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ILLUSTRATIVE ORIGINAL SURGICAL VIDEO

Endoscopic endonasal approach to sellar-suprasellar lesions

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The endoscopic endonasal approach through the transphenoidal and transtubercular access provides an excellent and panoramic view of the sellar-suprasellar lesions. The indications include pituitary adenomas, craniopharyngiomas, meningiomas, etc. The surgery is done using a zero-degree endoscope and, if required, angled endoscopes for resecting tumors around the corners. Tumors going lateral to the optic nerves are contraindications. Cerebrospinal fluid leak is a common complication of this skull base approach; however, it has been decreased significantly with the use of the nasoseptal mucosal flap. This educational video article describes a step-by-step approach to a case of pituitary macroadenoma, along with the indications, contraindications, advantages, limitations, complications, and their avoidance of this approach.

Keywords: cerebrospinal fluid leak, craniopharyngioma, endoscopy, neuroendoscopy, pituitary neoplasms, pituitary gland, sella turcica, skull base neoplasms

Introduction

The endoscopic endonasal approach is being increasingly utilized for managing the lesions involving the sellar-suprasellar region (1–3). This approach is indicated for lesions of pituitary adenomas, craniopharyngiomas, meningiomas, etc. that are located primarily in the midline and do not cross the optic nerves laterally. The tumor lobules that extend into the cavernous sinuses and are in proximity to the internal carotid artery are also excisable (4); however, one should achieve sufficient experience with simpler cases before attempting them. The technique provides the advantages of magnification, panoramic vision, and superior visualization that lead to an enhanced extent of resection of the lesion. The lesions hidden in the corners of the field can be visualized using the angled endoscopes.

Indications and contraindications

The indications of the endoscopic endonasal approach include pituitary adenomas, craniopharyngiomas, tuberculum sellae meningiomas, planum sphenoidale meningiomas, olfactory groove meningiomas, Rathke's cleft cysts, etc. Tumors extending to the cavernous sinus can also be excised. The approach is also useful for managing cerebrospinal fluid (CSF) rhinorrhea.

The contraindications of the procedure include tumors going lateral to the optic nerves, kissing carotids (both carotids coming and touching each other in the midline), and active infection in the paranasal sinuses. Pure intraventricular lesions, brain invasion with edema, and involvement or vasospasm of the arteries of the circle of Willis are also other contraindications.

Preoperative investigations

The surgeon should take a thorough history and perform a good clinical examination before investigating the patient. A hormone-secreting pituitary adenoma may show relevant clinical findings. The visual acuity, fundus, and visual field examination are important and may show temporal field cuts.

A magnetic resonance imaging (MRI) brain plain and contrast is needed to visualize the tumor size, extent, consistency, and relation with the surrounding structures,

such as the position of the internal carotid arteries, optic pathways, normal pituitary gland, and infundibulum. A T2 hyperintense lesion indicates soft, suckable lesion, while a hypointense lesion suggesting a firm mass may require a cavitron ultrasonic aspirator intraoperatively. Presence or absence of hydrocephalus should also be noted. A computed tomography (CT) scan of paranasal sinuses is performed to visualize the anatomy of the nasal septum, turbinates, etc. Before surgery, detailed evaluation of the sphenoid sinus is essential, including assessment of the sellar floor (prominent or flat type) configuration and degree of pneumatization, presence of any bony dehiscence over the optic nerve or carotid artery, attachment of sphenoid septa to these structures, as well as identification of complex septations or double flooring patterns such as Onodi cells. This distinction is particularly important in pituitary tumors, which are typically extradural. It is essential to identify whether the lesion is purely extradural (usually smooth and rounded) or if it has a subdural component, such as daughter tumors or blebs.

Hormonal evaluation is mandatory, and any deficiency, if found, needs to be corrected. In cases of functional adenoma, the baseline hormonal evaluation can be compared with the postoperative levels to confirm the complete excision of the lesion. The hormonal profiling includes serum prolactin, cortisol, growth hormone, Insulin-like Growth Factor 1 (IGF-1), Luteinizing Hormone (LH), and Follicle-Stimulating Hormone (FSH). A preoperative nasal culture is critical to rule out any active nasal infection.

