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ORIGINAL ARTICLE

Endoscopic Trans-Nasal Trans-Sphenoidal (TNTS) Approach For Pituitary Adenomas: Our Experience

Saurabh Varshney · Charitesh Gupta · K. K. Bansal · S. S. Bist · Sanjeev Bhagat

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Abstract Advances in optics, miniaturization, and endoscopic instrumentation have revolutionized surgery in the past decade. Current progress in the field of endoscopy promises to further this evolution: endoscopic telescopes and instruments have improved upon the optical and technical limitations of the microscope, and require an even less invasive approach to the sella. Pituitary surgery is traditionally within the realm of the neurosurgeon. However, since the reintroduction of the transseptal transsphenoidal approach and endoscopic transnasal transsphenoidal approach to the sella turcica for resection of pituitary adenoma, otolaryngologists have been active partners in the surgical management of these patients. Otolaryngologists have lent their expertise in nasal and sinus surgery, assisting the neurosurgeon with the operation. The otolaryngologist has the advantage of familiarity with the techniques and instruments used to gain exposure of the sella turcica by transnasal approach. Hence, the otolaryngologist provides the exposure, and the neurosurgeon resects the tumour. Such collaboration has resulted in decreased rates of complication and morbidity. We hereby discuss our experience of treating 54 cases of pituitary tumour by endoscopic transnasal approach at our hospital.

Keywords Pituitary surgery transsphenoidal · Pituitary adenoma · Transphenoid surgery · Endoscopic hypophysectomy

Introduction

Significant advances in the recognition and management of pituitary adenomas have taken place over the last decade. Highly sensitive hormonal assays and magnetic resonance imaging with gadolinium enhancement have led to earlier and more frequent diagnosis of pituitary adenomas. The evolution of pituitary surgery over the past century dates back to the work of Oscar Hirsch and Harvey Cushing in the early 1900s. An endoscopic transnasal sphenoidotomy approach without a septal dissection for resection of pituitary adenomas and other sellar lesions provided excellent exposure of the sella and adequate working space. The technique produces less postoperative pain and shortens hospital stay [10–13]. The sphenoidotomy approach eliminates the problems of lip numbness, septal perforations, and oronasal fistulas. The endoscopic sphenoidotomy approach has become our preferred approach to sellar lesions [1].

Two distinct advantages that an endoscope has over an operating microscope are its ability to visualize through a narrow surgical corridor and its ability to provide angled, close-up views. An endoscope can be used to assist the operating microscope (endoscope-assisted microsurgery) [5]. When endonasal endoscopy is chosen, the surgical approach can be made with a deep-transseptal, a paraseptal, a middle turbinectomy or a middle meatal approach (endonasal transsphenoidal endoscopy). Endonasal endoscopy can be performed via either one or two nostrils [4, 6].

Increasingly, the otolaryngologist is called on to provide exposure for the neurosurgeon performing transsphenoidal

S. Varshney (✉) · S. S. Bist · S. Bhagat
Department of E.N.T., Himalayan Institute of Medical Sciences, HIHT University, Jollygrant, Doiwala, Dehradun 248 140, Uttarakhand, India
e-mail: drsaurabh68@gmail.com

C. Gupta · K. K. Bansal
Department of Neurosurgery, Himalayan Institute of Medical Sciences, HIHT University, Jollygrant, Doiwala, Dehradun 248 140, Uttarakhand, India

hypophysectomy. Since the early days of pituitary surgery, a variety of transnasal approaches have been used to gain access to the sella turcica. Each of these approaches requires crossing the sphenoid sinus, hence the transsphenoidal designation of these methods [2, 3]. The team management of pituitary disorders is stressed. We reviewed our series of 52 patients undergoing transnasal hypophysectomy.

History

Surgical approaches to pituitary adenomas have undergone significant adaptation since the first attempted transcranial and transsphenoidal decompression operations of the early 19th century.

In 1889 Horsley, using a transcranial approach is credited with performing the first operation for a pituitary tumor [17]. In 1906 Schloffer reported the first removal of a pituitary tumor through an extracranial transsphenoidal approach [18]. Hirsch later modified this approach in 1909. However, it was Cushing's transseptal-transsphenoidal method introduced in 1910, which standardized this approach to pituitary tumors [33]. The transseptal-transsphenoidal technique gained popularity throughout the early 1900s. Cushing himself reported on 247 pituitary tumors removed by this method between 1910 and 1929 [7]. Inability to reach suprasellar tumor extension, poor illumination, CSF leakage, meningitis, and a high recurrence rate all led Cushing and his contemporaries to abandon the transseptal-transsphenoidal approach by the early 1930s in favor of the transcranial procedure [19].

