RESEARCH PAPER

Anesthesia Management Supratentory Tumors, Cushing Syndrome or Not?

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Abstract
Supratentorial brain tumors are often managed with long term corticosteroid therapy to control vasogenic edema and increased intracranial pressure. Prolonged steroid use can mimic Cushing's syndrome, creating challenges in neuroanesthesia management. Differentiating true Cushing's syndrome from iatrogenic corticosteroid effects is essential for appropriate perioperative steroid replacement. True Cushing's syndrome carries minimal adrenal crisis risk due to preserved hypothalamic pituitary adrenal axis function, whereas exogenous corticosteroids suppress this axis and require different management to prevent perioperative adrenal insufficiency. A 25-year-old female presented with progressive headache over five months, showing clinical signs suggestive of Cushing's syndrome due to dexamethasone 0.5 mg three times daily for eight months. Head CT scan revealed a hypodense mass in the left frontotemporal region with midline shift >5 mm. Laboratory results showed mild hypokalemia (potassium 3.1 mEq/L), but blood pressure and glucose remained within normal limits. Clinical evaluation favored iatrogenic corticosteroid effects over true Cushing's syndrome based on absence of the classic triad of hypertension, hyperglycemia, and severe hypokalemia. Neuroanesthesia management focused on preventing adrenal crisis with hydrocortisone replacement protocol of 25 mg IV intraoperatively followed by 100 mg IV postoperatively for three days. The patient underwent craniotomy under general anesthesia using Total Intravenous Anesthesia (TIVA). The procedure lasted 6.5 hours with 2800 cc blood loss managed with massive transfusion protocol. Recovery was uneventful with no major complications or adrenal crisis. Clinical manifestations resembling Cushing's syndrome in patients with supratentorial tumors require comprehensive evaluation to differentiate true Cushing's syndrome from iatrogenic corticosteroid effects. Proper differentiation determines neuroanesthesia management strategies, where iatrogenic effects require more aggressive steroid replacement protocols to prevent adrenal insufficiency, while true Cushing's syndrome requires different approaches. The successful management of this case emphasizes the importance of understanding underlying pathophysiology for optimal neuroanesthesia outcomes.

Keywords: Anesthetic Management, Cushing's Syndrome, Supratentorial Tumor.
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1. Introduction

Supratentorial brain tumors are intracranial neoplasms located above the tentorium cerebelli, with an incidence of approximately 29 per 100,000 population per year. The pathophysiology of supratentorial brain tumors consistently involves the development of vasogenic edema due to disruption of the blood-brain barrier, which represents the brain tissue's response to the presence of a pathological mass. This vasogenic edema develops through increased cerebral capillary permeability, leading to extravasation of plasma proteins and sodium into the brain extracellular space, ultimately contributing to elevated intracranial pressure (ICP). (Jha et al., 2019; Ostrom et al., 2020; Stokum et al., 2016)

Medical management of supratentorial brain tumors almost always involves the use of corticosteroids, particularly dexamethasone, as first-line therapy to reduce vasogenic edema and control neurological symptoms. Dexamethasone acts by stabilizing the blood-brain barrier, decreasing capillary permeability, and reducing cerebrospinal fluid production, thereby effectively lowering ICP. However, the long-term use of corticosteroids required in brain tumor management may result in complications manifesting as clinical features resembling iatrogenic Cushing syndrome. (de Arriba et al., 2022)

Cushing syndrome has a prevalence of approximately 10 to 15 cases per million population per year and is characterized by clinical manifestations resulting from chronic hypercortisolism. In Cushing syndrome, endogenous cortisol overproduction excessively activates glucocorticoid and mineralocorticoid receptors, leading to hypertension through mechanisms such as sodium retention, increased vascular sensitivity to catecholamines, and activation of the renin angiotensin aldosterone system. Hyperglycemia occurs due to increased

gluconeogenesis, peripheral insulin resistance, and impaired pancreatic insulin secretion, while central obesity results from redistribution of fat from the extremities to the central visceral regions. In contrast, iatrogenic effects caused by exogenous corticosteroid use produce similar clinical features such as moon face, striae, and weight gain, but through mechanisms involving suppression of the hypothalamic pituitary adrenal (HPA) axis as a result of negative feedback on corticotropin releasing hormone (CRH) and adrenocorticotropic hormone (ACTH) secretion. This suppression subsequently leads to adrenal cortical atrophy and reduced endogenous cortisol production. Therefore, the main distinction between the two conditions lies in the origin of hypercortisolism, where true Cushing syndrome is characterized by preserved or even increased HPA axis activity, whereas iatrogenic effects are associated with suppression of the HPA axis. It is also important to distinguish Cushing triad as a separate clinical entity unrelated to Cushing syndrome, as it refers to signs of increased intracranial pressure consisting of hypertension, bradycardia, and irregular respiration. (Fleseriu et al., 2016; Reincke & Fleseriu, 2023)

