Anesthetic Management and Considerations for Transsphenoidal Pituitary Tumor Resection

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LEARNING OBJECTIVES

- Classify pituitary adenomas
- Review pituitary hormone release
- Discuss considerations of acromegaly and Cushing's disease
- Discuss the phases of pituitary tumor resection, including diabetes insipidus (DI) and syndrome of inappropriate antidiuretic hormone (SIADH)
- Discuss general anesthetic considerations for management of transsphenoidal pituitary tumor resection

INTRODUCTION

Pituitary tumors can present in all patient populations with studies estimating that up to one in seven people develop an adenoma within their lifetime [1]. Pituitary adenomas are classified by size with microadenomas being less than 10 mm and macroadenomas being greater than 10 mm, as well as, by function as being either functioning, hormone-secreting, or nonfunctioning [1]. Nonfunctioning macroadenomas often exhibit symptoms of mass effect including headache, hypopituitarism due to anterior pituitary compression, or vision loss from optic chiasm compression [1]. Functioning adenomas often present with hormone excess resulting in disorders such as acromegaly and Cushing's disease. The pituitary gland sits within the sella turcica of the sphenoid and is divided into two lobes: anterior and posterior [2]. The anterior pituitary, adenohypophysis, produces and secretes growth hormone (GH), adrenocorticotrophic hormone (ACTH), thyroid-stimulating hormone (TSH), follicle-stimulating hormone (FSH), and luteinizing hormone (LH) whereas the posterior pituitary, neurohypophysis, secretes oxytocin and antidiuretic hormone (ADH) produced by the hypothalamus [2]. Due to the physiology of the pituitary gland, pituitary adenomas can result in a range of systemic pathologies. The anesthesia provider needs to be aware of the possible associated hormonal and metabolic changes and create an anesthesia plan accordingly.

PREOPERATIVE ASSESSMENT

A 10 y/o, 19.6 kg male presents for a transsphenoidal resection of a 4.6 x 2.7 x 3.4 cm pituitary tumor. Medical history includes hypothyroidism, ACTH deficiency, adamantinous craniopharyngioma (shown in **Figure 3**), diabetes insipidus, and recent vision loss. Home medications consist of acetaminophen, desmopressin, hydrocortisone, levothyroxine, and melatonin. Allergies noted for omnicef. Pre-op vitals include BP of 98/57, HR 110 bpm, RR 29, and SpO2 100% with labs indicating a Hgb of 11.4 and Hct of 32.6%. 22 G in L A/C in situ. He was appropriately NPO and a difficult airway was not anticipated.

ANESTHETIC PLAN

The anesthesia plan for this patient was a general anesthetic and background remifentanil infusion with 5.5 ETT, Mac 3 blade and standard induction. ASA standard monitors and an asleep radial arterial line were elected for monitoring. An additional PIV was planned post-induction. Deep extubation was planned in order to avoid bucking and coughing for a smoother emergence.

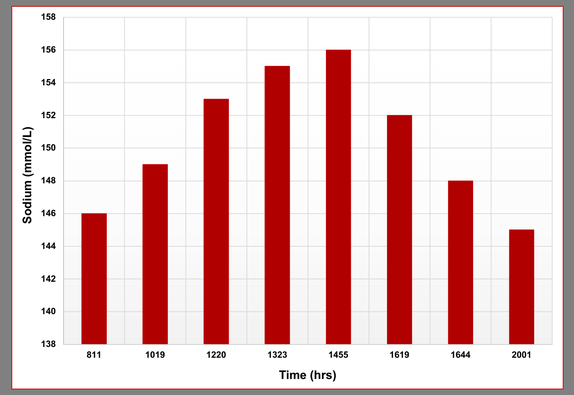

Figure 1. Serial serum sodium levels obtained from i-STAT CHEM8+.

Time	pH	pCO2	pO2	BE	Bicarb	O2 Sat	FiO2
0811	7.48	35	220	3	26.8	100%	41
1019	7.51	32	222	2	25.6	100%	42
1220	7.42	35	228	-2	23	100%	41
1323	7.53	28	300	1	23.6	100%	50

Figure 2. Intraoperative serial arterial blood gases including pH, PCO2, PO2, base excess (BE), bicarb, O2 saturation, and FiO2.

INTRAOPERATIVE COURSE

The patient was given 2 mg of midazolam preoperatively to reduce anxiety and induced with 25 mg lidocaine, 80 mg propofol, and 20 mg rocuronium via 22 G PIV. Successful bag mask ventilation was completed prior to intubation with a 5.5 ETT and Mac 3 blade, obtaining a Grade 1 view. An 18 G PIV and 22 G R radial arterial line were then placed. 200 mg IV clindamycin was later administered. He was maintained with a full MAC of sevoflurane and a remifentanil infusion ranging from 0.2 to 0.5 mcg/kg/min. Serial ABGs and i-STAT CHEM8+ tests were drawn throughout the case. **Figure 2** represents ABG trends, which exhibit respiratory alkalosis without metabolic compensation. **Figure 1** shows serum sodium levels obtained both intra- and postoperatively. Gradually worsening hypernatremia from 146 to 156 mmol/L was treated with 0.5 mmol/kg/hr of desmopressin upon consultation with endocrinology. Sodium levels began to improve approximately 5 hours into the postoperative period. The patient received a total of 1 L IV Plasmalyte. Estimated blood loss was 100 mL and urine output was 900 mL. A Bair Hugger was used to maintain the patient's body temperature. 4 mg of Decadron and 2 mg of Zofran were given for PONV. The patient was reversed with 50 mg sugammadex and vitals were within baseline. Deep extubation was performed along with 12 mcg of dexmedetomidine for a smoother emergence and he was taken to the PACU with an OPA in place.

