Anesthesia for Endovascular Approaches to Acute Ischemic Stroke

An ESSAY

Submitted by

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Abstract

Introduction: Stroke is a major cause of serious, long-term disability. According to the World Health Organization, 15 million people suffer a stroke worldwide annually. Of those, one third do not survive and another third is left with a significant neurological deficit. The majority of these events are ischemic (87%), as opposed to intracerebral (10%) and subarachnoid hemorrhages (3%).

Aim of the work: This essay aims to focus on the anesthetic management in patients with acute ischemic stroke (AIS) including the anesthetic techniques, the effect of the anesthetic technique on the state of reperfusion and their neurological outcomes .

Summary: Stroke is a major cause of serious, long-term disability. The majority of stroke cases are ischemic (87%). The initial treatment of patients with acute ischemic stroke (AIS) focuses on rapid recanalization, which often includes the use of endovascular therapies. Endovascular treatment depends upon micronavigation of catheters and devices into the cerebral vasculature, which is easier and safer with a motionless patient.

Recommendations: It is recommended that patients should go to a dedicated ICU specializing in neurovascular care or a stroke unit after the procedure. It is also recommended that continuous hemodynamic monitoring should be continued in the ICU or stroke unit . Patients who meet standard extubation criteria after the procedure should be extubated.

Keywords: Anesthesia, Endovascular, Acute Ischemic Stroke

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List of Abbreviations

AIS	Acute Ischemic Stroke
ABP	Arterial Blood Pressure
BBB	Blood Brain Barrier
BP	Blood Pressure
Ca^{2+}	Calcium
CBF	Cerebral Blood Flow
CI	Confidence Interval
CMR	Cerebral Metabolic Rate
CO2	Carbon Dioxide
CPP	Cerebral Perfusion Pressure
CS	Conscious Sedation
CSF	Cerebro-Spinal Fluid
CT	Computerized Tomography
DBP	Diastolic Blood Pressure
ED	Emergency Department
EPO	Erythropoietin
EVT	Endovascular Therapy
FiO2	Fraction Of Inspired Oxygen
GABA	Gamma Aminobutyric Acid
GA	General Anesthesia
GMC	General Medical Council

Hct	Hematocit
HMP shunt	Hexose Mono-Phosphate Shunt
IA	Intra-Arterial
IAT	Intra-Arterial Thrombectomy
ICH	Intracranial Hemorrhage
ICP	Intracranial Pressure
ICU	Intensive Care Unit
IMS 3	Third Interventional Management Of Stroke Trial
INR	Interventional Neuroradiologist
IV	Intravenous
IVT	Intravenous Thrombolysis
Mg^{2+}	Magnesium
mmHg	Millimeter Mercury
MRI	Magnetic Resonance Imaging
mRS	Modified Rankin Score
Na^{+}	Sodium
NCS	Neurocritical Care Society
NICE	National Institute For Health & Clinical Excellence
NIHSS	National Institutes Of Health Stroke Scale
NMDA	N-Methyl-D-Aspartate Receptor
O2	Oxygen
OR	Odds Ratio

PaCO2	Arterial Partial Pressure Of Carbon Dioxide
PaO2	Arterial Partial Pressure Of Oxygen
PEEP	Positive End Expiratory Pressure
RCT	Randomised Controlled Trial
SBP	Systolic Blood Pressure
SICH	Symptomatic Intracerebral Haemorrhage
SITS	Safe Implementation Of Treatments In Stroke
SNACC	Society For Neurosciences in Anesthesiology And Critical Care
SNIS	Society of Neuro Interventional Surgery
SpO2	Saturation of Oxygen in The Arterial Blood
TIA	Transient Ischemic Attack
TIVA	Total Intravenous Anaesthesia
tPA	Tissue Plasminogen Activator
VC	Vaso-Constriction
VD	Vaso-Dilatation

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Introduction

Stroke is a major cause of serious, long-term disability. According to the World Health Organization, 15 million people suffer a stroke worldwide annually. Of those, one third do not survive and another third is left with a significant neurological deficit. The majority of these events are ischemic (87%), as opposed to intracerebral (10%) and subarachnoid hemorrhages (3%) (American Heart Association, 2010).

