

Anesthesia and Intensive care implications for pituitary surgery: Recent trends and advancements

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ABSTRACT

The advancements in neuro-endocrine surgical interventions have been well supported by similar advancements in anesthesiology and intensive care. Surgery of the pituitary tumor poses unique challenges to the anesthesiologists and the intensivists as it involves the principles and practices of both endocrine and neurosurgical management. A multidisciplinary approach involving the endocrine surgeon, neurosurgeon, anesthesiologist, endocrinologist and intensivist is mandatory for a successful surgical outcome. The focus of pre-anesthetic checkup is mainly directed at the endocrinological manifestations of pituitary hypo or hyper-secretion as it secretes a variety of essential hormones, and also any pathological state that can cause imbalance of pituitary secretions. The pathophysiological aspects associated with pituitary tumors mandate a thorough airway, cardiovascular, neurologic and endocrinological assessment. A meticulous preoperative preparation and definite plans for the intra-operative period are the important clinical components of the anesthetic strategy. Various anesthetic modalities and drugs can be useful to provide a smooth intra-operative period by countering any complication and thus providing an uneventful recovery period.

Key words: Acromegaly, Cushing's disease, pituitary adenoma, transphenoidal approach

INTRODUCTION

Endocrine neoplasms pose numerous unique challenges during surgical, anesthetic and intensive care management. The advancements in neuro-endocrine surgical interventions, both diagnostic and therapeutic, have been well supported by similar advancements in anesthesiology and intensive care. The advent of new anesthetic drugs, adjuvants, cardiac agents, cerebro-protective agents, etc. has made the preoperative, peri-operative and postoperative management of these surgical procedures relatively easy. As a result it has propelled the surgical interventions to new horizons and has made the surgical resection of many endocrine neoplasms possible which were once thought to be incurable.

Safe and quality anesthesia practices mandate a thorough pre-operative assessment and preparation of the patient for surgery. Surgery of the pituitary tumor is quite unique as it involves the principles and practices of both endocrine and neurosurgical management. The challenges to the anesthesiologist become manifold as the surgical approach differs in different patients as some surgeons prefer the transcranial route compared to the transphenoidal approach by others while some patients undergo awake craniotomy, functional neurosurgery and interventional radiology.^[1-3] A multidisciplinary approach involving the endocrine surgeon, neurosurgeon, anesthesiologist, endocrinologist and intensivist is mandatory during the preoperative, peri-operative and postoperative period for a successful surgical outcome. In-depth knowledge of the anatomical and pathophysiological aspects of pituitary neoplasms is very essential as it can have various implications for the concerned anesthesiologist so as to deliver safe and smooth anesthesia services.^[4] The aim of the present article is to review and discuss some of the most important recent and advanced clinical aspects regarding the anesthesia and intensive care implications in pituitary surgery.

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Preoperative evaluation

As mentioned earlier, preoperative anesthetic checkup for pituitary and neurosurgical procedures has to be carried out in detail with elicitation of complete history and meticulous physical and clinical examination so as to formulate an appropriate anesthetic plan for surgical resection.^[5] The examination has to be carried out extensively to assess the hormonal secretion status of the pituitary and also its mass effect on adjacent vital structures in addition to the general principles and practices for neurosurgical aspects. Some amount of generalized anxiety is associated with any type of anticipated surgical procedure and patients with pituitary pathology are no exception. The anxiety levels may vary from mild to severe in patients with pituitary tumors and require a definite treatment before surgical intervention.^[6] A coordinated clinical examination by the neurosurgeon, endocrinologist and the anesthesiologist will further help to draw treatment plans for any present illness and co-morbidity. The focus of a pre-anesthetic checkup is mainly directed at the endocrinological manifestations of pituitary hypo- or hyper-secretion as it secretes a variety of essential hormones, and also any pathological state that can cause imbalance of pituitary secretions. Hypo-secretion of pituitary hormones mainly occurs either due to the compressive effects of pituitary adenoma, hemorrhage into the pituitary gland or pituitary infarction during the post-partum period (Sheehan's syndrome).^[4]