Surgical technique

Video 1 shows the technique step-by-step. The patient is positioned supine under general anesthesia. Oral packing is done with a roller bandage. Blood pressure is kept around 100 mm Hg systolic. The face is slightly tilted and turned towards the surgeon (right side for a right-handed surgeon). Both nostrils are sterilized and packed with 1:10,000 adrenaline-soaked cotton patties. This is known as primary packing and is done even before painting and draping the patient. By the time the nasal mucosa is being decongested, the surgeon should scrub up. The painting and draping of the nose and right thigh (or abdomen) for harvesting the fat is performed. Utilizing the zero-degree, 18 cm long, 4 mm wide endoscope, the surgeon then performs secondary packing of the nose. This involves the lateralization of the inferior and middle turbinates (MT) and keeping the adrenaline-soaked cotton patties for 5–10 minutes bilaterally. This time can be utilized for harvesting the fat from the thigh or abdomen.

VIDEO 1 | The video demonstrating endoscopic endonasal transsphenoidal excision of a Pituitary macroadenoma.
https://youtu.be/fEe6J5zktBE

At the end of decongestion, the nasal mucosa becomes pale. The super-selective packing is then done to lateralize the superior turbinate bilaterally. The time given for decongestion is rewarding and saves a lot of time later on. The surgeon holds the zero-degree, 18 cm long, 4 mm wide endoscope in his non-dominant hand and the working instrument in his dominant hand. The endoscope is stationed at the 12 o'clock position of the nostril, and the working instrument at the 6 o'clock position. However, when the surgeon uses a 30-degree scope, the scope is positioned at the 6 o'clock position.

The surgeon starts with lateralizing the turbinates. If the MT is bulky, the right-sided one may be resected. One should avoid pulling it; otherwise, there may be an iatrogenic CSF leak from the skull base. The MT is first coagulated at its bases from the skull base anteriorly and the perpendicular plate of the palatine bone posteriorly, and then sharply cut. The sphenoid ostia can be found just medial to the superior turbinate. It may also be searched around 1.5 cm cranial to the level of the choana. Gentle probing at the site can be done in a case of mucosa-covered ostia.

The nasoseptal flap is raised by making superior, inferior, and anterior cuts. The superior cut is started just inferior to the sphenoid ostia and progressed to the nasal septum. A 1-cm gap is left from the roof to preserve the olfactory mucosa. Anterior to the level of the middle turbinate, one can extend it to the roof to gain maximum width. The superior cut is brought anteriorly till the mucocutaneous junction. The anterior extent of the flap can be truncated in a case of small pituitary adenoma. The inferior cut of the nasoseptal flap is started just above the choana and brought inferiorly to the floor of the nasal cavity. This cut is extended anteriorly till the mucocutaneous junction. Both superior and inferior cuts are joined, which makes the anterior cut. The flap is raised submucosally and deposited in the choana.

The nasal septum is broken at its bony-cartilaginous junction, and its posterior 1/3 is then excised. This bony septum can be utilized for reconstruction at a later stage. The opposite side nasoseptal flap is then either reversed to cover the ipsilateral denuded nasal septum or excised. Care should be taken to coagulate the sphenopalatine artery of this excised mucosal flap to prevent bleeding in the postoperative period.

At this stage, either the scope can be changed to a 30 cm long one and attached to an endoscope holder, or the scope can be transferred to a trained assistant. This allows the surgeon to perform the surgery bimanually. The anterior sphenoid wall is then drilled away. The lateral extent of the bony opening should be as wide as possible to allow smooth maneuvering of the instruments. The rostrum of the sphenoid bone serves as a landmark for the midline. The sphenoid sinus mucosa is then taken out and septa drilled away. The anatomy of the sphenoid septa should be noted in the preoperative CT scan to avoid any injury to the critical neurovascular structures.

