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Perioperative Complications and Critical Care Management of a Patient with Pituitary Tumor Undergoing Endoscopic Endonasal Transsphenoidal Surgery (EETH)

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ABSTRACT

Pituitary tumours often necessitate complex surgical interventions, such as Endoscopic Endonasal Transsphenoidal Surgery (EETH), which carry significant perioperative risks, including fluid and electrolyte imbalances. This case report presents the critical care management of a 44-year-old male, Mr. N, who underwent EETH for a suspected craniopharyngioma. Mr N presented with progressive neurological symptoms, including headaches, right temporal hemianopia, and difficulty walking. Imaging revealed a large suprasellar mass and non-communicating hydrocephalus, leading to the placement of a Ventriculoperitoneal (VP) shunt prior to surgery. During the EETH procedure, the patient experienced a massive intraoperative haemorrhage of 4500 mL, necessitating the activation of a Massive Transfusion Protocol (MTP) and aggressive resuscitation efforts. Postoperatively, Mr. N was admitted to the ICU for intensive monitoring. His recovery was complicated by severe anaemia, cerebral salt wasting (CSW), and multiple episodes of cardiac arrest. Fluid resuscitation, electrolyte correction, and antimicrobial prophylaxis were initiated to stabilize the patient and prevent infection. Despite these interventions, Mr N's condition continued to decline, leading to family discussions on resuscitation preferences. Mr N ultimately succumbed to the complications related to a massive haemorrhage and critical care challenges. This case underscores the complexities of managing patients post-EETH and highlights the importance of a multidisciplinary approach and vigilant monitoring. Successful perioperative management in pituitary surgery requires anticipating complications like CSW and implementing rapid response protocols. Maintaining fluid and electrolyte balance is essential to improving outcomes in neurosurgical interventions.

Keywords: *Endoscopic Endonasal Transsphenoidal Surgery, Pituitary Adenoma, Vascular Injury, Massive Transfusion Protocol, Cerebral Salt Wasting Syndrome, Diabetes Insipidus, SIADH.*

1. INTRODUCTION

Fluid and electrolyte imbalances often occur in patients after surgery involving the hypothalamus and the posterior pituitary. Some conditions that may arise include central diabetes insipidus (DI), syndrome of inappropriate antidiuretic hormone release (SIADH), and cerebral salt wasting (CSW) [1]. In addition, DI, SIADH, and CSW have been reported to be associated with several neurosurgical conditions, especially after pituitary gland surgery or as sequelae of posttraumatic brain injury. Therefore, neurosurgeons should anticipate disturbances in water homeostasis after removing tumours from the sellar/suprasellar region and be prepared to treat them aggressively [2]. Delayed diagnosis and inadequate management can worsen neurological conditions, resulting in high mortality rates [1].

Diabetes insipidus (DI) is a rare disorder that affects approximately 1 in 25,000 people, or approximately 0.004% of the global population [3], [4]. DI is characterized by the inability of the body to concentrate urine, resulting in hypotonic urine and an increased urine volume. This condition can arise from a deficiency of antidiuretic hormones or unresponsiveness to their action in the renal tubules [3]. There are two main classifications of DI: central diabetes insipidus (CDI), characterized by deficiency of the posterior pituitary gland to release ADH, and nephrogenic diabetes insipidus (NDI), characterized by resistance of the distal terminal convoluted tubule and collecting duct to ADH [4].

CSW and SIADH are potential causes of hyponatremia in central nervous system (CNS) diseases [5], [6]. It is important to distinguish between Cerebral Salt Wasting and SIADH because they are treated with opposing treatment strategies [5]. SIADH is defined as the unsuppressed release of antidiuretic hormone (ADH) from the pituitary gland or non-pituitary sources or its continued action on vasopressin receptors [7]. In CSW, patients are administered fluid and sodium

supplementation, whereas in SIADH, patients are fluid-restricted. Brain salt reduction tends to resolve within weeks to months of disease onset but can remain a chronic problem. The main theories for the pathophysiology of CSW include the release of brain natriuretic peptide (BNP) or hypothalamic damage, followed by sympathetic nervous system dysfunction [5].

