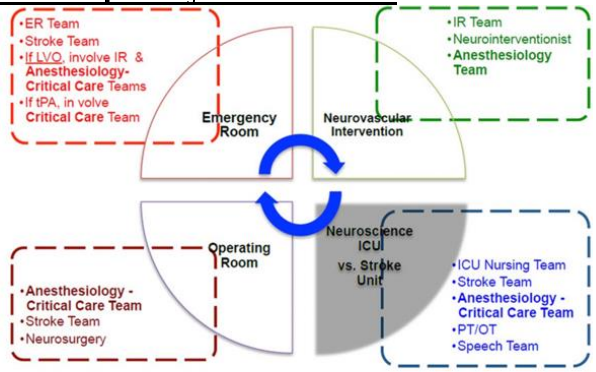
Endovascular therapy (EVT) is the most advanced technique since 2015 for restoration of cerebral blood flow in large vessel occlusion (LVO) as quickly as possible for salvaging ischemic brain tissue that has not yet infarcted. (penumbra)[1] The management of anesthesia in patients with acute ischemic stroke undergoing mechanical thrombectomy (MT) is a critical aspect of care that significantly influences both procedural success and patient outcomes. MT is a highly effective intervention for large vessel occlusions, time-sensitive and requires precise coordination between neurology, radiology, and anesthesiology teams.[2]

Anesthetic management during MT aims to maintain hemodynamic stability, optimize cerebral perfusion, and ensure patient safety, while minimizing delays to treatment. The choice between general anesthesia (GA), conscious sedation (CS), or monitored anesthesia care (MAC) remains a topic of ongoing research, with each approach offering distinct advantages and challenges. GA provides airway protection and procedural immobility but may be associated with delays and hemodynamic variability. Conversely, CS enables rapid initiation and continue neurological monitoring but is limited by patient cooperation and airway risks.[3]

Effective anesthetic care also requires addressing patient-specific factors such as cardiovascular stability, comorbidities, and the extent of neurological deficits. Advanced imaging and rapid evaluations further guide individualized strategies, ensuring that the benefits of MT are maximized while minimizing risks. As stroke management continues to evolve, anesthesiologists play a vital role in enhancing outcomes through evidence-based practices and interdisciplinary collaboration.[4]

During EVT the vascular access site, commonly the right groin or radial artery, is sterilized and draped to maintain a sterile field. Local anesthesia is administered at the access site before arterial cannulation. An introducer and catheter are then advanced into the extra- and intracranial arteries. Angiography identifies the arterial blockage, with movement minimized by breath-holding or ventilator pauses. The catheter is advanced intracranially for clot retrieval during mechanical thrombectomy or for intra-arterial thrombolytic administration. Patient immobility is crucial during the procedure. Once the clot is successfully retrieved or dissolved, a follow-up angiogram is performed to confirm vessel recanalization. Afterward, the catheters are removed, and pressure is applied to the access site. A follow-up head CT scan is conducted to rule out intracranial hemorrhage and ensure post-procedural stability.[1]

Multi-Disciplinary-Coordination:



Multidisciplinary Stroke Care-Anesthesia Team's involvement with the care continuum. ER indicates emergency room; ICU, intensive care unit; IR, interventional radiol large-vessel occlusion; OT, occupational therapy; PT, physical therapy; tPA, tissue plasminogen activator.

MT requires close collaboration among neurologists, anaesthesiologists, and interventional radiologists. Clinical management emphasize the importance of cohesive teamwork to ensure all specialists are aligned in the effective management of the patient. [5]

REVIEW OF ARTICLE:

This topic will provides a valuable insight on anaesthesic management for EVT for acute ischemic stroke. The choice between GA and sedation. Studies favouring GA as better choice for EVT.