STRUCTURAL AND FUNCTIONAL AIRWAY ASSESSMENT

Acromegaly, resulting from growth hormone excess can pose difficulties in airway management during general anesthesia. The structural airway changes induced by over-secretion of the growth hormone include macroglossia, hypertrophy and thickening of soft tissues of the oropharynx and enlargement of the soft palate, epiglottis and ary-epiglottic fold.^[7] These structural abnormalities make functional aspects of airway management and intubation very challenging as Mallampatti grade (MP) may not project a true picture of the interior airway thus causing difficult bag and mask ventilation during administration of general anesthesia.^[8] Therefore, one should be very careful and be well prepared before intubation even if the patients exhibits MP Grade I and II. Difficult airway management trolley should be thoroughly checked for all the various adjuncts required to secure the airway including well-lighted laryngoscopes, different sizes of endotracheal tubes and laryngeal mask airway (LMA), oro-pharyngeal airway, gum elastic bougies, combitube, light wand, cricothyrotomy set, retrograde intubation apparatus, etc. but the most important is the availability of the intubating fiberoptic

bronchoscope. Different anesthetic plans should be made preoperatively with an emphasis on airway management so that in case one plan fails, the alternative plan can be executed in no time. The presence of an experienced anesthesiologist, who has had a vast experience in difficult airway management, will really help in calming things down during any stormy period of airway management. Planning for an awake fiberoptic intubation is a better alternative than proceeding with general anesthesia and intubation, provided the patient is very cooperative and not displaying much anxiety. Recurrent laryngeal nerve palsy and enlargement of thyroid is common in acromegalics which can produce difficult intubation and difficult airway management. The deleterious effects of enlarged thyroid include compression of trachea thus causing potential possibility of postoperative respiratory obstruction due to tracheomalacia.^[4,9] Another significant finding in acromegalics is the high incidence of obstructive sleep apnea which can increase the incidence of postoperative respiratory obstruction and compromise.^[10-12] Apart from the lateral and anterior posterior view of X-ray neck, spirometry and indirect laryngoscopy have got a huge role in the preoperative evaluation of the respiratory and airway dynamics in these patients so as to formulate a plan for difficult airway management.^[8,13]

CARDIOVASCULAR ASSESSMENT

Cardiac abnormalities like left ventricular hypertrophy, coronary artery disease, arrhythmias, conduction disturbances, valvular heart diseases, cardiomyopathies and congestive heart failure are commonly associated with hyper-secretion from pituitary, acromegaly and Cushing's disease.^[14-16] Pulmonary hypertension progressing to cor-pulmonale can develop in patients with gross obesity and sleep apnea syndrome. As a result, these subsets of patients are very much vulnerable to develop respiratory failure postoperatively. Systemic hypertension is commonly observed in 80-85% of the patients with Cushing's disease and in 30-35% of patients with acromegaly.^[14,15] Cardiac diseases account for a larger proportion of deaths in the untreated acromegalics. Left ventricular hypertrophy and its accompanying need for high filling pressures is a hallmark of acromegaly which can occur even in 50% of the normotensive patients.^[17,18] The role of electrocardiography (ECG) and echocardiography is of prime importance in the diagnosis of these clinical cardiac diseases, especially diastolic dysfunction which can be present in patients with minimal left ventricular hypertrophy due to interstitial myocardial fibrosis.^[19,20] Coronary artery disease and conduction disturbances such as supraventricular and ventricular ectopics, ST-T wave changes and bundle branch

block are commonly manifested during a period of stress and exertion.^[21,22] Dobutamine stress testing is an important diagnostic tool to evaluate the fitness and capacity of the patient to bear the surgical and anesthetic stress.

NEUROLOGICAL EVALUATION

The most important aspect of neurological examination includes the possibilities of raised intracranial pressure and hydrocephalous.^[4,23] Visual field defects are common as the pituitary tumor compresses the optic chiasma causing bitemporal hemianopia. These mass effect symptoms are mainly manifested in patients who have non-functioning macroadenoma (>1 cm in diameter). The neuro-ophthalmic examination requires a well coordinated approach among the neurosurgeon, ophthalmologist and anesthesiologist to convey the approximate prognostic significance of the surgical procedure to the patient and his or her relatives.