It is Hardy however, who deserves much of credit for reestablishing the validity of the transsphenoidal approach, when in the 1960s he combined fluoroscopy and microsurgical techniques to further augment transsphenoidal pituitary tumor resection [7, 8]. These new technologies provided the transseptal-transsphenoidal approach with significant advantages over the transcranial procedure. The improved visualization, allowed for more complete tumor removal, and reduced the incidence of complications. In the ensuing 40 years several large series have established the transsphenoidal approach as the procedure of choice for all but the most massive pituitary adenomas, demonstrating outcomes equivalent or better than those reported for the transcranial procedure with fewer complications [15, 16].

The use of rigid endoscopes for sinus surgery provided the inspiration for their application to pituitary surgery [14]. In 1992 Jankowski provided the first description of fully endoscopic transnasal-technique [17]. Jho has published relatively large series describing his experience with 44 pituitary adenomas and 6 other parasellar lesions [18]. Reports have suggested that in addition to providing more complete tumor removal, the endoscopic technique may also result in a lower incidence of complications related to blind dissection [20–23].

We believe that these improved outcomes are the result of the superior illumination, visualization, and angled view provided by the endoscope. Angled endoscopes allow for complete resection of high-grade (invasive) tumors, visualizing parasellar and suprasellar tumor extension, and allowing for rapid decompression of the optic chiasm. Often, the full extent of extrasellar tumor growth is not visible with the direct line of site of the operating microscope.

Patients with massive suprasellar tumor extension are recommended to undergo a transcranial approach.

Treatment Options for Pituitary tumour-

Three treatments are used, alone or in combination:- Surgery (removing the tumor), Radiation therapy (using high-dose X-rays to kill tumor cells) and Medication to block excess hormone secretion, and sometimes, shrink the tumor The main treatment is surgery. The effectiveness of surgery depends on the tumor type, location, size, and whether it has spread into nearby tissues.

Surgery

There are three main surgical techniques:

Transphenoidal hypophysectomy

The tumor is reached and removed through the nasal cavity. Advantages are that no other part of the brain is touched, the neurological complication rate is low, and there is no visible scar. However, removing large tumors is difficult. If the tumor is a microadenoma, then the cure rates are high (greater than 80%). If the tumor is large or has invaded the nearby nerves or brain tissue, chances diminish for a surgical cure. The operation can usually be done through the nose without an external incision. The hospital stay is usually one night [24].

Transcranial hypophysectomy

This technique approaches the tumor through the upper part of the skull and usually is the procedure of choice for large and complicated tumors. Patients can often leave the hospital 4 days after surgery.

Computer-assisted surgery for tumor removal

In traditional craniotomies (skull surgery), incisions have to be large enough to ensure that the surgeon can find the brain tumor within the opening. The stereotactic (from Greek: stereo—three dimensions; tactic—to probe) methods in brain tumor surgery have significantly reduced the invasiveness of surgical procedures to remove brain tumors.

Radiation

Radiation uses high-energy rays to destroy tumors, alone or following surgery. It may also be used if surgery is not possible. Radiation therapy is often recommended when pituitary tumors persist or return after surgery and cause symptoms not relieved by medications.

External-beam radiation

This traditional therapy delivers radiation from outside the body. The radiation comes from a large machine, and treatments usually are given five times a week over four to 6 weeks on an outpatient basis. Although effective, this therapy has some disadvantages. It can take years before the tumor growth and/or hormone production are fully controlled. Also, this therapy cannot avoid damaging the remaining normal pituitary cells. In most cases, normal pituitary function will eventually be lost. Also some normal brain tissue may be damaged, particularly those areas near the pituitary gland.

Stereotactic radiosurgery

Some intriguing new methods in brain tumor treatment involve this type of radiation. The treatment precisely focuses radiation beams to the tumor. No scalpels are involved. Gamma Knife (stereotactic radiosurgery) delivers radiation beams to match the tumor precisely with the aid of brain imaging techniques. The advantage of stereotactic radiosurgery is that surrounding, healthy tissue receives minimal radiation compared to the tumor. It may be used with external-beam radiation, especially for tumors in deep or sensitive areas of the brain, where surgical removal is dangerous. It is a one-day outpatient procedure.

Medication

Medications can decrease the excess hormone production from pituitary tumors, or block the effects of these hormones. Prolactin-producing tumors may also shrink with medical therapy. Hormones that become deficient are replaced through medication.