Haemorrhage remains a significant cause of preventable death [8]. Management of patients with considerable haemorrhage often requires immediate administration of multiple blood products, termed massive transfusion (MT) [9]. Rapid transfusion of large volumes of blood products is required in patients with hemorrhagic shock, which can cause a unique set of complications. Recently, protocol-based management of these patients, using massive transfusion protocols, has shown improved outcomes [8]. Massive transfusion involves the administration of ≥ 10 units of whole blood or packed red blood cells (PRBCs) within 24 hours. The primary goal of massive transfusion is to prevent the fatal outcome of critical hypoperfusion while attempting to achieve hemostasis through surgical intervention, endoscopy, interventional radiology, or alternative interventions [10].

Preoperative antibiotic prophylaxis involves administering antibiotics before surgery to reduce the risk of postoperative infection. The evidence supporting the routine use of preoperative antibiotic prophylaxis continues to increase. Routine antibiotic prophylaxis is standard in cases where patients will have artificial implants or foreign bodies implanted as part of the procedure, bone grafting procedures, or other surgeries with extensive surgical intervention and expected higher blood loss [11].

Endoscopic endonasal transsphenoid surgery (EETS) is increasingly used for pituitary lesions [12]. EETS is a safe and effective treatment for pituitary apoplexy [13]. The use of neuronavigation, appropriate postoperative endocrine function care, establishing pituitary centres of excellence, and more focused use of endoscopy may improve outcomes [12]. The application of contemporary endoscopic technology to the anterior skull base approach has transformed the perioperative setting for patients who require pituitary surgery. Using a multidisciplinary unit in management decision-making facilitates the delivery of optimal care. The evolution of technology and surgical expertise in pituitary surgery requires an ongoing review of all the components of care that are important to these patients [14].

2. PATIENT INFORMATION

Mr N, a 44-year-old male, initially presented with non-communicating hydrocephalus suspected to be caused by an extra-axial tumour, likely a pituitary macroadenoma, leading to a ventriculoperitoneal (VP) shunt placement via the Kocher point. The patient subsequently experienced visual and neurological symptoms, including right temporal hemianopia and early optic atrophy due to compressive optic neuropathy, necessitating Endoscopic Endonasal Transsphenoidal Surgery (EETS). Over time, Mr N reported progressive symptoms, including difficulty walking, intermittent headaches, worsening cognitive and communication abilities, and increased urinary and faecal incontinence. These symptoms, coupled with blurred vision and persistent headache, led to a diagnosis of a suspected space-occupying lesion, possibly a craniopharyngioma, confirmed by a head CT scan showing a solid mass in the suprasellar region. After undergoing a second VP shunt surgery in March 2023 to address hydrocephalus, Mr N underwent another EETS in September 2023. Postoperatively, he demonstrated stable physiological and metabolic conditions, maintaining a clear airway, stable cardiovascular status with a heart rate of 74 beats per minute, blood pressure of 110/80 mmHg, and normal renal and liver functions. Neurological assessments confirmed that he was alert, with a Glasgow Coma Scale score of 15 and no evident neurological deficits. The radiological assessment showed no signs of lung or bone metastasis, and the placement of the VP shunt was verified as correct, indicating a stable postoperative condition without any immediate complications.

3. CLINICAL FINDINGS

An MRI conducted on September 17, 2023, revealed a heterogeneous mass with enhancement, cystic components, and calcifications measuring approximately 3.3 x 2.3 x 4.4 cm in the suprasellar area, indicative of craniopharyngioma and non-communicating hydrocephalus. MRI confirmed that the previously installed shunt in the right lateral ventricle effectively managed the right-sided hydrocephalus (Figure 1). After consultation with a neurosurgery consultant and multidisciplinary team, the patient was scheduled for Endoscopic Endonasal Transsphenoidal Surgery (EETS) under general anaesthesia, which included intubation and total intravenous anaesthesia with propofol, along with extensive monitoring setups. Presurgical preparations included setting up three large IV lines, an arterial blood pressure monitor, and an SPG block with 0.5% ropivacaine. The surgery commenced with rigorous protocols to maintain hemodynamic stability, using Fentanyl, Propofol, and Rocuronium for anaesthesia and Ropivacaine for the SPG block. The surgery, which began at 09:15, was initially successful, with approximately 40% of the tumour removed by 11:35 (2 hours 20 minutes). However, significant challenges arose when massive bleeding of approximately 4500 ml occurred within three minutes, necessitating immediate resuscitative efforts, including fluid, colloid administration, and uncrossed blood transfusion. The patient's condition stabilized after intensive intervention, and he was transferred to the ICU for ongoing monitoring, underscoring the complexity and risks associated with the surgical management of craniopharyngioma.