ENDOCRINE-PATHOLOGIC EVALUATION

Prolactinomas

These tumors account for nearly half of the total pituitary tumors and show a female predominance. The clinical symptomatology includes menstrual disturbances and galactorrhoea in females and secondary hypogonadism, erectile dysfunction, reduction in sperm count and decreased libido in males.^[24] Apart from causing visual field defects these tumors do not pose much difficulty for the anesthesiologist but definitely require bromocriptine or cabergoline for effective medical therapy.^[25]

Diabetes mellitus

The incidence of diabetes mellitus is quite high in Cushing's disease and acromegaly and therefore a stricter regimen of insulin has to be employed to control hyperglycemia preoperatively and peri-operatively hyperglycemia can be controlled with sliding scale insulin administration. It is recommended that preoperatively all the oral hypoglycemics should be stopped a day before surgery, especially the long-acting ones as they offer no advantage but add to the development of refractory hypoglycemia and a possible lactic acidosis with metformin. To counter any perioperative hyperglycemic episode intravenous infusion of regular insulin is the drug of choice. Postoperatively, patients having refractory hyperglycemia can be managed with sliding scale of insulin as most of the patients are not allowed oral intake for a long time.

Thyroid disease

Thyroid function tests including T3, T4 and TSH are important components of the preoperative preparation and optimization, especially if the cardiovascular system

is involved due to thyroid disease.^[26] Thyroid hormone replacement has to be done very cautiously in patients with impaired adreno-corticotrophic hormone ACTH reserves as it can precipitate an adrenal crisis. Therefore, glucocorticoid cover is essential before proceeding with thyroid hormone replacement.

Cortisol/Follicle stimulating hormone/ Leutinizing hormone

Measurement of serum cortisol will enable to find out the approximate supplementation dose of corticosteroids during the peri-operative and postoperative period, especially in patients with Cushing's disease. Premature puberty and resumption of menstrual cycles are a few of the rare manifestations due to abnormal FSH and LH secretion by the pituitary. Infertility, pan-hypopituitarism and epilepsy are some of the non-specific symptoms most commonly caused by the compression of the non-functioning adenoma or by hemorrhage into the pituitary causing pituitary apoplexy, and very rarely, by the Sheehan syndrome (post-partum pituitary infarction).

Cushing's disease

Besides involvement of cardiovascular system and higher incidence of diabetes mellitus as mentioned earlier, patients with Cushing's disease also have other clinical abnormalities like increased propensity for development of easy bruising due to increased skin fragility. The peripheral venous cannulation sometimes is very difficult to secure and discoloration occurs very quickly due to skin fragility. The truncal obesity, osteoporosis, myopathy and gastroesophageal reflux are important concerns in the context of positioning and airway control in patients with Cushing's disease. The majority of this symptomatology can be controlled with preoperative administration of metyrapone thus helping in preparing the patient for surgery.^[4,23]

Diagnostic modalities

Besides routine investigations like complete blood count, renal function tests, electrolytes and blood glucose, special investigations should be sought on patient to patient basis depending upon the history and clinical examination findings. Deranged sodium levels may indicate the possibilities of diabetes insipidus or syndrome of inappropriate anti-diuretic hormone secretion SIADH due to posterior pituitary dysfunction. Chest X-ray, lateral view of X-ray neck, ECG, echocardiography, pulmonary function tests, hormonal assays and coagulation profile should also be carried out depending upon the clinical condition and diagnosis. Arterial blood gas (ABG) analysis becomes essential in cases of sleep apnea syndrome and deranged pulmonary function tests exhibiting obstructive

airway disease. The presence of other respiratory co-morbidities can cause the pulmonary function to exhibit a restrictive pattern in few circumstances in addition to the common obstructive pattern in the majority of cases with morbid obesity and sleep apnea syndrome. Computed tomogram and magnetic resonance imaging is essential to know the exact location and extent of the tumor to chalk out the surgical plan.

PREMEDICATION

Invariably these patients are on multiple medications because of their endocrinological co-morbidities. As such, all the medications should be administered judiciously along with premedicants so as to prevent any drug interaction and clinical catastrophe during surgery. Antihypertensives, antianginals, antiarrhythmics, bronchodilators, antacids, oral hypoglycemics, insulin, etc. should be administered as per protocols for any intracranial surgery. All this drug administration should be guided by the laboratory values as well. Steroid cover is an essential component in case of pan-hypopituitarism along with relevant hormonal replacement. It is prudent to avoid long-acting sedative medications, especially in patients with history of sleep apnea syndrome as there is an increased possibility of respiratory depression and obstruction. Also, assessment of postoperative neurological status is very essential in pituitary surgery and thus forms another reason for avoiding the use of long-acting sedative medications. H-2 blockers like ranitidine and short-acting barbiturates like alprazolam are considered ideal for premedication in these patients.

