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Total Intravenous Anaesthesia (TIVA) in Supratentorial Meningioma Undergoing Craniotomy Tumour Removal : A Case Report

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ABSTRACT

Meningiomas are tumours that grow inside the head cavity or intra-cranial tumours, The incidence of intra-cranial tumours in patients of all ages is approximately 4.2 - 5.4 /100,000. The brain uses 20% of the body's total oxygen. The brain uses most of its oxygen consumption (60%) to generate adenosine triphosphate (ATP), which supports the electrical activity of neurons. In cranitomy tumour removal, it is expected that good oxygen supply and oxygen consumption by the brain are reduced by reducing electrical activity in the brain with the aim of relaxing the brain, Selection of 4 intravenous anaesthetic agents in craniotomy tumour removal in this patient in the form of Tiopental, Fentanyl, Rocuronium and Dexmedetomidine because the use of these agents is the best in reducing cerebral metabolic rate (CMR) and cerebral blood flow (CBF) so as to reduce intracranial pressure (ICP) which appears in this case stable hemodynamics and adequate depth of anaesthesia during surgery.

KEYWORDS:

Total Intravenous Anaesthesia , TIVA, Meningioma, Craniotomy

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INTRODUCTION

Meningiomas are tumours that grow inside the head cavity, or intra-cranial tumours, which can originate from the bones of the skull, brain membranes or meninges, cranial nerves, blood vessels, the pituitary gland or the brain parenchyma itself (1). The incidence of intra-cranial tumours in patients of all ages is approximately 4.2 - 5.4 /100,000 (2). Brain uses 20% of the body's total oxygen. Most of the brain's oxygen consumption (60%) is used to generate adenosine triphosphate (ATP) to support the electrical activity of neurons (3). The brain metabolic rate (CMR) is usually expressed in terms of oxygen consumption (CMR O2) and averages 3 to 3.8 mL/100 g/min (50 mL/min) in adults (4). CMR O2 is greatest in the gray matter of the brain cortex and generally parallels cortical electrical activity. Due to the rapid consumption of oxygen and the absence of significant oxygen reserves, impaired brain perfusion usually results in unconsciousness within 10 seconds (5).

If blood flow is not reestablished within 3 to 8 minutes under most conditions, ATP reserves are depleted, and irreversible cellular injury occurs. The higher regions of the brain (cortex, hippocampus)

are more sensitive to hypoxic injury than the brain stem (6).

The selection of 4 intravenous anaesthetic agents in the craniotomy for tumour removal in this patient was Tiopental, Fentanyl, Rocuronium and Dexmedetomidine because the use of these agents is the best at reducing CMR and cerebral blood flow (CBF) so as to reduce intracranial pressure (ICP) (7).

This can be proven by controlled hemodynamics and an intraoperative heart rate monitored from ABP with an intraoperative MAP range of 70-100 mmHg, then we can assess intracranial pressure by measuring central venous pressure (CVP), brain electrical activity with a bispectral index to assess the depth of anaesthesia in this patient (8).

CASE

A 33-year-old female presented with complaints of headaches for 2 years, blurred vision in the right eye, weakness in the extremities was denied, seizures and loss of consciousness were denied, vomiting, and signs of increased intracranial pressure were absent. There was no history of allergies or other comorbid diseases; the social and economic impression was good. The results of the physical examination showed vital signs within normal limits, blood pressure 136/93 mmHg, heart rate 89 beats per minute.