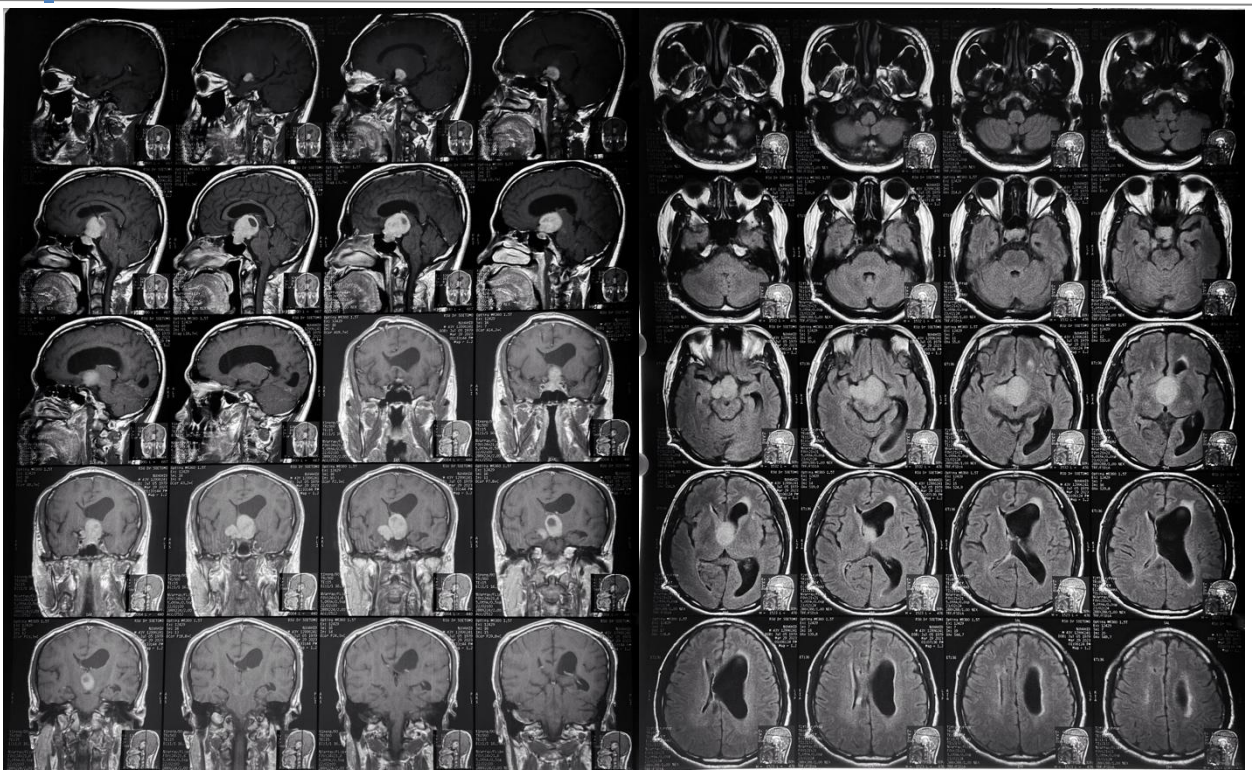

Figure 1. MRI results

The MRI results show a heterogeneously enhancing solid mass with cystic components and calcifications, measuring approximately 3.3 x 2.3 x 4.4 cm in the suprasellar region, suggesting a craniopharyngioma. This benign tumour is located near the pituitary gland, potentially affecting the function of this critical endocrine organ and adjacent structures like the optic chiasm. The images also indicate non-communicating hydrocephalus, where cerebrospinal fluid (CSF) flow is obstructed, increasing intracranial pressure. A ventriculoperitoneal (VP) shunt has been installed to alleviate this condition, with its distal tip in the right lateral ventricle and the insertion port in the posterior parietal region of the right side. This shunt placement has successfully corrected the right-sided hydrocephalus, as the MRI shows.