Pre-operative evaluation:

Mechanical thrombectomy (MT) for patients with acute ischemic stroke (AIS) is an emergency procedure requiring a focused and efficient pre-anesthetic evaluation to avoid delays in care. While urgency is critical, a thorough assessment of the patient's overall clinical status, including comorbid conditions and potential perioperative complications, remains essential.[2] Below is a streamlined, ordered, and non-duplicative version of the information:

Stroke Team and Anesthesia Team Coordination:

Once the stroke team alerts the anesthesia team, preparations for the operating room, drug readiness, intubation, and ventilator checklists should be conducted concurrently with patient evaluation.[2]

Focused Pre-Anesthesia Evaluation:

Review the patient's medical history, including medication use, particularly anticoagulants and antiplatelet agents.

Perform a rapid airway assessment and document any personal or family history of anesthesia-related complications.[6]

Baseline Status and Risk Assessment:

Assess the patient's baseline neurological and cardiovascular status.

Identify critical risks such as unstable cardiac conditions, severe hypertension, or coagulation disorders that require immediate management.[7]

Cervical spine injury:

If a stroke is suspected to have resulted in a fall, always suspect cervical spine injury and precautions should be taken, especially during airway management under general anesthesia to prevent further injury and ensure patient safety.[8]

Diagnostic Tests:

Conduct essential diagnostic tests as part of the evaluation process.

Focus on ensuring all information is quickly gathered without delaying the procedure.

The anesthesiologist should evaluate diagnostic tests that provide critical information about the patient's condition. Key priorities include complete blood count, coagulation profile, and blood glucose levels, as these tests are vital for guiding perioperative decision-making and ensuring patient safety. [9,10]

An electrocardiogram (ECG) serves as a crucial tool for evaluating cardiac function, aiding in the detection of arrhythmias like atrial fibrillation, which may have contributed to the stroke and could influence anesthetic management. Additionally, if accessible, a recent echocardiogram provides valuable insights into cardiac health, identifying conditions such as prior myocardial infarction or valve abnormalities, which are essential for tailoring perioperative care. [10]

Point-of-care ultrasound (POCUS) offers the anesthesiologist valuable, real-time insights with minimal delay. A focused cardiac examination is particularly important for evaluating the patient's hemodynamic status and overall cardiovascular health. Additionally, a gastric ultrasound can help identify the risk of regurgitation in unconscious patients, enabling better airway management and reducing perioperative complications.[11]

For POCUS to be efficient and to avoid delays, proper operator training is essential. A limitation of this imaging modality largely depends on the experience and skill of the user. [11]

Computed tomography (CT) or magnetic resonance imaging (MRI) scans are essential diagnostic tools in evaluating patients with ischemic stroke. These imaging techniques help determine the size and location of the infarct and are critical for ruling out hemorrhagic stroke before proceeding with treatment. [12]

Informed consent:

Obtaining consent is essential. If the patient cannot consent, legal guardian should be approached following institutional guidelines. This process includes offering detailed updates on the patient's status, explaining the procedure thoroughly, and addressing potential risks. Clear and open communication fosters trust and ensures that the family is well-informed about the treatment plan and its potential outcomes. [11]

Intra operative management:
During this phase providers must consider Monitoring, Airway management, sedation for anesthesia administration and hemodynamic stability of patient.

Premedications:
Premedication should be tailored to the patient's neurological condition and anxiety or pain levels. Generally, premedication is avoided to maintain reliable neurological assessment. [13]

Choice of Anaesthesia Technique:
GA VS MAC: EVT can be performed under GA, MAC, or local anesthesia, depending on patient and procedural needs, resources, and collaboration with the interventionalist. For cases where GA or MAC are viable, GA is often preferred due to its ability to secure the airway, minimize movement, manage procedural pain, and provide controlled apnea. GA is Recommended for hemodynamically unstable patients, those at risk of aspiration or seizures, or those requiring intubation for airway protection and reducing risks of vascular injury. Controlled ventilation ensures optimal oxygenation, which can improve outcomes. [14]

MAC VS GA:
Some clinicians favor MAC for allowing neurological assessment during and immediately after the procedure.
MAC is Suitable for cooperative patients who can maintain their airway and tolerate lying flat and communicative, and maintain airway protection. This approach is generally inappropriate for individuals at higher risk of respiratory depression or airway obstruction due to conditions like obstructive sleep apnea or stroke-induced swallowing difficulties (dysphagia). MAC facilitates quicker initiation of treatment with out delay, reduces intraoperative hypotension, lowers respiratory complication risks, and allows early neurological assessment. [15]