PREOPERATIVE PREPARATION

Though intracranial surgery can be accomplished by simply shaving the head the transphenoidal approach requires more intensive preparation.^[27] Nasal mucosa has to be prepared well before operation so as to minimize the potential bleeding during surgery thus providing an almost bloodless field during surgery. Traditionally, cocaine was used to provide nasal infiltration but the associated side-effects of cocaine have made it obsolete nowadays.^[28,29] In our setting we use xylometazoline nasal drops 10-15 min before induction of anesthesia and supplement it with injection of 2% lignocaine with adrenaline (200,000) just before the start of surgery during the transphenoidal approach. The new school of thought recommends that it is unnecessary to infiltrate the nasal mucosa with local anesthetic and epinephrine during endoscopic procedure as topical anesthesia will suffice for this purpose. Though the hypertensive response is frequently encountered during this

procedure, various drug regimens are available to counter this deleterious response.^[30,31] We have been commonly using metoprolol and nitroglycerine in our setting to obtund this side-effect. Patients on beta blockers can develop severe hypertension during the peri-operative period due to unopposed action of epinephrine on α -receptors.^[32] Treatment to this complication consists of either administration of direct vasodilator or increasing the depth of anesthesia. Literary evidence cites the effective usage of opioids and the above mentioned drugs to attenuate the hypertensive response. Recently, we have started using α -2 agonist dexmedetomidine as intravenous infusion (1 μ g/kg over 20 min preoperatively) which is proving to be very effective not only in decreasing the stress response to laryngoscopy and intubation but also to counter effectively the chronotropic and ionotropic effects of adrenaline infiltration. The other added advantage of dexmedetomidine infusion includes decreased peri-operative consumption of anesthetics and opioids as well as rapid emergence and recovery from anesthesia. Patients usually get awake in no time after extubation and respond very well to verbal commands. The only side-effects we observed during dexmedetomidine infusion include occasional bradycardia at higher dose (2-3 μ g/kg rapidly) with no significant hypotension and a 10-15% incidence of postoperative dry mouth which is not significant in the context of the magnitude of the surgery.

OBJECTIVES OF ANESTHESIA

Though pituitary surgery encompasses the principles of neuro-anesthesia more consideration should be given to those aspects which involve issues related to the pituitary. As far as possible the best anesthetic measures and techniques should be adopted to have a peri-operative hemodynamic stability, maintenance of normal intracranial pressure (ICP), provision of smooth surgical conditions like 'lax brain', maintenance of adequate cerebral blood and oxygen supply, metabolic homeostasis, adequate renal protection, rapid action to deal with any peri-operative complication and rapid emergence and recovery from anesthesia on completion of surgery.

Induction of anesthesia should be accompanied with thiopentone sodium as it has got a neuro-protective role. Propofol is a good alternative to thiopentone, especially in patients who are morbidly obese, patients allergic to the sulphha group of drugs and in patients with a positive history of sleep apnea syndrome. Propofol is considered superior as compared to thiopentone when an early recovery and emergence from anesthesia is desired. Succinylcholine is the drug of choice for patients with anticipated and established difficult airway. On the contrary, it should

be avoided on account of its increased propensity to increase the intracranial pressure. Vecuronium is a good pharmacological agent for peri-operative muscle relaxation as it also provides good hemodynamic stability. Total intravenous anaesthesia (TIVA) has emerged as one of the most popular techniques for administering general anaesthesia. Various pharmacological agents comprising different components of TIVA include propofol, midazolam, fentanyl, remifentanyl, ketamine, etc. In the context of pituitary surgery, TIVA can provide smooth induction and maintenance of anaesthesia, minimal side-effects and rapid recovery from the effects of anaesthesia.