4. FOLLOW-UP AND OUTCOMES

On postoperative day 1, the patient exhibited a critical condition with a low haemoglobin level of 8.9 g/dL and a hematocrit of 26.8%, indicative of significant surgical bleeding-induced anaemia. Hypokalemia with a potassium level of 2.7 mmol/L and a reduced albumin level of 3.01 g/dL was also noted, suggesting potential acute catabolic effects or protein loss. Respiratory efficiency was confirmed by a FiO_2 of 40%, a pH of 7.30, a low pCO2 of 39 mmHg, and a normal-range P/F ratio of 367.5. By Day 2, there were improvements across various parameters, including haemoglobin and hematocrit levels, with potassium levels approaching normal. However, elevated liver enzymes and kidney stress markers signalled ongoing metabolic stress, although still within manageable limits, with a P/F ratio improvement of 420, indicating better respiratory function (Table 2).

In the ICU, mechanical ventilation supported optimal % oxygen saturation of 98% despite suboptimal capillary refill time, suggesting persistent perfusion challenges. Active fluid resuscitation and carefully managing fluids and electrolytes were implemented to address the significant fluid deficit. On the second day, hemodynamic stability was noted, with improved perfusion. Radiological assessments confirmed the correct placement of the Endotracheal Tube and Central Venous Catheter without structural abnormalities in the heart and lungs. Despite these positive signs, the patient remained under intensive monitoring to manage potential complications such as anaemia, metabolic stress, and the effects of a residual mass and subarachnoid haemorrhage, as revealed by postoperative imaging. This vigilant care stabilises the patient's condition and supports optimal recovery.

5. INTERVENTION

On the third postoperative day, Mr N remained in the ICU on ventilator support in spontaneous mode with a pressure support of 12, PEEP of 5, and FiO2 at 50%, maintaining stable oxygen saturation at 96%. His hemodynamics were stable, with a heart rate of 126 beats per minute and blood pressure of 142/87 mmHg without pharmacological support. Continuous medications include sedatives, antibiotics, anticonvulsants, and other therapies to manage metabolic imbalances and fluid levels. The urine output was adequate at 2400 ml over 24 h, suggesting effective fluid management. On the same day, the patient underwent embolization and angiography to manage his intracranial condition, highlighting the complexity of his treatment with a regimen of Ringer's Fundin, Dextrose, and enteral nutrition.

Despite stable respiratory settings and hemodynamics, the following day's assessment showed suboptimal perfusion, including pallor and cold extremities, spontaneous bleeding, and decreased urine output. The laboratory results indicated persistent anaemia and hypoalbuminemia, revealing ongoing nutritional and metabolic challenges (Tables 1 and 2). Transfemoral Cerebral Angiography revealed an aneurysm in the left internal carotid artery, which was successfully treated with coil embolization (Figure 2). However, N's condition worsened, leading to cardiac arrest on September 20, 2023, which required CPR and adrenaline administration, eventually restoring the spontaneous circulation. Sadly, the patient experienced another cardiac arrest on September 21, and after a discussion with the family, a decision for Do Not Resuscitate (DNR) was made in light of his critical condition.

Table 1. Mr N measurement of laboratory parameters before and after surgery.