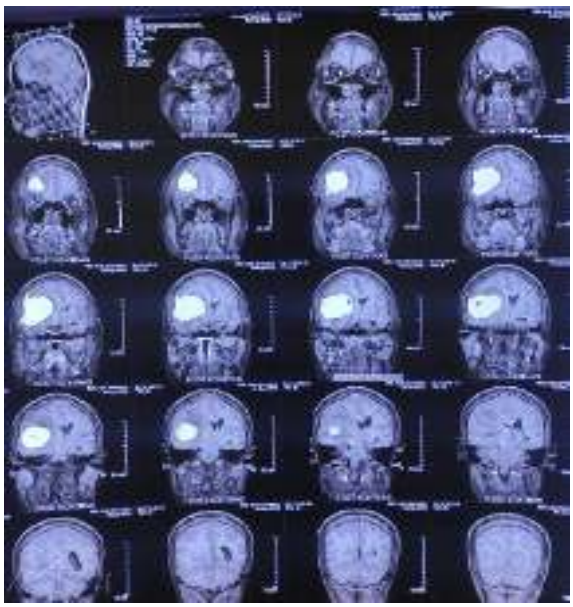

Figure 1. MRI Head

Breathing frequency 20 beats per minute and 99% room air saturation, body weight 75 kg, and height 170 cm with a BMI 26.3 kg/m2. On physical examination, there was a right eye visual deficit of 20/60, but no other neurological deficits or other physical abnormalities were found. In the laboratory, supporting examinations obtained Hb 13.1 and other results within normal limits. From the results of the horax X-ray examination obtained within normal limits, the MRI head obtained extra axial mass in the right temporal base, accompanied by perifocal edema and lateralization as far as 15 mm to the left, right temporal hyperostosis. The patient is prepared in the operating room with preparation for general anaesthesia with total intravenous anesthesia technique. In the operating room, the patient is installed Arterial Blood Pressure (ABP), ECG, oxygen saturation and connected to bispectral index

monitoring. Evalution of pulse, blood pressure, and oxygen saturation.

This patient had a pre-anesthetic pulse of 77 beats/minute, blood pressure of 116/83 mmHg, and oxygen saturation of 98% in room air. Oxygenation with O2 8 L/min through a face mask, and flow towards the front of the patient's face, induction of anaesthesia is carried out with, intravenous anaesthetic agents. Fentanyl 200 mcg, Tiopental 300 mg, Rocuronium 45 mg, Lidocain 100 mg for blunting sympathetic reflexes, the second dose of Tiopental 150 mg 30 seconds before intubation to deepen anaesthetic sedation before laryngoscopy, then the patient is intubated and anaesthesia during surgery is given. O2: Air (50:50) Flow 4 litres per minute with ventilator VC TV 500, PEEP 4, RR 14x/min T insp 1. 7 L then intravenous anaesthetic drugs with Tiopental 150 mg/hour (dose 2 mg / kg / hour), Fentanyl 75 mcg / hour (dose 1 mcg / kg / hour), Dexmedetomidine loading dose (1 mcg / kg) 75 mcg discharged in 15 minutes with a syringe pump (loading dose) then maintenance 52.5 mcg/hour (dose 0. 7 mcg/ kg / hour) and muscle relaxant Rocuronium 22.5 mg/hour (dose of 5 mcg/kg/ minute), haemodynamic monitoring during surgery is stable, of anaesthesia measured from the bispectral index obtained deep sedation with a score of 41, the operation lasted for 3 hours with bleeding 700 cc and crystalloid fluid 1500 cc and colloid 500 cc with urine output in 3 hours 370 cc. At the end of the operation, the intravenous anaesthetic drug was stopped and the patient was made to breathe spontaneously, the patient was extubated after full consciousness and obeyed command by administering analgesics and blunting with lidocain 1.5 mg /kg before extubation.

DISCUSSION

The main purpose of choosing Total intravenous anaesthesia technique in this case is to complete the concept of neuroanesthesia in the form "ABCDEFG" mnemonic with the aim of preventing secondary brain injury and lowering intra cranial pressure (ICP) and Cerebral Blood Flow (CBF) as well as achieving a good level of anaesthetic depth to reduce Cerebral Metabolic Rate (CMR), The concept of -"ABCDEFG" mnemonic is interpreted as airway must always be free, breathing slightly hypocapni, Circulation is good by ensuring sufficient intravascular volume, Drugs are using anaesthetic agents that reduce intracranial pressure, Environment patients are made slightly hypothermic 35 ^{0}C to reduce ICP, as well as the selection of fluids that are slightly hyperosmolar and regulation of Blood Glucose. (9).

