Emergency management of intracerebral haemorrhage in hypertensive, alkalotic patients: a case report

Made Suandika[1,2], *Rahmaya Nova* Handayani[2], *Sekar Mutiara Triya* Suryani[2*], *Yuniar Melissa* Kisdyanti[2], *Valentina Intan Ayu* Puspita[2], and *Mariah* Ulfah[3]

[1]The Graduate Institute of Clinical Medicine Science, College of Medicine, Chang Gung University, Tao-Yuan, Taiwan
[2]Anesthesiology Nursing Study Program, Faculty of Health, Universitas Harapan Bangsa, Indonesia
[3]Nursing Study Program, Faculty of Health, Universitas Harapan Bangsa, Indonesia

Abstract. The high incidence of neurosurgical cases involving anaesthesia poses a challenge for anaesthesiologists. This study is a type of case study with an observational descriptive design in a single case which aims to provide a holistic view and description of interventions in anaesthesia surgery with intubation. This is a case study with an novelty on the surgical management of emergency craniotomy in a patient with intracerebral haemorrhage accompanied by hypertension and metabolic alkalosis. The results obtained in the surgery of intracerebral haemorrhage patients focus on reducing intra cranial pressure, expanding the haematoma, maintaining cerebral homeostatis, managing haemodynamic stability and administering appropriate induction doses with postoperative care is monitoring propofol sedation in improving the quality of controlled sleep in the intensive care unit. The conclusion of this case study is the need for well-coordinated perioperative anaesthetic considerations in cases of intracerebral haemorrhage so that emergency craniotomy surgery can be successful and avoid excessive post-anesthetic complications.

1 Introduction

Intracerebral Hemorrhage (ICH) refers to non-traumatic brain parenchymal bleeding, a stroke type characterized by significant morbidity and mortality [1]. Globally, approximately two million individuals are affected by the most common form of ICH each year, with a third succumbing within the initial month and two survivors facing varied disability levels, vulnerable to recurrent ICH [2]. Immediate treatment of acute intracerebral hemorrhage involves crucial interventions to alleviate symptoms and avert complications. Both perioperative and ward care for ICH patients concentrate on blood pressure reduction and intra-cranial pressure mitigation [3]. In line with research by Manoel (2020) explaining that hyperacute management in ICH patients is the management of breathing, circulation, and prevention of haematoma expansion [4].

* Corresponding author: sekarmutiara11@gmail.com

The first step is to assess the severity score obtained based on the neurological examination. Patients with GCS <8 should be immediately assessed for airway support. Patients with reduced level of consciousness characterised by pupillary changes and/or other signs of herniation should undergo temporary manoeuvres to suppress the increase in Intracranial Pressure (ICP), such as temporary hyperventilation and hyperosmotic including mannitol or 3% saline intervention. CT examination should be performed immediately to determine the diagnosis, location and extent of haemorrhage [5].

Once the bleeding cause and location are identified, surgery is conducted to alleviate brain pressure and eliminate the blood clot. Intraoperative objectives involve removing as many clots as possible, halting the bleeding source. Surgical decisions align with diagnostic findings from X-rays, Computerized Tomography (CT) scan, and Magnetic Resonance Imaging (MRI), synchronized with clinical symptoms like reduced consciousness, elevated blood pressure, muscle weakness decline, and increased Intra Cranial Pressure (ICP). Additionally, acid-base laboratory tests uncover fully compensated metabolic alkalosis tied to uncontrolled hypertension. This scenario may call for a craniotomy or stereotactic aspiration, the aim is to provide a holistic view of the patient's physiological response to the underlying condition and surgical intervention under intubation general anaesthesia [6] [7].

This study has made a useful contribution to the addition of references that support theoretical and applicative understanding in the development of anaesthesiology nursing and perioperative nursing, to anaesthetic nurses can improve anaesthesiology nursing care for ICH patients to reduce complications, to hospital agencies can improve service quality, and to further researchers to develop research with more than a single patient.