The key anatomical landmarks, such as the medial and lateral opticocarotid recess, optic prominence, carotid prominence, clival recess, etc., may be identified. The sellar floor is then drilled slowly under irrigation. One should see four blue lines—superior, inferior, and two lateral—that mark the boundaries of cavernous sinuses. The tuberculum sellae is also drilled away, which is especially helpful in resecting the suprasellar portion of the adenoma. The anterior extent of the drilling may further be enhanced in a case of planum sphenoidale meningioma. In a case of unclear anatomy, the surgeon can utilize microdoppler to note the course of the internal carotid artery or a neuronavigation system.

The sellar dura is coagulated and opened posteriorly using a retractable dura knife or an 11 no. blade. The posterior opening (T shape) is made first to avoid premature falling of the arachnoid. The tumor is taken for biopsy and slowly excised in piecemeal fashion using a combination of suction, ring curettes and pituitary forceps. One should move the suction and ring curette in a diagonally opposite manner to open up the tumor. Tumor removal begins posteriorly, then laterally, and lastly anteriorly. The tearing of the arachnoid can be prevented by keeping the suction pressure low and utilizing the cotton patties. The normal pituitary gland is pinkish yellow and is generally found in the postero-superior region or laterally or draped on the diaphragm sellae. An angled endoscope (30 degrees) may be utilized to see any remnant in the corners. A uniform descent of the arachnoid indicates complete tumor removal.

The hemostasis is achieved using a combination of irrigation and oxidized regenerated cellulose layering. The multilayered reconstruction is then done using a fat piece (loosely placed at the level of the sellar dura), fibrin glue, and a nasoseptal flap. Dural suturing can also be done (5). The nasal septum bone can be placed over this reconstruction, especially when there is a large arachnoid tear. A pulsatile reconstruction indicates that the packing is not producing any pressure. The nasal cavities are then packed for 3–5 days using Meroceal.

Postoperative management

The patient is managed postoperatively in the intensive care unit. Apart from vitals, the input-output charting is critical to note early detection of diabetes insipidus, electrolyte abnormalities, or syndrome of inappropriate antidiuretic hormone secretion. Mild nasal discharge is expected; however, a clear and profuse discharge (even in the throat) indicates a CSF leak and is an indication for early repair. Visual acuity assessment is vital for assessing both adequate decompression of the visual apparatus and predicting any hematoma formation. Hormonal evaluation is important, particularly in the functional adenoma cases. We perform a CT scan within 24–48 hours to detect any hematoma formation and an MRI of the brain after 3–6 weeks to assess the extent of resection and as a baseline for any future recurrence.

Outcomes

This approach has demonstrated excellent safety and efficacy in terms of tumor resection, postoperative visual improvement, and hormonal normalization in several studies (6–8).

Complications and their avoidance

The intraoperative complications include iatrogenic CSF leaks from the skull base, arachnoid tears, injury to optic nerves, carotid artery, etc. The CSF leak from the skull base can be prevented by avoiding traction over the middle turbinate. The arachnoid tears can be prevented by careful and gentle excision of the tumor. The optic nerve injury can be prevented by careful and periodic irrigation while drilling. The irrigation prevents the heat-related injuries. Preoperative knowledge of patient-related anatomy, usage of microvascular Doppler, and avoidance of Kerrison punches while removing the sellar floor prevent the dreaded carotid injury. In a case of carotid injury, one should immediately pack the site and proceed with the patient to the endovascular suite. However, minor carotid repair can be performed after sufficient experience in endoscopy.

The early complications include CSF leak, hematoma formation, excessive pressure due to the nasal packing, and electrolyte imbalances. Their avoidance is already mentioned in the surgical technique. Preservation of the pituitary stalk and normal pituitary gland generally avoids any hormonal imbalances (9).

Late complications include recurrence of the tumor, pseudoaneurysm, and nasal complications. The surgeon may upskill themselves before embarking on surgery through cadaveric dissections, practice on indigenous models, and participation in live surgical workshops (10–13).

Conclusion

The endoscopic endonasal transsphenoidal approach is a safe and effective technique for resecting sellar-suprasellar lesions, including pituitary macroadenomas, functional pituitary adenomas, craniopharyngiomas, meningiomas, and Rathke's cleft cysts.

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