Literature review to evaluate the effectiveness and outcomes of GA compared to MAC or CS:
A meta-analysis published in 2023, which included seven randomized trials involving 980 patients (GA, N = 487; non-GA, N = 493), to evaluate the outcomes of (GA) compared to non-GA techniques such as local anesthesia(LA) and CS). The study reported that patients undergoing GA had higher rates of successful recanalization by 9.0% (GA 84.6% vs non-GA 75.6% and showed improved functional recovery at three months by 8.4% (GA 44.6% vs non-GA 36.2%. It is concluded that (GA) is recommended as the preferred approach for most endovascular thrombectomy (EVT) procedures in acute ischemic stroke. It has a Level A recommendation for achieving successful recanalization and a Level B recommendation for enhancing functional recovery. [16]
Another randomized multi-center trial involving 273 patients who underwent mechanical thrombectomy for large vessel anterior circulation acute ischemic stroke found no significant differences in outcomes between patients receiving general anesthesia (using intravenous or inhalational methods) and those undergoing mild to moderate procedural sedation. Functional independence at 90 days and the incidence of major complications within 7 days were compared across both groups.
At 90 days, the rate of patients achieving functional independence was 33.3% (45 of 135) with GA and 39.1% (54 of 138) with CS suggesting similar safety and efficacy for the two approaches in this clinical context. [17]
Another prospective non-randomized controlled trial involving 149 consecutive patients with acute anterior circulation stroke who underwent endovascular thrombectomy (EVT) was conducted to evaluate the outcome by using the modified Rankin Scale (mRS) at three months post-procedure. The independence (mRS scale 0 to 2) at 3 months was equal between patients who received GA and those who received CS (odds ratio=0.73, 95% confidence interval. [18]

Anesthetic consideration during EVT:
Monitoring and Equipment:
All anaesthetics should routinely involve standard monitoring as recommended by the ASA, including ECG, pulse oximetry, non-invasive blood pressure, and temperature tracking. Capnography is essential during general anesthesia (GA) or moderate to deep sedation and should be utilized for all patients undergoing EVT with either GA or MAC. In MAC, capnography helps prevent respiratory depression from sedation, monitors respiratory patterns, and detects airway obstructions. Following arterial access, blood gases should be assessed, correlating end-tidal carbon dioxide (ETCO2) with arterial carbon dioxide pressure (PaCO2). [19]

Intraoperative management:
It is essential to ensure effective ventilation, maintain hemodynamic stability, achieve an appropriate depth of anesthesia, and regulate glucose levels to avoid both hyperglycemia and hypoglycemia. Additionally, careful control of body temperature is crucial to prevent hypothermia, which could negatively impact patient outcomes.

Invasive Monitoring and Catheters:
Continuous invasive blood pressure monitoring via intra-arterial catheter should be accessible during EVT regardless of the anesthetic approach. While arterial catheters are often placed during the initial stroke

evaluation preferably before GA induction delays in treatment for their placement should be avoided. Direct arterial pressure can also be measured via the introducer catheter used during the procedure by interventional radiologist. [20]

Venus Access:

It is adviseable to have at least two peripheral IV lines (one large-bore, ≥18 gauge) for EVT procedures to ensure rapid fluid or medication administration. vascular access, Additional if required, should not impede procedural progress. [20]

Induction of anesthesia:

Anesthesia induction should minimize ischemic penumbra damage by avoiding hypoxemia, hypotension, or excessive hyperventilation. RSII is recommended due to uncertain gastric emptying and aspiration risks. [21] Medications and dosages should be aligned with patient factors to ensure hemodynamic stability.