2 Method

This study employed a descriptive observational method through a single case study approach on a 49-year-old male patient with a diagnosis of Intracerebral Haemorrhage accompanied by alkalosis and hypertension who underwent emergency craniotomy with general anaesthesia intubation. The sample was carefully selected based on specific parameters related to the research objectives. The instrument in this study used pre, intra, and post anaesthesia assessment with data collected from the patient's medical record, B6 (Breathing, Blood, Brain, Bladder, Bowel, and Bone) physical examination, AMPLE (Allergy, Medical drug, Past Illness, Last meal, and Environtments) examination, laboratory examination results, Head CT Scan examination results, and intensive monitoring of Vital Signs (blood pressure, heart rate, respiration, and oxygen saturation). To strengthen the methodology, this case report has been declared to meet the ethical clearance criteria at the Harapan Bangsa University ethics committee with No.BLPPM-UHB-229/02/2024. Data analysis was performed descriptively, involving observation and interpretation of clinical data to understand the patient's physiological response to perianesthetic interventions, evaluate the effectiveness of anaesthetic and surgical strategies in managing intracerebral haemorrhage accompanied by alkalosis and hypertension, and compare the results with relevant literature.

3 Results and Discussion

3.1 Result

3.1.1 Case History

Here, we report a case of intracerebral haemorrhage with hypertensive and alkalotic who successfully craniotomy surgery under the general anaesthesia with the use volatile agent isoflurane to maintenance intra-anaesthesia. The consent to publish this report was obtained from the patient. A 49-year-old male, weighing 85 kg and measuring 175 cm, presented to the emergency room with a history of nausea, vomiting, and a post-head trauma Glasgow Coma Scale (GCS) score of 4 (Verbal 1 Motoric 1 Eye 2), indicating sopor to comatose consciousness lasting seven hours. Following assessment by emergency department staff, the patient was diagnosed with a Spinal Cord Injury (SCI) accompanied by Intracerebral Hemorrhage (ICH). The patient had a history of uncontrolled hypertension.

The patient exhibited hypertension (180/115 mmHg) along with tachycardia (135 bpm). Respiratory examination revealed dyspnoea (26 breath per minute) and gurgling breath sounds. Oxygen saturation was initially 89%, improving to 95% after 15 liters per minute of Non-Rebreathing Oxygen Face Mask (NRM) assistance and installation of Oropharyngeal Airway (OPA) no.3 to maintain the airway open in decreased consciousness. Laboratory tests indicated leukocytosis, lymphocytosis, and hyperneutrophilia indicating viruses and infections, and cardiac disorders, stroke, and renal failure as shown by elevated HDL, LDL, monocytes, triglycerides, creatinine, SGOT, and SGPT. Arterial blood gas analysis (ABG) before surgery showed fully compensated metabolic alkalosis (Table 1). Plain head CT examination revealed Intracerebral Hemorrharge (ICH) in the right frontal lobe, Intraventricular Hemorrharge (IVH), Subarachnoid Hemorrharge (SAH), and signs of increased intra cranial pressure (ICP) (Figure 2). All of these symptoms will be taken into consideration in providing appropriate perioperative treatment.

HDL: High Density Lipoprotein; LDL: Low-Density Lipoprotein; SGOT: Serum Glutamic Oxaloacetic Transaminase; SGPT: Serum Glutamic Pyruvic Transaminase; pH: Potential of Hydrogen; pCO2: Partial Pressure Of Carbondioxide; pO2: Partial Pressure of Oxygen; BE: Base Excess.

Given the patient's history, clinical signs, and radiological findings, the diagnosis was SCI due to ICH, resulting in decreased consciousness and respiratory distress necessitating an urgent craniotomy. In the preoperative room, the patient received oxygen therapy via an NRM mask at 15 Liters per minute and was administered a Mannitol 20% infusion of 350 mL/15 min, intravenous Furosemide injection of 20 mg, and a Nicardipine 10 mg/10 mL which has been diluted with 40 mL of distilled water infusion via syringe pump at 12,75 mL/h—medications initially provided in the emergency room. Preoperative monitoring included hemodynamic parameters such as pulse, blood pressure, Mean Arterial Pressure (MAP), oxygen saturation, and temperature. Additionally, fluid/electrolyte requirements and arterial blood acid-base balance were closely monitored. The patient received intravenous therapy via two Intravenous (IV) lines: Koloid infusion (Asering) at 500 mL with a rate of 20 drops per minute on one line, and NaCl 0.9% infusion at 500 mL with a rate of 15 drops per minute on the second line. Preoperative premedication consisted of intravenous Ondansetron (4 mg/2 mL) and Dexamethasone (10 mg/2 mL).