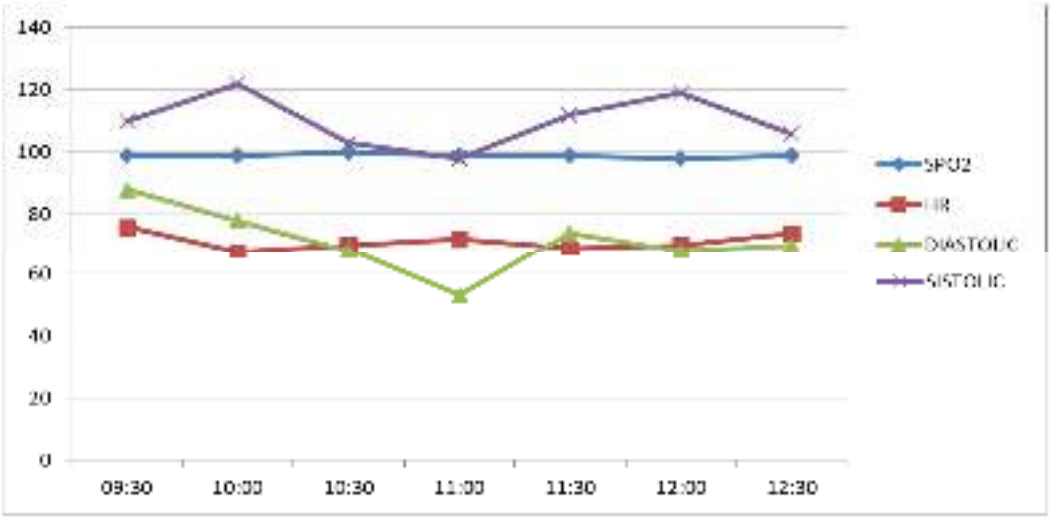

Figure 2. Haemodinamyc Monitoring

Figure 3. Bispectral Index

Figure 4. Intraoperative Blood Gas Analysis

Table 1. Postoperative Follow up

	POD 1
GCS	E4M6V5
BP	136/78 mmHg
HR	88X/minute
RR	16X/minute
SpO_2	99% (NC 3 LPM)
BGA	Ph/PCo2/PO2/HCO3/TCO2/BE/SaO2/ 7.1414/34/185/21.7/-3/100%

Gracia et al 2018 in Medan Hajj Hospital said tha0t intravenous anaesthetic drugs that can reduce ICP and CBF from the induction drug group are thiopental, propofol, etomidate, and midazolam. The aim of this study was to obtain a comparison of haemodynamic responses after the administration of propofol and thiopental as induction drugs in brain surgery under general anaesthesia. From this study they get results that are slightly different from the theory so far, they get the results of significant hemodynamic differences in the administration of thiopental and propofol drugs in brain surgery patients. Thiopental showed lower systolic blood pressure, diastolic blood pressure and mean arterial pressure than propofol for induction (10).

From the research of S.R. Tasbihgo et al 2021 said the unique pharmacodynamic properties of dexmedetomidine as a sedative make it a drug with several advantages when used during selected neurosurgical procedures. Its action through the locus coeruleus causes a state of sedation without respiratory depression, which provides comfort to the patient while still allowing neurological tests to be performed and has minimal effect on monitoring evoked potentials. In addition, it can be used via intranasal administration to provide pre-medication for anxious or mentally impaired, uncooperative patients. Its perioperative role in delirium prevention and neuroprotection has yet to be confirmed (11).

Zhang study in 2022 compared surgery with the use of neuromuscular blocking agents with Rocuronium administered by intermittent and continuous infusion and assessed by motor evoked potential (MEP) and concluded that continuous infusion of rocuronium effectively inhibited the patient's involuntary movements and spontaneous breathing while allowing MEP monitoring (12).