Difficult airway trolley with all the gadgets for difficult airway should be ready before induction of anaesthesia and preferably should have a fiberoptic bronchoscope. A cricothyrotomy and tracheostomy set should be ready, and availability of an Ear, nose and throat ENT surgeon is a desirable requirement during airway management, especially when intubating patients with acromegaly.

A reinforced endotracheal tube or south pole Ring Adair Elvin RAE tube is preferred for pituitary surgery as it provides an ample free area to the surgeons around the cephalic region of the patient and also minimizes chances of kinking of endotracheal tube or its obstruction during the surgical procedure. During the trans-sphenoid approach, it becomes mandatory to secure the oral cavity with throat packs as the bleeding during the dissection of nasal tissues can accumulate in the oro-pharynx and trickle down the endotracheal tube in spite of the inflated cuff most often by the 'channeling' mechanism.

Lumbar Spinal Drain

Some surgeons prefer to put a lumbar drain catheter mostly at the L3-4 interspace to assist in the dissection of suprasellar tumors. The mechanism involves the injection of 5-10 ml of 0.9% normal saline through the spinal catheter into the subarachnoid space which by pressure effect pushes the suprasellar extension of the tumor into the surgical field of the infrasellar tumor thus allowing almost complete excision of the tumor.^[31] The biggest concern here is strict maintenance of sterilization barriers. This approach is quite controversial and is not universally followed as the possibility of cerebrospinal fluid CSF fistula development is definitely there which may require repair.

Permissive hypercapnia

Permissive hypercapnia ($\text{PaCO}_2 = 60 \text{ mmHg}$) can be useful in increasing ICP transiently thereby displacing the suprasellar portion of the pituitary tumor into the infrasellar space for ease of surgical excision.^[33] The deliberate attempt to produce hypercarbia is also associated with deleterious

side-effects like hypertension, tachycardia and imbalance of oxygen demand-supply to the myocardium.

POSITIONING

Transcranial procedures are performed with patients lying supine on the operation table. But for transphenoidal surgery, a head up position is a must as it not only decreases venous engorgement but also minimizes bleeding during the surgical procedure. The head up position is associated with increased possibilities of venous air embolism (VAE). With the availability of modern monitoring gadgets like end-tidal CO_2 , ABG analysis and color Doppler, the risk of VAE has reduced drastically by early detection and intervention. Therapeutic interventions to deal with VAE include aspiration of air with multiorifice catheter, pressure on internal jugular veins bilaterally, supplementation with 100% oxygen, continuous irrigation of the operative field with saline and hemostasis and repair of the open vessels.^[34] The most dreaded complication during the transphenoidal approach includes injury to the carotid artery and resultant massive bleeding.^[35] In spite of diligently dealing with carotid artery repair and hemostasis, there are increased possibilities of development of pseudo aneurysms and carotid cavernous fistula postoperatively.^[36] Such patients should preferably be electively ventilated and should be extubated only after ensuring adequate control of injury by various investigations like carotid angiography. Blood should be arranged in adequate quantity, rather a cross-match should be carried out preoperatively whenever such procedures are undertaken to ensure uninterrupted blood supply in case of a bleeding catastrophe.

PERI-OPERATIVE MONITORING

In addition to routine monitoring of heart rate (HR), non-invasive blood pressure (NIBP), end tidal carbon di-oxide (EtCO_2) and ECG, it is prudent to put a central venous line to guide fluid therapy and hemodynamic optimization.^[37] In a few selected high-risk cases, especially with cardiac pathology, an arterial line is also preferred to monitor beat to beat variation of BP. During insertion of radial arterial line one has to be cautious as there is a possibility of the ulnar circulation being compromised, especially in acromegaly patients due to the carpal tunnel syndrome.^[38] As a result there is an increase in the chances of the development of ischemia of hand if proper evaluation of hand circulation is not carried out preoperatively. Cannulation of the dorsalis pedis artery or femoral artery is a better alternative to avoid this potentially hazardous complication. Invasive monitoring has got a definite role and significance in patients with uncontrolled

longstanding hypertension, decreased cardio-respiratory reserves (evident from decreased exercise tolerance), cardiomyopathies and other cardiac lesions.^[39]