Intraoperatively, a general anaesthesia with Endotracheal Tube (ETT) was utilized. Induction involved intravenous Fentanyl (100 mcg/2 ml) for analgesia, intravenous Propofol (200 mg/20 ml) for sedation, and intravenous Atracurium (20 mg/2 ml) as a muscle relaxant. Intubation occurred three minutes after Atracurium administration using a size 3 Macintosh laryngoscope blade, an ET tube size 7, a stylet for assistance, and 5 cc fixation. A No. 3 Oropharyngeal Airway (OPA) was inserted to address airway obstruction related to the

patient's falling tongue, followed by connection to a ventilator for controlled breathing with tidal volumes ranging from 500-800 cc.

Table 1. Laboratory Test Results

Test	Result
Leukocytes	15.23 10^3uL
Erythrocyte's	7.52 million/mm3
Neutrophyls %	41.5 %
Lymphocyte %	47.0 %
Monocytes %	8.9 %
Absolute Lymphocyte	7.2 10^3uL
HDL-Cholesterol	36.4 mg/dL
LDL-Cholesterol	114.3 mg/dL
Triglyceride	150.2 mg/dL
Creatinine	1.46 mg/dL
SGOT	51 u/L
SGPT	105 u/L
BLOOD GAS ANALYSIS	
pH	7.45
pCO2	31.4 mmHg
pO2	111.2 mmHg
BE	- 3.5 mmol/L
HCO3	29.5 mmol/L
SO2	98.4 %

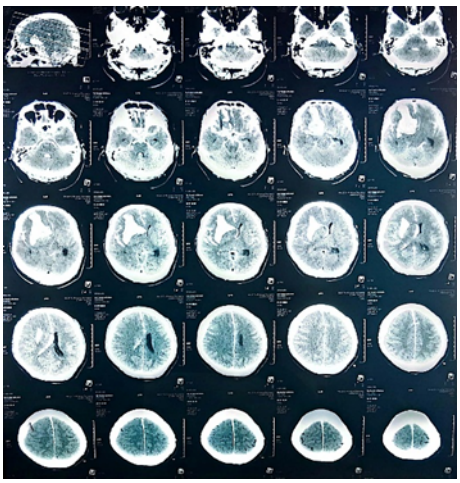

Figure 1. *CT Plain Head (showed ICH in the right frontal lobe, IVH, SAH, and Increased ICP)*

In the intraoperative phase, anaesthesia was maintained with 2 Liters of oxygen, 1.5% Isoflurane inhalation, and Ringer Lactate infusion in Total Intravenous Anaesthesia (TIVA). This was coupled with the administration of Propofol IV (200 mg/20 ml), Fentanyl IV (100 mcg/2 ml), and Atracurium IV (10 mg/1 ml) every 20 minutes was administered to maintain blood pressure below 90 mmHg, considering the patient's history of hypertension in neurosurgery.

The ICH craniotomy procedure lasted for 90 minutes. Postoperatively, the patient with Aldrete score 3 (consciousness 0; activity 0; circulation 1; respiration 1; and saturation 1) was transferred to the Intensive Care Unit (ICU) with no extubation to maintain the patient's airway under the influence of sedation maintained with propofol infusion with the aim of keeping the patient in a controlled sleep state. Therapy carried out in ICU care by observing the patient's consciousness and response, as well as positioning the patient supine by monitoring haemodynamic changes every 5 minutes and maintaining the patient's condition in the range of the level of stability of the patient's general condition in a sustainable and continuous manner.

3.2 Discussion

A sudden onset of Intracerebral Hemorrhage (ICH) leads to increased blood volume in brain tissue, exerting pressure on surrounding nerve tissue and potentially causing focal neurological impairments by disrupting communication between adjacent cells. The Multi Sliced Computerized Tomography (MSCT) findings for the patient, categorized as ASA 4E with a BMI of 29.4 kg/m², revealed ICH, Intraventricular Hemorrhage (IVH), Subarachnoid Hemorrhage (SAH), and elevated Intracranial Pressure (ICP), key focus areas for neuro-anaesthesia [1].

To address elevated ICP, pre-surgical measures involved administering vasodilators and diuretics to mitigate intracranial hypertension, maintaining a consistent Cerebral Perfusion Pressure (CPP) in the normal brain. Interventions like Nicardipine IV titration at 10.0 mL/h, Furosemide injection at 20 mg, and osmotic Mannitol 20% diuretic infusion at 350 ml/15 minutes aimed to minimize ICP elevation. During the operative phase, the intervention goal was to prevent cerebral hypoperfusion and subsequent cardiovascular complications post-surgery [8].