This complexity raises a fundamental question: do Cushing like clinical manifestations in patients with supratentorial tumors receiving long term corticosteroid therapy represent true Cushing syndrome, or are they attributable to the location and effects of the supratentorial tumor itself, such as increased intracranial pressure or possible hormonal disturbances, although the latter are very rare. Anesthetic management strategies in such cases present a challenge for neuroanesthesiologists and neurocritical care specialists, particularly in providing perioperative corticosteroid replacement therapy and preventing adrenal crisis.

2. Case

2.1 Anamnesis

The patient presented with intermittent headaches that began five months prior to hospital admission, with progressive worsening over the preceding three months, although the symptoms remained responsive to oral analgesic therapy. There were no associated symptoms of decreased level of consciousness, seizures, visual field deficits, fever, behavioral changes, or a history of head trauma. The patient initially presented to the emergency department of Radjak Hospital, where a noncontrast head computed tomography scan was performed, leading to the diagnosis of a brain tumor. The patient was subsequently hospitalized for six days and discharged in improved clinical condition, after which the patient was referred to Siloam Purwakarta Hospital and advised continuing further management at the Neurosurgery outpatient clinic of RSHS. As part of preoperative preparation, the patient was scheduled for six hours of preoperative fasting and has been receiving dexamethasone therapy at a dose of 0.5 mg three times daily for the past eight months. The past medical history was unremarkable, with no history of hypertension, diabetes mellitus, prior surgery, drug allergies, or other ongoing medications. Notable findings included a history of hormonal contraceptive use for approximately eight years to date, a weight gain of approximately 15 kg over the preceding eight months, and irregular menstrual cycles over the past several months.

2.2 Physical Examination

General Status:

The patient presented with a Glasgow Coma Scale score of E4M6V5. Blood pressure was 104/78 mmHg with a mean arterial pressure of 86.7 mmHg, heart rate 108 beats per minute, respiratory rate 20 breaths per minute, body temperature 36.9 °C, and oxygen saturation 96% while breathing room air with a fraction of inspired oxygen of 21%.

Local Examination

On thoracic examination, bilateral vesicular breath sounds were symmetrical, with no rales or wheezing. Cutaneous striae were noted, and the face appeared rounded, consistent with a moon face.

Neurological Status

The patient was fully conscious with a Glasgow Coma Scale score of 15, and no signs of nuchal rigidity were observed. Pupillary examination revealed bilaterally equal pupils measuring 3 mm in diameter, isocoric, with intact light reflexes in both eyes. Visual acuity in both eyes was greater than 6/60. Funduscopic examination demonstrated well defined optic disc margins bilaterally. Extraocular movements were within normal limits. Examination of the remaining cranial nerves revealed no abnormalities. Motor function was intact with no evidence of paresis, sensory examination was within normal limits, physiological reflexes were preserved bilaterally, and no pathological reflexes were elicited.

2.3 Supporting Examinations:

Laboratory

Laboratory results showed a hemoglobin level of 14.7 g/dL, hematocrit 42.7%, leukocyte count 11,500 per microliter, and platelet count 276,000 per microliter. Prothrombin time was 12.0 seconds with an international normalized ratio of 0.86, and activated partial thromboplastin time was 35.90 seconds. Serum electrolyte analysis revealed a sodium level of 139 mEq per liter and a potassium level of 3.1 mEq per liter. Random blood glucose was 91 mg per deciliter. Liver function tests showed serum glutamic oxaloacetic transaminase of 13 units per liter and serum glutamic pyruvic transaminase of 16 units per liter. Renal function parameters

demonstrated a urea level of 15.9 mg per deciliter and a creatinine level of 0.53 mg per deciliter.