Lignocaine 1 to 2 mg/kg intravenous (I/V)

Fentanyl 1 to 3 mcg/kg IV

Propofol 2 to 2.5 mg/kg IV followed immediately by phenylehrine 50 to 100 mcg IV to avoid hypotension or, for patients with hemodynamic compromise, etomidate 0.2 to 0.5 mg/kg IV

Succinylcholine1 to 1.5 mg/kg IV, or rocuronium 1 to 1.2 mg/kg IV [21]

Maintenance:

The anesthetic agent should be chosen to avoid hypotension, using inhalational agents like sevoflurane or desflurane, intravenous agents like propofol, or a combination.

Oxygenation and Ventilation:

Maintain peripheral oxygen saturation above 92% and PaO2 above 60 mmHg. Avoid hyperventilation to prevent hypocapnia-induced ischemia and hypercapnia-related intracranial hypertension. Minute volume should be adjusted to maintain normocapnia (partial pressure of carbon dioxide [$PaCO_2$] between 35 to 45 mmHg) during general anesthesia.[22]

Vasopressor Choice:

The choice of vasopressor should usually be a potent alpha-agonist such as norepinephrine or phenylephrine, since the most likely cause of hypotension would be anesthetic-induced vasodilation. It should be selected and titrated according to the patient's overall hemodynamic stability and pre-existing comorbidities..[23]

Intraoperative Blood Pressure Management:

First-line agents for hypertension management include . Labetalol 10 to 20 mg intravenously over 1 to 2 minutes, may repeat one time; or Nicardipine 5 mg/hour IV, titrate up by 2.5 mg/hour every 5 to 15 minutes, maximum 15 mg/hour or Clevidipine 1 to 2 mg/h IV, titrate by increasing the dose every 2 to 5 min, maximum 21 mg/h or other agents such as hydralazine, Sodium nitropruside and enalaprilat can also be used. .[24]

Fluid Management:

The goals for fluid management during EVT include maintenance of normovolemia to maintain adequate cerebral perfusion, and avoidance of cerebral edema. When possible, volume status should be monitored with dynamic tests, such as pulse pressure variation or stroke volume variation. Hemodilution with volume expension and use of albumen is not recommended in patient with AIS. For most patients, dextrose-free isotonic plasmalyte), slightly hypotonic (e.g Ringer's lactate), or slightly hypertonic (e.g 0.9 % [NaCl] crystalloid. Solutions can also be given as maintenance fluid during EVT. Hypotonic fluids should be avoided. [25]

Blood Glucose Control:

monitor blood glucose every 45 to 60 minutes during EVT.Low serum glucose (<60 mg/dL) should be corrected rapidly. It is reasonable to aim to maintain blood glucose between 140 and 180 mg/dL. Avoid large fluctuations in blood glucose. Consider intravenous insulin infusion and titrate intraoperatively. Sliding scale IV insulin is recommended over subcutaneous dosing. [26]

Temperature Monitoring:

Patient temperature should be monitored during EVT with the goal of maintaining normothermia. Core temperature should be maintained between 35-37°C. Avoid hyperthermia as fever has been associated with poor neurologic outcome after stroke.In patients with AIS the benefit of induced hypothermia is uncertain. [27]

Neuromuscular Blockade:

Neuromuscular blockade with neuromuscular blocking agents during EVT and its monitoring aimed at one to two twitches 50% blockade, using a train-of-four twitch monitor especially when passing intracranial catheters. [28]

Depth of anesthesia:

Monitoring the depth of anesthesia is essential whenever possible, but challenges such as difficulty in placing sensors on the head will interfere with work of radiologist. However, sone authers suggest that processed EEG sensors generally cause minimal interference. [7] Monitoring anesthesia depth provides two main benefits: it ensures adequate sedation for the patient and helps protect neurological function while avoiding the risks associated with oversedation. [29]

MAC Protocol:
Administer supplemental oxygen to maintain SpO2 >92%. Use short-acting sedatives like fentanyl or propofol for quick titration. Transition to GA if airway obstruction occurs or sedation deepens unexpectedly. Always prepare for Plan B for emergency intubation during MAC if needed. [30]

Emergence and Extubation:
Patients should be extubated awake with complete reversal from neuromuscular blocade effect after EVT and a post-procedure CT scan. Smooth emergence, free from coughing or agitation, facilitates prompt neurological assessment while maintaining blood pressure goals. [15]

Complication during EVT:
Intraoperative EVT complications include access site bleeding or local vessel or nerve injury (eg, arterial dissection, pseudoaneurysm formation, retroperitoneal hemorrhage), or intracranial perforation or hemorrhage. Anesthesia clinicians should be aware of anaphylaxis and anaphylactoid reactions, which may occur with administration of contrast agents or tPA or following the administration of any other drug.