The selection of 4 intravenous anaesthetic agents in the form of Tiopental, Fentanyl, Rocuronium and Dexmedetomidine is because the use of these agents is the best in reducing CMR and CBF so as to reduce ICP, Patients are induced with Tiopental, Fentanyl and Rocuronium and then maintenance of anaesthesia with 4 intravenous anaesthetic agents with syringe pump administration, these agents are Tiopental, Fentanyl, Rocuronium and Dexmedetomidine, based on the literature Tiopental has four main actions on the CNS: hypnosis, CMR depression, CBF reduction due to increased cerebral vascular resistance, and anticonvulsant activity (13). Furthermore, for opioids, Fentanyl was chosen as the main choice because from several studies the administration of other opioids such as Sufentanyl and Alfentanil can increase ICP (14), Rocuronium was chosen as a relaxant because it works with a fast onset and a long duration and does not produce laudanosine metabolic residues such as atracurium, Furthermore, analgesic and sedation agent Dexmedetomidine was added, this drug was chosen because in some literature it is said that the use of dexmedetomidine has also been associated with neuroprotective effects and a decrease in the incidence of delirium (15).

This condition can be seen with controlled intraoperative haemodynamics and heart rate monitored from Arterial Blood Pressure (ABP) with an intraoperative Mean Arterial Pressure (MAP) range of 70-100 mmHg, then we can assess intra-cranial pressure from the normal Central Vein Pressure, and was able to assess the depth of anaesthesia by measuring the electrical activity in the brain with the bispectral index device and obtained adequate results with a value of 41 (8).

The concept of total intravenous anaesthesia used in this operation is not only beneficial for intracranial according to the discussion based on previous journals, another important thing that we can take from the use of total intravenous anaesthesia in tumour removal craniotomy is that we support the preservation of nature and maintain ozone stability, the concept of green anaesthesia in a study conducted by Jasper et al 2023 they recommended 7 concepts for green anaesthesia, namely: Use total intravenous anaesthesia rather than inhalation-based anaesthesia, Use ultra-low fresh gas flow (<0.5 l/min) during inhalation-based anaesthesia and higher flow (4-6 l/min) during total intravenous anaesthesia, Anaesthetic gas capture technology may have limited environmental benefits, while also increasing costs. In the clinical setting, epidural or intravenous analgesia during labour is preferred over nitrogen oxide inhalation. Properly designed air treatment systems save energy and reduce costs. Unused air treatment systems can save up to 70% of energy. Reusable equipment is almost always associated with lower environmental impact and lower costs compared to disposable equipment (16).

CONCLUSION

The principle of Neuroanesthesia with "ABCDEFG" to improve intraoperative conditions and achieve neuroanesthesia targets, the first is Airway by freeing the airway to ensure good oxygenation, Breathing to ensure respiration gas pressure and PCO2 are on target, Circulation to ensure regulating Cerebral Blood Flow and Cerebral Blood Volume, Drug with anaesthetic drugs, especially intravenous agents which are proven to be better at regulating CBF, ICP and reducing CMRO, Furthermore Environment with a target of slight hypothermia, Fluid with the administration of Isoosmolar fluids and Glucose control. Monitoring carried out intraoperatively is monitoring PCO2 with ETCO2 and intraoperative Blood Gas Analysis (BGA) examination, monitoring haemodynamics and intraoperative heart rate monitored from Arterial Blood Pressure (ABP) with a range of Mean Arterial Pressure (MAP) intraoperatively 70-100 mmHg. Furthermore, the selection of anaesthetic drugs with good intra-venous anaesthetic drugs as a neuroanesthetic technique, then for the patient's environment point, the temperature is made with a slight hypothermia with a target temperature of 35 ^{o}C and glucose control and blood glucose checks during intraoperation. Anesthesia technique and intraoperative monitoring for good neuroanesthesia will make the postoperative condition good and recover consciousness faster.