Contrast-Enhanced CT scan

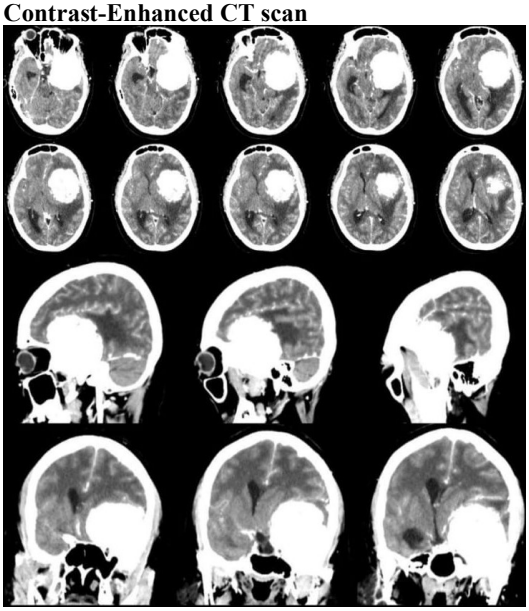

Figure 1. Contrast-Enhanced Head CT scan

Findings:

- Compression of sulci and gyri
- Compression of the Sylvian fissure
- Ventricular compression
- Cisterns not compressed
- Hypodense mass in the left frontotemporal region
- Hyperostosis of the left sphenoid and temporal bones
- Positive midline shift > 5 mm to the right

Diagnosis

Left supratentorial frontotemporal tumor, suspected meningioma, with suspected Cushing syndrome.

2.4 Anesthesia Management

Planned Procedure: Cranioplasty and craniectomy with tumor removal

Preoperative:

The patient was fasted for 6 hours prior to surgery. The primary identified clinical problem was an intracranial mass (supratentorial space-occupying lesion) with clinical manifestations of increased intracranial pressure. Potential complications included hemorrhage, infection, cerebral edema, tumor location–related effects on vital functions, and the risk of adrenal crisis due to long-term steroid use, with cerebral edema identified as an actual ongoing concern. The patient was classified as American Society of Anesthesiologists (ASA) physical status II, with a planned anesthetic technique of general anesthesia (GA).

Maintenance intravenous fluids were administered using Ringerfundin at 100 mL/hour. Intravenous access was established using a three-way line. Blood products were prepared for potential intraoperative transfusion. Complete anesthetic equipment and monitoring were applied, including end-tidal carbon dioxide ($etCO_2$), invasive blood pressure (IBP), non-invasive blood pressure (NIBP), peripheral oxygen saturation (SpO_2), electrocardiography (ECG), and urine output monitoring. The patient was positioned supine.

Anesthetic Management

Anesthesia induction was achieved with fentanyl 200 µg, propofol administered via target-controlled infusion (TCI) at a target concentration of 5 µg/mL, and rocuronium 50 mg for muscle relaxation. Anesthesia was maintained with propofol TCI at 2–3 µg/mL and remifentanil at 0.25–0.5 µg/kg/min.

Intraoperative Course

The surgical procedure lasted 6 hours and 30 minutes. Estimated intraoperative blood loss was approximately 2,800 mL. Fluid therapy consisted of 3,000 mL of crystalloids, 1,500 mL of colloids, 550 mL of packed red cells (PRC), and 300 mL of fresh frozen plasma (FFP). Hydrocortisone 25 mg IV was administered intraoperatively to prevent adrenal crisis. Throughout the procedure, the patient's hemodynamic status remained stable, with no major anesthetic complications observed.

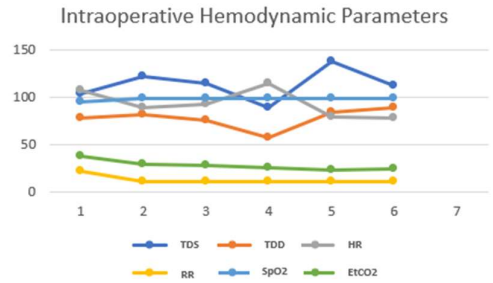

Figure 2. Intraoperative Hemodynamic Parameters

2.5 Postoperative Management

After completion of surgery, the patient was transferred to the intensive care unit with the head elevated at 30 degrees to prevent increased intracranial pressure. Ventilatory support was provided as required, and close monitoring was continued. Postoperative laboratory evaluation revealed a hemoglobin level of 10.5 g/dL, hematocrit of 31.9 percent, leukocyte count of 17,540 per microliter, and erythrocyte count of 3.79 million per microliter. The platelet count was 402,000 per microliter. Erythrocyte indices showed a mean corpuscular volume of 84.2 femtoliters, mean corpuscular hemoglobin of 27.7 picograms, and mean corpuscular hemoglobin concentration of