Intracranial arterial perforation:
Extravasation of contrast material on post-thrombectomy computed tomography (CT) scans suggests arterial perforation (but may also indicate blood brain barrier disruption). Arterial perforation requires immediate management, in consultation with the neuro-interventionalist. [31]

Call for help, and for immediate neurosurgical consultation.
Alert the operating room that emergency craniotomy may be necessary
Control blood pressure with careful titration of short-acting medications (eg, nicardipine, nitropruside), aiming for a systolic blood pressure ≤140 mmHg
Discuss with the interventionalist for discontinuation and immediate reversal of heparin, tPA, and any other anticoagulant or antiplatelet medications in effect. [33]

Extracranial complication:
Arterial perforation in the chest, abdomen, or retroperitoneum may occur during the procedure, and may be indicated by an unexplained decrease in blood pressure. If Arterial perforation in the chest, abdomen, or retroperitoneum may occur during the procedure, and may be indicated by an unexplained decrease in blood pressure. If such a perforation is suspected, the following steps are appropriate:
Notify the interventionalist who may be able to confirm the diagnosis angiographically.
If the diagnosis is confirmed call for help; a vascular neurosurgeon or other interventionalist may be required.Venous access as necessary, alert the operating room if an invasive procedure is contemplated.
Control blood pressure with careful titration of short-acting medications (eg, nicardipine, nitropruside), target systolic blood pressure ≤140 mmHg. [34]

Management in the Postoperative Recovery Unit:
Patients post-mechanical thrombectomy in the recovery unit involves critical steps to ensure optimal recovery and minimize complications.

Continuous Monitoring and Postoperative Care by dedicated PACU staff:
Vital Signs: Monitor blood pressure, heart rate, oxygen saturation, and respiratory rate

Neurological Assessment:
Conduct regular examinations to assess mental status, motor function, and sensory deficits.

Hemodynamic monitoring:
Maintain blood pressure within specified ranges as directed by the neurovascular team to prevent re-occlusion or hemorrhage.

Fluid Balance:
Monitor fluid intake and output meticulously to prevent dehydration or fluid overload.

Monitoring for Complications:
Bleeding: Monitor for signs of hemorrhage at puncture sites or intracranial bleeding, such as severe headache, neurological deterioration, or signs of shock.
Reperfusion Injury symptoms like brain swelling or hemorrhage indicating reperfusion injury. [15]

DISCUSSION:
Mechanical thrombectomy (MT) has emerged as a widespread of take care of acute ischemic stroke (AIS) because of big vessel occlusions (LVOs), notably improving results in patients while finished within the ideal time window.

GA Provides controlled airway management, patient immobility, and optimized procedural conditions. However, GA may cause delays and transient blood pressure fluctuations during induction, potentially affecting cerebral perfusion. [14]

CS and MAC allow for quicker initiation of the procedure and real-time neurological assessments. These techniques are associated with faster recovery but require cooperative patients and may not be suitable in cases of severe agitation or respiratory compromise.

Studies comparing GA and CS have yielded mixed results. Some meta-analyses suggest better recanalization rates and functional outcomes with GA, while others report no significant differences. [15]

Maintaining stable blood pressure is critical to ensuring adequate cerebral perfusion, particularly in the ischemic penumbra. Both hypotension and hypertension can exacerbate ischemic injury.Close monitoring and rapid adjustments using vasoactive agents are necessary to maintain individualized blood pressure targets. [32]

Anesthetic agents may offer neuroprotective benefits. For instance, volatile anesthetics and certain intravenous agents like propofol have shown potential in reducing ischemia-reperfusion injury. [33]

However, evidence remains inconclusive, and the choice of anesthetic should prioritize patient stability and procedural efficiency.