INDUCED HYPOTENSION

There are chances of continuous oozing from the operative field which makes the surgical conditions very difficult. The amount of bleeding does not correlate well with the actually measured central venous pressure or cavernous pressure but is more definitely associated with the large size of the tumor, especially in tumors with suprasellar extension.^[40] The significance of induced hypotension is of prime importance as the reduced bleeding from the vascular bed provides a clear field for surgical exploration. Keeping the mean arterial pressure (MAP) above 65 mmHg should be the central point for induced hypotension as the patient is already in the head up position and as such blood supply to the brain is not compromised. Various pharmacological agents like sevoflurane, isoflurane, propofol, thiopentone, β -blockers, nitroglycerine, nitroprusside, dexmedetomidine, etc. are available but the choice should be made keeping in mind the rapid recovery and emergence from anesthesia. We are using dexmedetomidine nowadays in our setting and the results are wonderful with this newly introduced drug as not only does it maintain hemodynamic stability on the lower side but also reduces the peri-operative anesthetic requirement up to 30-40%.

POSTOPERATIVE EVALUATION

Postoperative neurological assessment is very essential and is feasible only with rapid recovery and emergence from anesthesia.^[41] After the completion of the surgical procedure, the throat should be cleared of blood and secretions, preferably under direct vision with laryngoscopy. In our day to day practice, we keep a throat pack under direct vision with the help of Magill forceps and the distal end of the pack is given a single knot which is kept just below the inferior aspect of the endotracheal tube where it enters the glottis. This intervention seems to be very safe as we have not encountered any trickling of blood or secretions by the channeling mechanism in a single patient out of more than 250 transphenoidal, maxillofacial, oral and fiberoptic endoscopic sinus surgery (FESS). We use soft foam nasal packs postoperatively and insert a small-sized uncuffed endotracheal tube (usually Number 5) cut proximally to the appropriate size of insertion. This has worked out to be a very economical method to keep the nasal cavity patent instead of using the costly nasopharyngeal airway. Ideally, all these patients should be extubated when fully awake with adequate return of

protective airway reflexes as postoperative ventilation with mask is very difficult in these patients and continuous positive airway pressure (CPAP) also cannot be applied after transphenoidal surgery. The preoperative counseling is of immense importance in these patients as they have to be told about the breathing through the mouth opening after the completion of surgery. This makes the task of the anesthesiologist very easy and even we have not faced much difficulty post extubation in any of these patients who have undergone the above-mentioned procedures.

Postoperative airway management, analgesia, monitoring of vital signs, hormonal supplementation and fluid balance are some of the important components to ensure a smooth uneventful recovery period. Postoperatively, these patients can have breathing obstruction possibly due to the trickling of blood from the naso-pharynx in case of the transphenoidal approach. At greater risk are the patients with acromegaly, gross obesity or those with history of sleep apnea. In our practice, we monitor this subset of patients either in the post-anesthesia care unit or in the intensive care unit (ICU), depending upon their clinical status, for the next 24 h with a continuous vigil on hemodynamic parameters, respiratory dynamics, neurological status and visual field acuity. Cranial nerve dysfunction is an important aspect to look for, especially related to visual acuity, visual fields and extra-ocular muscle function as cranial nerves from II-VI are almost in the vicinity of the pituitary gland.

Postoperative analgesia is an important issue and more so after transcranial surgery as compared to the transphenoidal route.^[42,43] Opioids are very effective for relief of pain but owing to their side-effects like nausea, vomiting, pruritis, respiratory depression and urinary retention, they are very cautiously used for relief of pain in these neuro-endocrine procedures.^[44] Among opioids, fentanyl is considered better as it is associated with a far lower incidence of respiratory depression, nausea and vomiting as compared to traditional morphine.^[45] Nausea and vomiting can have detrimental effects on the ICP and we administer palonosetron 75 mcg by slow IV injection 15 min before the anticipated completion of surgery.^[46] This H-3 receptor antagonist has proved to be very beneficial in controlling the nausea and vomiting postoperatively as the long duration of its action provides a smooth recovery period of longer duration. Patient-controlled analgesia (PCA) is gaining huge popularity nowadays and is being practiced in many centers but its universal availability is restricted in developing countries like ours due to huge economic constraints. The big advantage for the patients is that they can decide the administration of analgesia themselves and thus get a smooth pain-free postoperative period. The safety

mechanisms are definitely there in the software which delivers a pre-calculated and pre-set required dose thus avoiding the chances of over-dosage by the patient.