Haemodynamic management is the main focus in the management of surgically treated patients with ICH, which is in line with a study conducted by Messana et al. (2022), who used a 74-question electronic questionnaire survey to identify that cardiovascular complications were the main reason for advanced haemodynamic monitoring in acute brain injury patients, including patients with ICH [9].

In this case, the patient experienced uncontrolled hypertension, prompting the administration of fast-acting antihypertensive therapy in the form of Nicardipine and NaCl syringe pump infusion to prevent post-induction anaesthesia-induced hypotension. Hypotensive events may stem from cerebral vasodilation auto-regulation, leading to increased Cerebral Blood Flow (CBF) and Cerebral Blood Volume (CBV, which contribute to ICP and CPP maintenance. Conversely, hypertensive individuals experience vasoconstriction due to auto-regulation, resulting in decreased CBF and CBV while upholding ICP and CPP. Significant changes in cerebral blood flow beyond the normal range can lead to brain ischemia and damage [10] [11].

The anaesthesia protocol aims to uphold cerebral homeostasis by ensuring perfusion, oxygenation, and managing hemodynamic alterations. Preoperative targeted euvolemia signals the use of osmotic diuretics like mannitol and hypertonic saline or NaCl to acutely increase blood plasma osmolality, reducing brain water content, especially in regions with an

intact Blood-Brain Barrier (BBB), consequently lowering intra-cranial pressure [12]. This response restores brain elasticity, facilitating surgical access [13].

Implementing neuroprotective strategies and balanced anaesthesia, combining TIVA induction with low volatile analgesic concentrations and sedative Propofol (200 mg) takes into account the patient's Body Mass Index (BMI) of 29.4 kg/m² (classified as overweight). Clinical benefits of propofol include its effect on reducing cerebral metabolic rate of oxygen consumption (CMRO2), leading to cerebral vasoconstriction and decreased CBF, CBV, and ICP [14]. Intravenous Nicardipine provided pre-anaesthesia, through syringe pump titration, serves to act as a negative inotrope during surgery, proven to diminish cerebral ischemia and systemic blood pressure by inducing vascular relaxation, boosting cardiac output, and enhancing coronary blood flow for improved myocardial oxygenation [15].

The use of the volatile ruminal agent Isoflurane at a 1.5% MAC concentration in therapy can promote the development of the central nervous system's microvascular network, leading to new blood vessel growth. This practice, associated with minimal risks relating to Intracranial Pressure (ICP) and ischemia, and providing excellent brain relaxation, is a focal point of ongoing intraoperative research. Selection of Isoflurane has shown a reduction in the infarct area and an improvement in neurological function scores [16].

Blood Gas Analysis (BGA) results for the patient indicated a fully compensated metabolic alkalosis with pH at 7.45. Nausea and vomiting contributed to an increase in HCO3 levels to 29.5 mmol/L due to H+ loss from the gastrointestinal tract. Management strategies should focus on addressing hypokalaemia, with a PCO2 of 31.4 mmHg, likely supporting autoregulation by reducing Cerebral Blood Flow to prevent brain oedema [17] [18].

Patients necessitating ventilator support postoperatively are typically transferred to the intensive care unit for continued monitoring to maintain eucapnia [19], based on the Suryadi and Kulsum (2023) technique. This care approach involves not extubating patients as their consciousness diminishes and respiratory complications surface after stroke recovery under neuro-anaesthesia [20]. Moreover, postoperative Propofol dosing is adjusted to ensure patients achieve a controlled, restful sleep state [21] [22].

Emergency craniotomy surgery in ICH patients who have lost consciousness for less than 24 hours is to focus on blood pressure management, the need to administer therapy in chronic hypertension remains within the rules and does not exceed the recommended dose. The administration of calcium antagonists is required in pre-anesthetic control while being limited in intra-anesthetic administration to prevent complications of excessive post-operative blood pressure recovery [23].

4 Conclusion

The anaesthetic plan for patients with ICH cases indicated for immediate craniotomy focuses on lowering intracranial pressure, maintaining cerebral homeostasis, monitoring haemodynamics, it is essential to deliver well-coordinated perioperative induction doses while maintaining adequate perfusion and oxygenation through a balanced selection of anesthetic techniques, and considering controlled sleep quality post-surgery to optimise recovery.

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