Effective airway management is crucial in patients with reduced consciousness or aspiration risk. GA provides complete airway control, while CS requires careful patient selection to avoid complications like hypoventilation or hypoxia.Ventilation strategies should ensure adequate oxygenation and avoid hypercapnia, which can exacerbate intracranial pressure. [34]

Time efficiency is critical in stroke management. Streamlined protocols for preoperative assessment, anesthetic preparation, and equipment readiness are essential to minimize delays.

Interdisciplinary collaboration between neurologists, interventional radiologists, and anesthesiologists ensures cohesive care.

Ultimately, the goal is to support timely and effective recanalization while minimizing risks and optimizing neurological recovery.

CONCLUSION:

The anesthetic management of patients with acute ischemic stroke undergoing mechanical thrombectomy (MT) plays a crucial role in optimizing outcomes. Key conclusions include:

Tailored Anesthetic Approach:

The choice GA and CS should be individualized based on the patient's clinical status, procedure requirements, and team expertise. GA offers better procedural control and immobility, while CS allows for quicker assessment and shorter preparation times.

Hemodynamic Stability:

Maintaining stable hemodynamics and cerebral perfusion is critical during MT to minimize secondry ischemic insult and support optimal neurological outcomes.

Airway and Ventilation Management:

Proper airway management is essential, particularly in patients with compromised consciousness or those at risk of aspiration. Adequate oxygenation and ventilation are necessary to prevent secondary brain injury.

Neuroprotection:

Anesthetic strategies should focus on minimizing ischemia-reperfusion injury and avoiding oversedation, ensuring timely intervention with neuroprotective considerations.

Interdisciplinary Collaboration:

Effective communication and coordination among neurologists, anesthesiologists, and interventional radiologists are vital for seamless patient care.

Rapid Decision-Making:

Given the time-sensitive nature of MT, anesthetic preparation and patient evaluation must be streamlined to avoid procedural delays.

In summary, the anesthetic management of patients undergoing MT requires a careful balance of providing procedural conditions, maintaining physiological stability, and minimizing potential complications.

REFERENCES:

1. Jovin TG, Chamorro A, Cobo E, et al. Thrombectomy within 8 hours after symptom onset in ischemic stroke. N Engl J Med2015; 372:2296–306. DOI: 10.1056/NEJMoa1503780
2. W Butt et al, anesthetic modalities for endovascular stroke treatment Journal of NeuroInterventional Surgery, 2021. DOI: 10.1136/neurintsurg-2021-017360
3. A Maurice, MD. et al General Anesthesia *versus* Sedation, Both with Hemodynamic Control, during Intraarterial Treatment for Stroke: The GASS Randomized Trial, Anesthesiology April 2022, Vol. 136, 567–576. https://doi.org/10.1097/ALN.0000000000004142
4. Melinda J. Davis et al. Anesthetic Management and Outcome in Patients Undergoing Endovascular Treatment for Acute Ischemic Stroke. Anesthetic Management and Outcome in Patients Undergoing Endovascular Treatment for Acute Ischemic Stroke. Anesthesiology , Vol. 116, 396–405 February 1, 2012 DOI: 10.1097/ALN.0b013e318242a5d2
5. J Redgrave, Helen Ellis, G Eapen, Interventional therapies in stroke management: anaesthetic and critical care implications BJA Education, Volume 17, Issue 2, February 2017, Pages 43-47 https://doi.org/10.1093/bjaed/mkw039
6. Jamary Oliveira-Filho, et al Initial assessment and management of acute stroke,uptodate Anesthesia Oct 01, 2024. https://www.wolterskluwer.com/en/know/clinical-effectiveness-terms.