NEURO-ENDOCRINE ABNORMALITIES

There is a possibility of the development of diabetes insipidus (DI) postoperatively which can create a huge fluid deficit and imbalance. The measurement of central venous pressure CVP is of immense importance during this period rather than administering fluids by simply chasing the output. The diagnosis of DI is very simple and can be arrived at by measuring increased plasma osmolality (>295 mosmol/kg) and decreased urine osmolality (<300 mosmol/kg) on the background of increased urinary output (> 2ml/kg/h).^[47] In our practice we treat DI with intranasal administration of desmopressin. Early treatment of DI is warranted as it can lead to development of hypernatremia and dehydration.

SIADH can develop which may cause derangement in water balance and usually occurs due to the overenthusiastic use of desmopressin, ultimately resulting in the development of hyponatremia.^[48] The diagnosis is established by demonstration of serum sodium concentration of <135 mEq/L, urinary excretion of sodium >40 mEq/L and low serum uric acid levels in the context of hypo-osmolar serum, hyperosmolar urine and a euvolemic state.^[49] Mild cases can be treated simply by fluid restriction (500-1000 ml/d) but in severe symptomatic cases when serum sodium falls below 120 mEq/L, in addition to fluid restriction, hypertonic saline 3% has to be administered to overcome the acute crisis. To prevent central pontine myelolysis instead of giving rapid infusion of hypertonic fluids for correction of hyponatremia, therapy can be instituted slowly by giving the fluid over 24-48 h.^[49]

CSF leakage is another potential complication of this surgery as there is a possible incidence of rhinorrhoea or trickling of the fluid in the posterior pharyngeal wall. The complaint by the patient regarding fluid trickling should be dealt with seriously, especially when associated with headache and exacerbation of pain on leaning forward. The leaked fluid should be collected and sent for γ -transferrin examination to establish the definite presence of CSF leak. The treatment modalities vary but commonly an autologous fat packing very effectively treats the postoperative leakage.

Invariably, almost all patients require postoperative cortisol replacement and this should be chosen diligently on individual to individual basis to achieve adequate maintenance levels.^[50] The ideal approach is to measure cortisol levels before instituting these regimens [Table 1].

Table 1: Glucocorticoids' replacement therapy on the basis of cortisol levels

Plasma cortisol levels (nmol/L)	Maintenance therapy of hydrocortisone reqd (mg)	Investigations required
<100	15-30 mg/d	No tests required
100-250	10-20 mg/d	Hypothalamic pituitary axis HPA tests are required
250-450	Only during stress period	HPA testing mandatory
>450	No therapy required	No further testing required

But a standard regimen which is universally followed consists of administration of hydrocortisone 50 mg bd on the first postoperative day, 25 mg bd on the second postoperative day and reduction to 20 mg and 10 mg in the morning and evening on the third postoperative day.^[51] The normal replacement required for maintenance after the discharge from the hospital is 15 mg in the morning and 5 mg in the evening. The scenario in Cushing's disease is more complicated as these patients normally have chronic suppression of corticotrophs and as a result require maintenance replacement therapy for a long duration. Measurement of blood glucose becomes mandatory in these patients as most of them have hyperglycemia and this steroid cover regimen can further accentuate this hyperglycemic entity.^[52]

CONCLUSIONS

With the advancements of diagnostic methods and continuous improvement in medical and surgical therapeutic interventions, most of the once thought to be surgically impossible excision of pituitary tumors are now amenable to treatment. The 24-h availability of ever-improving intensive care facilities has further boosted the successful outcome of these surgical undertakings. A multi-disciplinary coordinated approach among the anesthesiologist, intensivists, neurosurgeon and endocrinologist is all that is required for the smooth and successful management of such cases.

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Announcement

IJEM ANNUAL AWARDS

IJEM thanks its contributors and reviewers for their timely contributions. This has helped make the first issue of 2011 a success.

IJEM announces the following annual awards for the year 2011:

- Best reviewers (2)
- Best review articles (2)
- Best original articles (2)
- Best case reports/images (2)
- Best letters to the editor (2)
- Most downloaded articles (2)
- Most cited articles (2)

The awards will be presented at the Annual Endocrine Society of India Conference to be held in Pune from 1-3 December.