Variables (min values)/Date	Pre-op	Post- op			
	14-9-2023	16-09-2023	17-09-2023	19-09-2023	20-09-2023
Hemoglobin (F: 12 g/dL; M: 13.5 g/dL for males)	14.4	8.9	10.7	9.1	9.0
Hematocrit (36% for females, 41% for males)	41.9	26.8	31.7	27.3	26.5
White Blood Cells (4,500 cells/uL)	8.460	11.020	15.930	9.950	12.050
Platelet (150,000 cells/uL)	409.000	171.000	214.000	168.000	189.000
PPT/aPTT (11 /25)	10.8 / 34.1	-	-	-	-
Fasting Blood Glucose (70 mg/dL)	103	189	107	98	121
Sodium (135 mEq/L)	140	142	153	138	132
Potassium (3.5 mEq/L)	4	2.7	3.4	3.8	6.7
Chloride (96 mEq/L)	107	109	119	104	95
BUN (6 mg/dL)/ SC (F: 0.6 mg/dL; M: 0.7 mg/dL)	9/ 1.0	9 / 1	-	-	62.2/5.9
Albumin (3.5 g/dL)	4.4	3.01	3.76	2.88	2.27
SGOT/SGPT (10 U/L; 7 U/L)	17 / 19	25/28	-	-	282/151
Bilirubin D/T (0 mg/dL;0.1 mg/dL)	-	0.7/1.3	-	-	-

Notes: F, female; M, male; uL, microliter; PPT/aPTT: Prothrombin Time/Activated Partial Thromboplastin Time, Sc: Serum Creatinine, SGOT/SGPT (Serum Glutamic-Oxaloacetic Transaminase/Serum Glutamic-Pyruvic Transaminase, Bilirubin D/T (Bilirubin Direct/Total).

Table 2. Mr N's respiratory and blood gas parameters follow up after surgery

Post-op variables	17-09-2023	19-09-2023	20-09-2023
FiO2 (>20%)	40	60	80
pH (7.35-7.45)	7.44	7.36	7.26
pCO_2 (35-45 mmHg)	36	44	39
pO2 (75-100 mmHg)	168	81	60
HCO_3 (22-26 mEq/L)	24.5	24.9	18.3

Post-op variables	17-09-2023	19-09-2023	20-09-2023
BE (-2 to +2 mEq/L)	0.3	-0.5	-8.4
SO_2 (95-100%)	100	95	87
P/F ratio (300-500 mmHg)	420	135	75

Notes:
FiO2: fraction of inspired oxygen
pH: power of hydrogen
pCO_2: partial pressure of carbon dioxide,
pO_2: partial pressure of oxygen
HCO_3: bicarbonate
BE: base excess
SO_2: oxygen saturation
P/F Ratio: PaO2/FiO2 Ratio