REFERENCES

1. Putri TAK, Prihatin LM, Priyanto B. Meningioma: A Literature Review. J Biol Trop. 2023;23(1):364–70.
2. Ogasawara C, Philbrick BD, Adamson DC. Meningioma: A Review of Epidemiology, Pathology, Diagnosis, Treatment, and Future Directions. Biomedicines. 2021 Mar

21;9(3):319.

3. Siwicka-Gieroba D, Robba C, Gołacki J, Badenes R, Dabrowski W. Cerebral Oxygen Delivery and Consumption in Brain-Injured Patients. J Pers Med. 2022;12(11).
4. Claassen JAHR, Thijssen DHJ, Panerai RB, Faraci FM. Regulation of cerebral blood flowin humans: Physiology and clinical implications of autoregulation. Physiol Rev. 2021;101(4):1487–559.
5. Chong SP, Merkle CW, Leahy C, Srinivasan VJ. Cerebral metabolic rate of oxygen (CMRO_2) assessed by combined Doppler and spectroscopic OCT. Biomed Opt Express. 2015;6(10):3941.
6. Mañago MM, Kimbrell K, Hager ER, Dwight H, Owens J, Bade M. Clinical use of blood flow restriction in people with neurologic conditions: a cross-sectional survey. J Phys Ther Sci. 2022;34(4):275–83.
7. Al-Rifai Z, Mulvey D. Principles of total intravenous anaesthesia: practical aspects of using total intravenous anaesthesia. BJA Educ [Internet]. 2016;16(8):276–80. Available from: http://dx.doi.org/10.1093/bjaed/mkv074
8. You H, Qiao H. Intraoperative Neuromonitoring During Resection of Gliomas Involving Eloquent Areas. Front Neurol. 2021;12(June):1–7.
9. Dinsmore J. Anaesthesia for elective neurosurgery. Br J Anaesth. 2007;99(1):68–74.
10. Gracia CZ, Hanafie A, Nasution AH. Comparison of hemodynamic response between propofol and thiopental as an induction agent in neurosurgery anesthesia at Haji Adam Malik General Hospital Medan-Indonesa. Bali Med J. 2018 Oct 3;7(3).
11. Tasbihgou SR, Barends CRM, Absalom AR. The role of dexmedetomidine in neurosurgery. Best Pract Res Clin Anaesthesiol [Internet]. 2021;35(2):221–9. Available from: https://doi.org/10.1016/j.bpa.2020.10.002
12. Zhang X, Hu H, Yan R, Li T, Wang W, Yang W. Effects of rocuronium dosage on intraoperative neurophysiological monitoring in patients undergoing spinal surgery. J Clin Pharm Ther. 2022;47(3):313–20.
13. Chui J, Mariappan R, Mehta J, Manninen P, Venkatraghavan L. Comparison of propofol and volatile agents for maintenance of anesthesia during elective craniotomy procedures: Systematic review and meta-analysis. Can J Anesth. 2014;61(4):347–56.
14. Wiener J, McIntyre A, Janzen S, Mirkowski M, MacKenzie HM, Teasell R. Opioids and cerebral physiology in the acute management of traumatic brain injury: a systematic review. Brain Inj [Internet]. 2019;33(5):559–66. Available from: https://doi.org/10.1080/02699052.2019.1574328
15. Khan KS, Hayes I, Buggy DJ. Pharmacology of anaesthetic agents I: Intravenous anaesthetic agents. Contin Educ Anaesthesia, Crit Care Pain [Internet]. 2014;14(3):100–5. Available from: http://dx.doi.org/10.1093/bjaceaccp/mkt039
16. Kampman JM, Sperna Weiland NH. Anaesthesia and environment: Impact of a green anaesthesia on economics. Curr Opin Anaesthesiol. 2023;36(2):188–95.