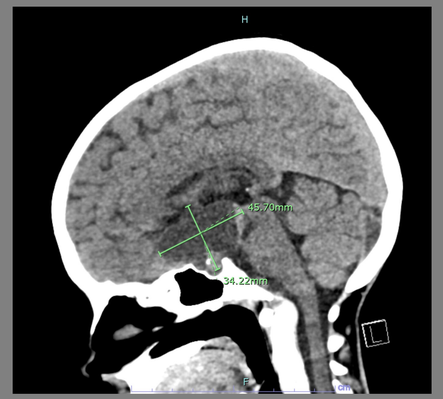

Figure 3. Sagittal head CT showing the craniopharyngioma.

DISCUSSION

There are many anesthetic considerations for management of transsphenoidal pituitary tumor resections. The clinician must also be aware that these changes may be exacerbated by previous medical history and therefore a thorough preoperative evaluation is vital for best plan of care.

Hormone hypersecretion caused by functioning adenomas can result in disorders such as acromegaly and Cushing's disease, both of which present anesthetic challenges [5]. Acromegaly is caused by an excess of GH after the onset of puberty [2]. Patients will present with macroglossia, macrognathia, and abundant upper airway soft tissue leading to obstruction, making bag mask ventilation and intubation via direct laryngoscopy more difficult [4]. Video laryngoscopy or even awake fiberoptic intubation should be considered if a difficult airway is of high suspicion. Cardiac manifestations including cardiomegaly due to ventricular hypertrophy, cardiomyopathy, arrhythmias, and ischemic heart disease are associated with acromegaly [2, 4]. Thorough review of cardiac history and preoperative echocardiography should be considered to assess function.

Cushing's disease results from hypersecretion of ACTH, causing chronic glucocorticoid excess [2]. Presentation includes moon facies, truncal obesity, peripheral muscle wasting, easily bruising skin, and osteoporotic joints [2]. This population may also be a difficult airway due to upper airway obstruction and challenging positioning from obesity and notable 'buffalo hump.' Consider video laryngoscopy or fiberoptic intubation as first-line approach. Cardiovascular changes include hypertension, left ventricular hypertrophy, and diastolic dysfunction [2, 4]. Additionally, some form of glucose intolerance will be present and glucose levels should be closely monitored perioperatively [4].

Postoperatively, there is often a triphasic response in the setting of pituitary tumor resection [3]. Within the first 24 hours, the polyuric phase is caused by transient central diabetes insipidus (DI) [3].

DISCUSSION CONT'D.

DI is a result of hyposecretion of ADH and characterized by polyuria, hypernatremia, and low urine osmolarity. Treatment includes isotonic or hypotonic fluid resuscitation and desmopressin (DDAVP) [1]. DDAVP should be titrated closely with serum sodium levels and urine output as to avoid 'overshoot' hyponatremia [1]. After four or more days, the anti-diuretic phase is caused by syndrome of inappropriate antidiuretic hormone (SIADH), resulting in low urine output, hyponatremia, and high urine osmolarity [3]. Treatment includes fluid restriction and careful administration of hypertonic saline. The third phase is variable as normalization can occur or chronic central DI will return [3].

The transsphenoidal approach has become more routine due to improved endoscopic tumor visualization and decreased risk of nasal and dental complications [1]. The bed is often turned 90º or 180º and the airway is not within immediate reach of the anesthetist in addition to being shared with the surgical team. Therefore, it is vital to ensure that the ETT has been safely secured in place and to communicate with the surgeon(s) should any airway complications be suspected. An OG tube should also be placed to gain the ability to suction blood from gastric contents to reduce risk of PONV. Prior to extubation, ensure that throat packs have been removed by the surgical team [5].

Permissive hypercapnia may be requested by the surgeon(s) to increase ICP and shift the tumor into the sella turcica for improved view for surgical resection [5]. However, if the patient's ICP is already elevated, avoid any conditions that would further increase it and consider a TIVA such as propofol and remifentanil over use of inhalational agents [5].

Complications associated with this procedure include CSF leak, venous air embolism, hemorrhage, and cranial nerve damage [5]. The anesthetist should be aware of these and prepared to address them should they occur.

CONCLUSIONS

Numerous considerations contribute to the anesthetic management of patients who require transsphenoidal pituitary tumor resection. Careful review of medical history is important to evaluate for hormonal disorders including acromegaly and Cushing's disease, both of which pose potential difficult airway challenges and cardiac changes. Serum sodium levels should be closely monitored for evidence of the triphasic response often seen with pituitary tumor resections. The initial polyuric phase is characterized by central DI and hypernatremia, the second anti-diuretic phase is a result of SIADH and hyponatremia, while the final phase is either normalization or a return to central DI. Ensure that the airway has been properly secured as it will not be within immediate reach and will be shared with the surgical team. If an airway complication is of any suspicion, communicate with the surgeon(s) promptly. Management of pituitary tumor resection involves several systemic and anesthetic considerations as well as multidisciplinary cooperation with anesthesia, ENT, and neurosurgery.

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