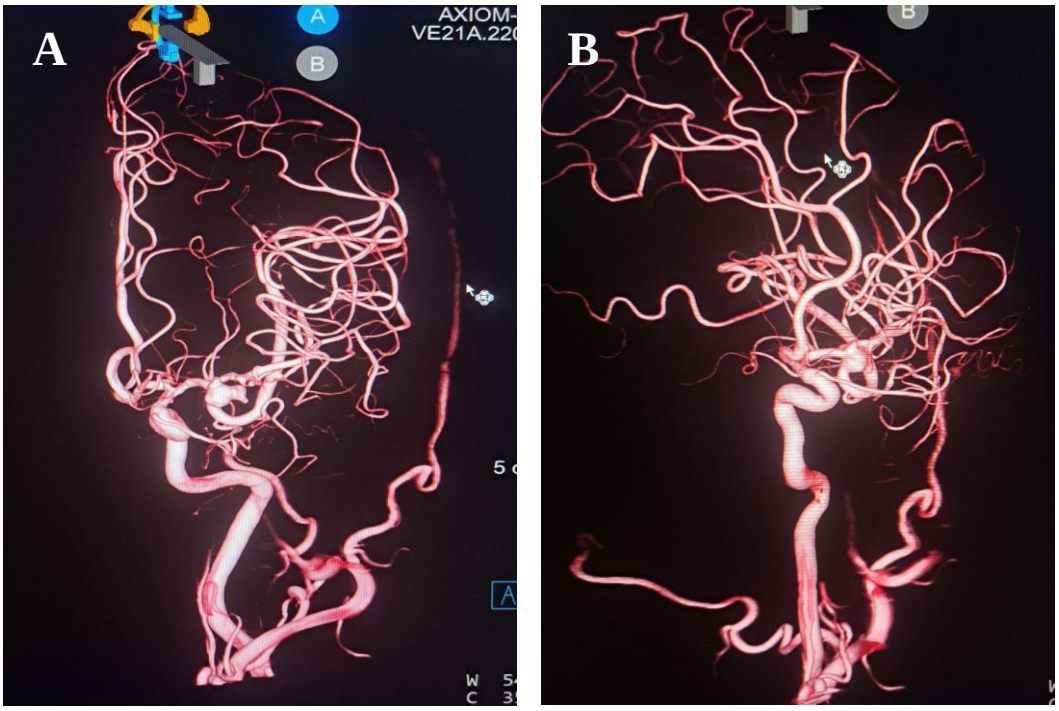

Figure 2. Transfemoral cerebral angiography results of Mr. N. A) Right internal carotid artery showed no evidence of aneurysms, dissections, or other vascular malformations. B) Left internal carotid artery revealed an aneurysm on the left posterior communicating artery, with a dome measuring 3.3 x 2.6 mm and a neck of 2.07 mm. No aneurysms or vascular abnormalities were identified in the right vertebral artery.

6. DISCUSSION

The perioperative management of pituitary adenomas and related sellar or parasellar pathologies demands a comprehensive, multidisciplinary approach, with a specialised team consisting of neurosurgeons, endocrinologists, otolaryngologists, ophthalmologists, radiation oncologists, pathologists, neuro-oncologists, and radiologists coordinating care [14]. A thorough preoperative examination to identify potential challenges like a problematic airway is essential to perioperative planning.[18] Symptoms such as visual field deficits, diplopia, headaches, nausea, or lethargy, which vary by the tumour's size, invasion, and hormonal activity, underscore the necessity for tailored surgical and anaesthetic plans [15]. Preoperative assessments, including anterior rhinoscopy and flexible nasal endoscopy, are vital for identifying septal deviations, perforations, polyps, mucous build-up, or nasopharyngeal swelling, optimising the sinonasal tract to reduce intraoperative bleeding, and improving postoperative nasal symptoms, thereby enhancing patient recovery and outcomes [16], [17], [18].

Preoperative testing is integral to assessing a patient's readiness for pituitary surgery, requiring a comprehensive baseline hormone panel, including TSH, free T4, prolactin, GH, ACTH, cortisol, serum sodium, and sex hormones, alongside screening for bleeding diathesis through complete blood count and coagulation profiles [19]. Patients presenting with conditions like acromegaly or Cushing's disease often have significant comorbidities such as diabetes, hypertension, and obstructive sleep apnea, which necessitate thorough preoperative medical optimization [20]. Delaying surgery by up to a

week to manage these conditions can significantly improve surgical outcomes, with preoperative treatments like intranasal steroids and antihistamines recommended for reducing intraoperative bleeding and aiding recovery [21], [22]. Comprehensive preparation is vital for minimising complications and ensuring successful outcomes by enhancing patient safety and long-term health post-surgery [23]. In the case of Mr N, undergoing Endoscopic Endonasal Transsphenoidal Surgery (EETH), the intraoperative phase was marked by significant challenges, including a massive haemorrhage that triggered a Massive Transfusion Protocol (MTP), requiring rapid transfusion of packed red blood cells (RBCs) and the administration of vasopressors to maintain hemodynamic stability. Postoperatively, meticulous monitoring is necessary to manage potential complications, such as coagulopathy, infections, and fluid-electrolyte imbalances. The administration of cefoperazone-sulbactam was crucial for infection prevention, while managing DI, CSWS, or SIADH involved close monitoring of serum sodium levels and urine output, with interventions such as desmopressin for DI and CSWS and fluid restriction for SIADH to maintain balance.