7. Alessandro De Cassai, et al Anesthetic Management of Acute Ischemic Stroke Undergoing Mechanical Thrombectomy: An Overview. Diagnostics 2024, *14*(19), 2113 https://doi.org/10.3390/diagnostics14192113
8. Oteir AO, Smith K, Stoelwinder JU, et al. Should suspected cervical spinal cord injury be immobilised?: a systematic review. Injury 2015; 46:528. DOI: 10.1016/j.injury.2014.12.032
9. Halvorsen, S.; Mehilli, J.; Cassese, S.; Hall, T.S.; Abdelhamid, M.; Barbato, E.; De Hert, S.; de Laval, I.; Geisler, T.; Hinterbuchner, L.; et al. 2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery. Eur. Heart J. 2022, 43, 3826–3924. DOI: 10.1093/eurheartj/ehac270.
10. Fleisher, L.A.; Fleischmann, K.E.; Auerbach, A.D.; Barnason, S.A.; Beckman, J.A.; Bozkurt, B.; Davila-Roman, V.G.; Gerhard-Herman, M.D.; Holly, T.A.; Kane, G.C.; et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. Circulation 2014, 130, e278–e333 DOI: 10.1007/s12350-014-0025-z.
11. Li, L.; Yong, R.J.; Kaye, A.D.; Urman, R.D. Perioperative Point of Care Ultrasound (POCUS) for Anesthesiologists: An Overview. Cureus 2021 May 24;13(5):e15217. doi: 10.7759/cureus.15217
12. Kidwell CS, Chalela JA, Saver JL, Starkman S, Hill MD, Demchuk AM, Butman JA, Patronas N, Alger JR, Latour LL, Luby ML, Baird AE, Leary MC, Tremwel M, Ovbiagele B, Fredieu A, Suzuki S, Villablanca JP, Davis S, Dunn B, Todd JW, Ezzeddine MA, Haymore J, Lynch JK, Davis L, Warach S. Comparison of MRI and CT for detection of acute intracerebral hemorrhage. JAMA. 2004; *292*: 1823–1830. DOI: 10.1001/jama.292.15.1823
13. Powers, W. J., Rabinstein, A. A., Ackerson, T., Adeoye, O. M., Bambakidis, N. C., Becker, K., Guidelines for the Early Management of Patients with Acute Ischemic Stroke: 2019 Update to the 2018 Guidelines for the Early Management of Acute Ischemic Stroke: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association & American Heart Association Stroke Council. (2019). https://doi.org/10.1161/STR.0000000000000211
14. W Brinjikji , MH Murad, AA Rabinstein , HJ Cloft , G Lanzino , DF Kallmes. Conscious Sedation versus General Anesthesia during Endovascular Acute Ischemic Stroke Treatment: A Systematic Review and Meta-Analysis. AJNR Am J Neuroradiol 2015 Mar;36(3):525–529. DOI: 10.3174/ajnr.A4159
15. Powers WJ, Rabinstein AA, Ackerson T, et al**.** 2018**.** Guidelines for the Early Management of Patients With Acute Ischemic Stroke: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association. Volume 49, Number 3 https://doi.org/10.1161/STR.0000000000000158
16. Campbell D, Butler E, Campbell RB, Ho J, Barber PA General Anesthesia Compared With Non-GA in Endovascular Thrombectomy for Ischemic Stroke: A Systematic Review and Meta-analysis of Randomized Controlled Trials. Neurology. 2023;100(16):e1655. Epub 2023 Feb DOI: 10.1212/WNL.0000000000207066
17. Chabanne R, Geeraerts T, Begard M, Balança B. Outcomes After Endovascular Therapy With Procedural Sedation vs General Anesthesia in Patients With Acute Ischemic Stroke: The AMETIS Randomized Clinical Trial. JAMA Neurol. 2023;80(5):474. DOI:10.1001/jamaneurol.2023.0413
18. Peng Y, Wu Y, Huo X, Wu P, Zhou Y, Outcomes of Anesthesia Selection in Endovascular Treatment of Acute Ischemic Stroke. Neurosurg Anesthesiol. 2019;31(1):43. DOI: 10.1097/ANA.0000000000000500
19. Sou, B.S.; Aglio, L.S.; Zhou, J. Anesthetic Management of Acute Ischemic Stroke in the Interventional Neuro-Radiology Suite: State of the Art. Curr. Opin. Anaesthesiol. 2021, 34, 476–48. DOI: 10.1097/ACO.0000000000001020.
20. Jovany Cruz Navarro, MD W Andrew Kofke, MD. Anesthesia for endovascular therapy for acute ischemic stroke in adults, UpToDate Jan 16, 2024.
21. Lauren C Berkow, MD, FASA. Rapid sequence induction and intubation (RSII) for anesthesia. UpToDate Nov 19, 2024.
22. Talke PO, Sharma D, Heyer EJ, Anesthesia for endovascular therapy for acute ischemic stroke in adults Neurosurg Anesthesiol. 2014;26(2):95 DOI: 10.1097/ANA.0000000000000042.
23. Martin J London, Intraoperative use of vasoactive agents. UpToDate. Jun 16, 2023.