Endovascular treatment of acute ischemic stroke (AIS) provides a supplement or alternative to systemic intravenous thrombolysis in carefully selected patients. Several studies have shown intra-arterial thrombolysis or mechanical clot-removing devices to be efficacious for recanalization and restoration of cerebral blood flow, which has been correlated with better neurological outcome (Nogueira et al., 2011). All patients who present within 3 hours of symptom onset and have no contraindications to therapy are treated with IV tPA. Patients who present between 3 and 4.5 hours after stroke onset and have no contraindications may be considered for treatment with IV tPA. Patients who are not eligible for IV tPA (due to delayed time to presentation or contraindications to tPA therapy such as recent

surgery or coagulopathy) can be considered for endovascular therapy (Broderick et al., 2013).

Patients with AIS are often elderly with multiple comorbidities. Their neurological status at time of ictus may vary from almost normal to comatose. An anesthesia team is frequently involved in patient care during endovascular treatment of AIS. During endovascular procedures, anesthesiologists are intimately involved in sedating, anesthetizing and monitoring the patient, managing hemodynamics, oxygenation, ventilation, glycemic control and periprocedure complications, all of which may have a significant effect on the patient's long-term outcome. Despite the significance of the anesthetic management of these patients, evidence supporting specific practices is limited.

The use of local anesthesia with conscious sedation for endovascular treatment of AIS is associated with lower mortality and better neurological outcomes compared with GA However, existing literature is limited by selection bias and the quality of existing data is not sufficient to influence clinical practice. Local anesthesia with sedation offers the advantages of allowing neurological monitoring during the procedure and does not delay intervention due to anesthetic induction but may expose the patient to the risk of aspiration, respiratory depression, undesirable

movement and possibly increased procedure duration. GA offers the advantages of airway control with avoidance of intraprocedure aspiration, patient immobility, and possibly reduced procedural duration, but may expose patients to the risk of blood pressure fluctuations, restricts neurological monitoring during intervention, and requires qualified anesthesia providers; GA may also be associated with pneumonia and sepsis (Davis et al., 2012).

The maintenance of an adequate cerebral perfusion and an adequate oxygenation or ventilation are the main targets during the procedure. (Talke et al., 2014).

The neuroprotective strategies including pharmacologic, hemodilution, hypothermia and ischemic conditioning are essential for anesthesiologist to reach better outcome .

The occurrence of hyperglycemia and hypoglycemia are known to be associated with increased mortality and poor recovery after AIS (Talke et al., 2014).

Complications during intravascular treatment of AIS are an area that needs more investigation. There are certain complications attributed to the type of anesthesia used either GA

or local anesthesia with sedation, Other complications are due to patient comorbidities, The procedure itself may have the risk of inadvertent rupture of an intracranial artery (Gi\\ et a\., 20\4) .

AIM OF THE WORK

This essay aims to focus on the anesthetic management in patients with acute ischemic stroke (AIS) including the anesthetic techniques, the effect of the anesthetic technique on the state of reperfusion and their neurological outcomes .

Anesthetic Technique for Endovascular Treatment of AIS

Endovascular therapy (EVT) has been shown to be an effective treatment for select AIS patients (Smith and Furlan 2016, Chen et al, 2015). The EVT for AIS involves puncture of an artery, introduction of guide wires and therapeutic catheter into the vascular system, injection of fibrinolytic agents, and/or mechanically extraction of the blood clots that block the blood vessels of the brain. A successful and timely EVT can reestablish the blood supply to the lesion and improve the clinical outcome.

EVT combined with medical treatment was associated with better functional outcome, especially for patients with large vessel occlusion or treated with the newer stent retriever device (Chen et al, 2015). The EVT (specifically mechanical thrombectomy, the direct extraction of the blood clots) is rapidly changing the landscape of AIS management and is claimed to be the promisingly new gold standard for AIS by some experts (Palaniswami and Yan 2015).

For AIS patients, National Institute of Health Stroke Scale/Score (NIHSS) gives at the presentation to the emergency room to evaluate the eligibility for fibrinolytic agent and also serves as a comprehensive indictor of stroke severity. NIHSS is