Intraoperative and Postoperative Management in Endoscopic Endonasal Transsphenoidal Surgery (EETH)

Anaesthetic techniques minimize nasal perfusion and improve surgical visibility during endoscopic endonasal transsphenoidal surgery. Preferred techniques involve the safe reduction of cardiac output with Total Intravenous Anesthesia (TIVA) and inhalational anaesthetics. However, TIVA has been shown to be superior due to its ability to reduce operative field bleeding, enhancing visibility [24]. Controlled hypotension and bradycardia are commonly used to further this effect, with recent research supporting their safety in clinical settings [25]. Additionally, antifibrinolytic agents such as tranexamic acid are utilized to decrease intraoperative blood loss, thus improving the surgical field quality and reducing postoperative complications such as edema and ecchymosis [26], contributing to better patient outcomes and quicker recovery.

During the procedure, the patient experienced sudden and massive bleeding of approximately 4500 mL within three minutes, likely due to the inherent fragility of the internal carotid artery, which can be vulnerable to injury in complex surgeries. Managing such injuries might require complex endovascular procedures such as occlusion or stenting despite their technical challenges and associated risks. Standard hemostatic agents often fail to control high-velocity blood flow from ICA injury, underscoring the critical nature of this complication. Using nasal splints and postoperative packing can help stabilize the surgical site and support grafts, reducing complications such as cerebrospinal fluid (CSF) leaks [27].

Postoperative management following transsphenoidal pituitary surgery involves close monitoring in a high-dependency unit, where critical parameters, such as consciousness levels, blood pressure, visual acuity, sodium levels, urinary output, and signs of complications, such as epistaxis or CSF leaks, are regularly assessed. Management of sodium disturbances is crucial, with hypernatremia often indicating central diabetes insipidus (DI) and hyponatremia indicating conditions such as the syndrome of inappropriate secretion of antidiuretic hormone (SIADH) or cerebral salt wasting (CSW). DI management might involve desmopressin administration, especially in obtunded patients. Simultaneously, SIADH is managed by restricting free water intake, and CSW is managed by fluid repletion and sodium supplementation with fludrocortisone as a possible treatment in refractory cases. However, careful monitoring of complications, such as hypokalemia, fluid overload, and hypertension, is essential.

Diabetes Insipidus (DI), Cerebral Salt Wasting (CSW), and Syndrome of Inappropriate Antidiuretic Hormone (SIADH)

Postoperative fluid and electrolyte imbalances, particularly hyponatremia affecting 8–35% of patients, are significant concerns after pituitary gland surgeries involving critical disorders such as Diabetes Insipidus (DI) and Cerebral Salt Wasting Syndrome (CSWS). DI is marked by a triphasic response where patients experience phases of significant polyuria transient antidiuresis, potentially leading to a Syndrome of Inappropriate Antidiuretic Hormone Secretion (SIADH) and possibly chronic polyuria due to ADH deficiency; managing this requires careful fluid balance and the use of synthetic ADH like desmopressin with frequent dosage adjustments to avoid severe dehydration [28]. CSWS, often linked with brain injuries such as subarachnoid haemorrhage, leads to renal sodium loss and decreased extracellular fluid volume; its complexity requires early intervention to prevent severe outcomes such as dehydration and hypotension.

For Mr. N, who was diagnosed with CSWS, management involved aggressive fluid resuscitation and electrolyte adjustment, utilization of intravenous isotonic saline and sodium supplements to address sodium deficiency and dehydration, and monitoring to avoid fluid overload while maintaining adequate sodium levels. In refractory cases, treatments such as fludrocortisone were administered to enhance sodium retention in the kidneys, requiring vigilant monitoring to prevent complications such as hypokalemia or hypertension [29], [30]. Conversely, SIADH involves excessive ADH release, leading to water retention and dilutional hyponatremia, and is treated by restricting water intake and addressing the underlying causes of ADH release. However, Mr N showed signs more indicative of CSWS than SIADH, highlighting the need for tailored treatment strategies based on accurate diagnosis and ongoing assessment of the patient's fluid and electrolyte status [31], [32]. These conditions, DI, SIADH, and CSWS represent significant challenges in post-pituitary surgery management due to their overlapping presentations concerning sodium abnormalities, necessitating vigilant monitoring, prompt diagnosis, and

tailored treatment strategies [33].