32.9 percent. Red cell distribution width-coefficient of variation was 15.9 percent, and red cell distribution width-standard deviation was 47.6 femtoliters. Random blood glucose level was 122 mg/dL. Electrolyte analysis demonstrated a sodium level of 135 mEq/L and a potassium level of 4.3 mEq/L.

Postoperative therapy included fentanyl at a rate of 25 micrograms per hour administered via syringe pump for analgesia, hydrocortisone 100 milligrams intravenously continued for three days, and maintenance fluids with Ringerfundin at 100 mL per hour. Additional therapy was provided based on neurosurgical evaluation. During the ICU stay, the patient's hemodynamic and respiratory status remained stable. No adrenal crisis or other complications were observed. The patient's level of consciousness gradually improved with adequate intensive care.

3. Discussion

The incidence of primary malignant brain and central nervous system tumors in the United States is approximately 7.08 per 100,000 population, with nearly 50 percent comprising glioblastoma, which has a median survival of 14.6 months and a five-year survival rate of 6.8 percent. Approximately 60 percent of these tumors are located in the supratentorial region, making early surgical resection crucial (Soto et al., 2023). Brain tumors occur more frequently in males and are predominantly supratentorial, although certain tumor types are found in the posterior fossa. Indonesian data show similar patterns, with 54 percent of tumors located supratentorially, a predominance in males of 67 percent, and the most common histological types being pilocytic astrocytoma, medulloblastoma, and craniopharyngioma. (Putra et al., 2019)

In the present case, a 25-year-old woman with a left frontotemporal supratentorial tumor suspected to be a meningioma illustrates the application of neuroanesthetic management principles. Preoperative evaluation emphasized neurological assessment, including Glasgow Coma Scale score and focal neurological deficits, as well as radiological evaluation to determine tumor size, midline shift, and signs of increased intracranial pressure. The patient presented with a Glasgow Coma Scale score of 15 and a history of progressive headache for five months. Computed tomography imaging revealed a hypodense mass with a midline shift greater than 5 mm, indicating significant intracranial hypertension with important implications for anesthetic strategy.

The Cushing like clinical manifestations observed in this case were more suggestive of iatrogenic corticosteroid effects. Dexamethasone, as a potent glucocorticoid, can suppress the hypothalamic pituitary adrenal axis through negative feedback mechanisms, even after low dose use for two to four weeks. Clinical findings such as moon face, striae, weight gain, and menstrual irregularities support an iatrogenic etiology, whereas the absence of hypertension, hyperglycemia, and severe hypokalemia argues against true endogenous Cushing syndrome. Nevertheless, definitive diagnosis requires specific hormonal investigations. (Reincke & Fleseriu, 2023)

The diagnosis of Cushing syndrome requires primary screening tests such as 24 hour urinary free cortisol measurement, late night salivary cortisol, and the low dose one milligram dexamethasone suppression test, followed by adrenocorticotropic hormone measurement to differentiate adrenocorticotropic hormone dependent and independent forms, with further investigations as indicated (Balomenaki et al., 2022). The Endocrine Society guidelines recommend at least one highly accurate screening test, with a cortisol cutoff value below 1.8 micrograms per deciliter on the one milligram dexamethasone suppression test to exclude Cushing syndrome, achieving a sensitivity of up to 95 percent. (Fleseriu et al., 2021)

Clinical and laboratory analyses in this case were more consistent with suppression of the hypothalamic pituitary adrenal axis due to exogenous steroid use rather than endogenous Cushing syndrome, supported by normal blood pressure and glucose levels and only mild hypokalemia (Wang et al., 2025). Differentiation between exogenous and endogenous hypercortisolism requires a systematic approach that integrates clinical findings, laboratory data, and medication history. (Woodcock et al., 2020)