24. De Georgia, M., Bowen, T., Duncan, K.R. *et al.* Blood pressure management in ischemic stroke patients undergoing mechanical thrombectomy. *Neurol. Res.* Pract. 5, 12 (2023). https://doi.org/10.1186/s42466-023-00238-8
25. Miller, T.E. · Myles, P.Perioperative fluid therapy for major surgery Anesthesiology. pubs.asahq.org 2019**;** 130**:**825-832. DOI: 10.1097/ALN.0000000000002603
26. Ángel Chamorro, Scott Brown, Sergio Amaro, Michael D. Hill, Glucose Modifies the Effect of Endovascular Thrombectomy in Patients With Acute Stroke. StrokeVolume 50, Issue 3, March 2019; Pages 690-696. DOI: 10.1161/STROKEAHA.118.023769.
27. Dhanesh D. Binda, Maxwell B. Baker, Shama Varghese, Jennifer Wang. Targeted Temperature Management for Patients with Acute Ischemic Stroke: A Literature Review. J. Clin. Med. 2024, 13(2), 586; https://doi.org/10.3390/jcm1302058628.
28. Madalina Dutu, Robert Ivascu, Oana Tudorache. Neuromuscular monitoring: an update. Romanian Journel of anaesthesia and intensive care 2018 vol 25 No 1,55-60 DOI: 10.21454/rjaic.7518.251.nrm
29. Fernando Seoane, Syed Reza Atefi , Jens Tomner , Konstantinos Kostulas , Kaj Lindecrantz. Electrical Bioimpedance Spectroscopy on Acute Unilateral Stroke Patients: Initial Observations regarding Differences between Sides. Epub 2015 Oct doi: 10.1155/2015/613247.
30. Richard D. Zane, Deitch K et al, Does Supplemental Oxygen During Propofol Sedation Prevent Hypoxia? A randomized, controlled trial. NEJM Journal watch. 2008 Jul, 18. 52:1.
31. Eric Whitney, Yasir R Khan, Anthony Alastra.Contrast Extravasation Post Thrombectomy in Patients With Acute Cerebral Stroke: A Review and Recommendations for Future Studies. Cureus 2020 Sep 23;12(9):e10616. doi: 10.7759/cureus.10616
32. Pilgram-Pastor SM, Eike I Piechowiak J Stroke thrombectomy complication management. Neuro interv Surg 2021 Jun 22;13(10):912–917. DOI: 10.1136/neurintsurg-2021-017349
33. Byrappa Vinay, Nitin Manohara, Francisco A. Lobo. Inhalational versus Intravenous General Anesthesia for mechanical thrombectomy for stroke: A single centre retrospective study, Clinical Neurology and Neurosurgery, June 2023, 107719. DOI: 10.1016/j.clineuro.2023.107719
34. Min Chen, Dorothea Kronsteiner, Johannes A R Pfaff. Emergency intubation during thrombectomy for acute ischemic stroke in patients under primary procedural sedation Neurological Research and Practice 3(1):27 2021 May 17 DOI: 10.1186/s42466-021-00125-0