The Massive Transfusion Protocol (MTP) serves as a crucial standardized response to manage severe blood loss in trauma or surgical settings, typically involving the transfusion of ten or more units of packed red blood cells (RBCs) within the first 24 h of admission, with varying criteria that may include replacing an entire blood volume within 24 h or 50% of total blood volume within three hours [34], [35]. This protocol employs an aggressive transfusion strategy, often adopting a 1:1:1 ratio of fresh frozen plasma (FFP), platelets, and RBCs to improve survival rates and minimize mortality, as evidenced by the PROPPR study [36]. Managing massive transfusions involves not only replenishing intravascular volume but also crucial blood components while monitoring coagulation parameters to maintain hemodynamic stability and prevent complications such as disseminated intravascular coagulation (DIC), lactic acidosis, and transfusion-related acute lung injury (TRALI) [36], [37], [38], [39].

In Mr N's case, the application of the MTP was critical during surgery that led to significant blood loss of approximately 4500 mL in less than three minutes, necessitating immediate robust transfusion measures to stabilize hemodynamic parameters. The rapid administration of crystalloids, colloids, and uncrossed RBCs, alongside high-dose vasopressors, such as norepinephrine and adrenaline, is crucial in managing bleeding and maintaining blood pressure. The 1:1:1 transfusion strategy facilitated an effective balance among RBCs, FFP, and platelets, which are essential for mitigating bleeding risks and promoting clot formation while continuously monitoring Mr N's coagulation status and potential electrolyte imbalances [36], [37]. This intricate balancing act underscores the complexities and the critical nature of MTP in managing patients undergoing massive transfusions, highlighting the importance of precise, coordinated care in high-stakes medical scenarios.

Antibiotic Prophylaxis in the Context of Thiopental Use

In patients with Mr N who suffer from traumatic or hemorrhagic brain injuries, management of cerebral edema and hypoperfusion is critical to prevent secondary brain injury due to elevated intracranial pressure (ICP). Sedatives such as thiopental are often employed to control refractory ICP, but while effective, thiopental can induce significant side effects, including hypotension, hypokalemia, respiratory complications, and hepatic dysfunction [40]. Regarding antibiotic prophylaxis, the standard practice in ICU settings post-surgery involves following emergency or ward protocols within the first 48 hours. Selective digestive decontamination (SDD) using topical and systemic antibiotics prevents healthcare-associated pneumonia in intubated patients, especially in mechanically ventilated patients [41], [42].

In the specific case of Mr. N, who underwent Endoscopic Endonasal Transsphenoidal Surgery (EETS) and required mechanical ventilation postoperatively, prophylactic antibiotics were crucial in preventing potential infections. Given the increased risk of healthcare-associated pneumonia and other nosocomial infections, a regimen of cefoperazone-sulbactam was administered regularly to combat common pathogens responsible for postsurgical infections or ventilator-associated pneumonia (VAP). This strategy reflects a careful balance between preventing secondary infections, mitigating the risks of antimicrobial resistance, and unnecessary antibiotic use. The administration of antibiotics is a vital component of Mr N's perioperative and postoperative care, aimed at managing infection risks associated with both neurosurgical intervention and prolonged ICU stay, thus ensuring comprehensive care in a critical setting.

7. CONCLUSION

Perioperative management of Endoscopic Endonasal Transsphenoidal Surgery (EETH) for pituitary adenomas requires a comprehensive multidisciplinary approach to minimize complications. Preoperative evaluation, perioperative management of elevated intracranial pressure with sedation and osmotherapy, careful anesthetic application such as TIVA, postoperative infection prevention with antibiotics, and selective digestive decontamination are critical for optimizing surgical outcomes and ensuring patient safety in neurosurgical procedures. Additionally, managing electrolyte imbalances, such as diabetes insipidus (DI), syndrome of inappropriate antidiuretic hormone secretion (SIADH), or cerebral salt wasting syndrome (CSWS), is crucial to prevent further neurological complications. A well-coordinated, multidisciplinary strategy is essential for recognizing and managing these potential complications early and optimizing outcomes for patients undergoing this complex neurosurgical procedure.

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