Neuroanesthetic management requires particular attention to adrenal function in patients receiving long term dexamethasone therapy. A dexamethasone dose of 1.5 mg per day, equivalent to approximately 10 mg of prednisolone, still carries the potential to suppress the hypothalamic pituitary adrenal axis. The perioperative hydrocortisone supplementation administered in this case, consisting of 25 mg intravenously intraoperatively followed by 100 mg per day postoperatively, was consistent with recommendations for major surgery, with close monitoring of hemodynamics, electrolytes, and glucose levels to prevent adrenal crisis. (Wang et al., 2025)

The primary anesthetic goals during supratentorial tumor resection are optimal brain relaxation, corresponding to a brain relaxation score of 1 to 2, which is particularly important in cases with large mass lesions and midline shift exceeding 5 mm (de Arriba et al., 2022). Strategies include head up positioning at 30 degrees, mild hyperventilation with a target arterial carbon dioxide tension of 30 to 35 mmHg, administration of mannitol or diuretics, temperature control, and

maintenance of adequate cerebral perfusion pressure. Total intravenous anesthesia based on propofol was selected because it provides superior brain relaxation compared with inhalational anesthesia.(de Arriba et al., 2022)

The selection of hydrocortisone was based on its pharmacological similarity to endogenous cortisol, its mild mineralocorticoid activity, intermediate duration of action, and flexibility for titration during surgical stress (Woodcock et al., 2020). Alternative corticosteroids may be used with appropriate dose equivalence calculations and close monitoring, ideally with endocrinology involvement for long term management. (Chen Cardenas et al., 2023)

Total intravenous anesthesia using propofol and remifentanil provides excellent hemodynamic control and facilitates rapid neurological recovery (Subagyo & Nofiyanto, 2024). Remifentanil is advantageous because its pharmacokinetics are independent of renal and hepatic function, allowing rapid titration and early postoperative neurological assessment, with transition analgesia provided by longer acting opioids. (Son et al., 2021)

The intraoperative blood loss of 2,800 mL reflected the highly vascular nature of meningiomas and was managed with appropriate fluid resuscitation and transfusion according to massive bleeding principles, supported by invasive monitoring. Postoperatively, the patient was managed in the intensive care unit with head up positioning, adequate analgesia without compromising neurological evaluation, and continuation of hydrocortisone therapy to prevent adrenal insufficiency. (Subagyo & Nofiyanto, 2024)

In patients with central obesity, heightened vigilance is required regarding airway management and respiratory complications, with intraoperative strategies including optimal preoxygenation, strict respiratory monitoring, and prevention of thromboembolic events. (Elshazly et al., 2021; Hardt & Wappler, 2023)

Massive transfusion management was conducted in accordance with established protocols, including appropriate replacement of fluids and blood components, prevention of hypothermia and coagulopathy, and serial laboratory monitoring (Subagyo & Nofiyanto, 2024). Administration of fresh frozen plasma should be selective because it has not been proven beneficial in the absence of coagulopathy and carries a risk of serious complications. (Lawrence & Siau, 2022; Porchezhian et al., 2023; Sakhariya et al., 2024)

Overall, this case demonstrates the successful application of comprehensive neuroanesthetic management, achieving hemodynamic stability, effective control of massive intraoperative bleeding, and favorable postoperative outcomes without major complications.

4. Conclusion

This case illustrates the importance of a critical and comprehensive evaluation in distinguishing true Cushing syndrome from the iatrogenic effects of long term corticosteroid use in patients with supratentorial brain tumors. Although the patient exhibited several clinical features resembling Cushing syndrome, there was no laboratory evidence supporting endogenous cortisol overproduction, and the symptoms developed in temporal association with dexamethasone therapy, favoring an iatrogenic etiology. The neuroanesthetic management implemented was consistent with perioperative principles for patients at risk of adrenal insufficiency, including the use of an appropriate steroid replacement protocol and close perioperative monitoring. Anesthetic management using a total intravenous anesthesia technique, comprehensive massive bleeding management, and postoperative care in the intensive care unit were carried out optimally without major complications. This case underscores the importance of a multidisciplinary approach and careful endocrinological considerations in the management of brain tumor patients with a history of chronic steroid use, in order to avoid diagnostic errors and serious complications such as adrenal crisis.

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