Observations

Surgery for pituitary tumours at our institution was performed by rhinosurgical route by combined procedure by otolaryngologist and neurosurgeons. A retrospective review of case records of patients who had endonasal endoscopic transsphenoidal approach for pituitary tumours from April 2005 to March 2011 was performed. A total of 58 transphenoidal surgeries were performed during this study period. (Figs. 1, 2, 3) Only 54 case records with adequate information were available for review, which were for primary or recurrent pituitary adenomas. From a total of 54 pituitary adenomas, 44 (81.5%) were hormonally active, while 10 (18.5%) were non-functioning. Mean follow-up period was 18.2 months. The average length of hospital stay was 2.4 days. The most common indications for longer hospitalization included temporary diabetes insipidus and prior co-morbid conditions which required extended monitoring or rehabilitation. All patients had postoperative MRI/CT studies to assess residual or recurrent disease;

Fig. 1 Coronal MRI brain- showing pituitary tumour

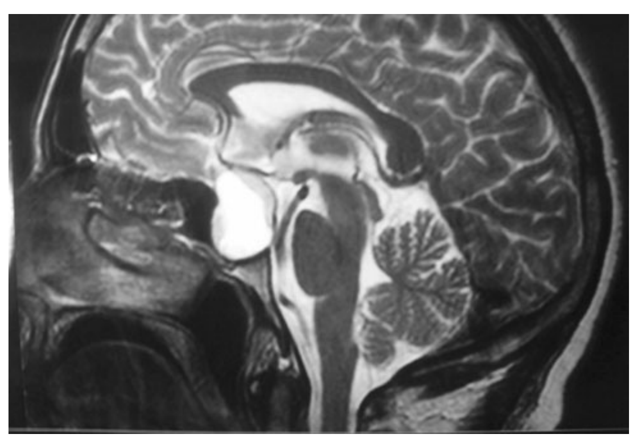

Fig. 2 Sagittal MRI brain- showing pituitary tumour

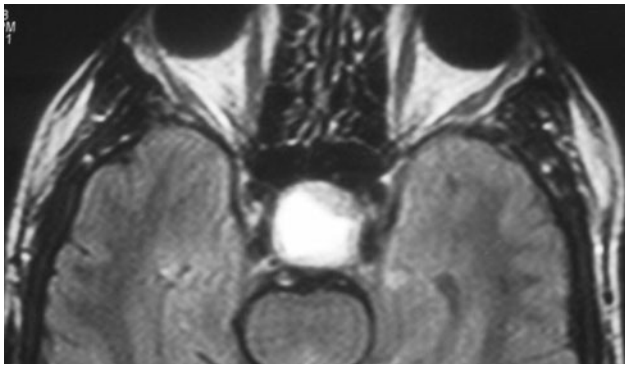

Fig. 3 Sagittal MRI brain- showing pituitary tumour (pressing on optic chiasma)

(Fig. 4) all patients with hormonally active tumors had additonal postoperative hormonal studies. Remission, being defined as no hormonal or radiological evidence of recurrence within the time-frame of the follow-up. Remission was demonstrated in 49/54 (90.7%) of adenomas.

There were 26 males (48.1%) and 28 females (51.9%). The age ranged from 18 years to 56 years, with a mean of 26.4 years. Other than hormonal symptoms the most common presenting complaints included visual symptoms—changes in visual acuity or visual field deficits (48) (88.9%) headache (38) (70.4%) menstrual cycle disturbance or impotence (18) (33.33%), and acromegalic features (16) (29.62%). Forty-eight patients had macroadenoma (88.9%) and 6 had microadenomas (11.1%). Thirty-six patients out of 48 macro-adenoma had suprasellar extensions (66.6%). Only 05 patients (9.25%) had lumbar drain inserted prior to commencement of the surgery and the majority of these were macroadenomas. All cases were done under general anaesthesia. The mean follow-up duration for these patients post-surgery was 8.2 months. The common complications encountered were diabetes insipidus (4) (7.40%), cerebrospinal fluid leak (2) (3.70%), meningitis (2) (3.70%), epistaxis (2) (3.70%)- post-operative sphenopalatine bleed, septal perforation (1) (1.85%), and anterior pituitary insufficiency (2) (3.70%). and one patient developed numbness of the tip of the nose. Mean operative time was 90 min. Our study reveals that endonasal transsphenoidal approach is a safe and effective method of management of pituitary adenomas.

Patient outcomes were determined from intra-operative assessment of tumor resection, postoperative hormonal levels and MR imaging results. MR imaging studies were performed for all patients during the early postoperative period, to be repeated after 6–12 months and then annually for the rest of their follow-up period. Endoscopic transnasal hypophysectomy technique demonstrated remission (being defined as no hormonal or radiological evidence of recurrence within the time-frame of follow-up) in 49/54 (90.7%) patients. Five of the patients demonstrating recurrent tumor had a mass ranging from 5 to 8 mm on an MRI scan performed postoperatively, two of them underwent revision surgery and 3 of them having recurrence located in the cavernous sinus were referred for Gamma knife surgery. There was no mortality in our series.

Surgical Procedure

The operation takes place with the patient supine The head of the bed is elevated and the patient's neck is slightly extended and rotated toward the nostril to be used for the procedure. Depending on the pre-operative assessment of

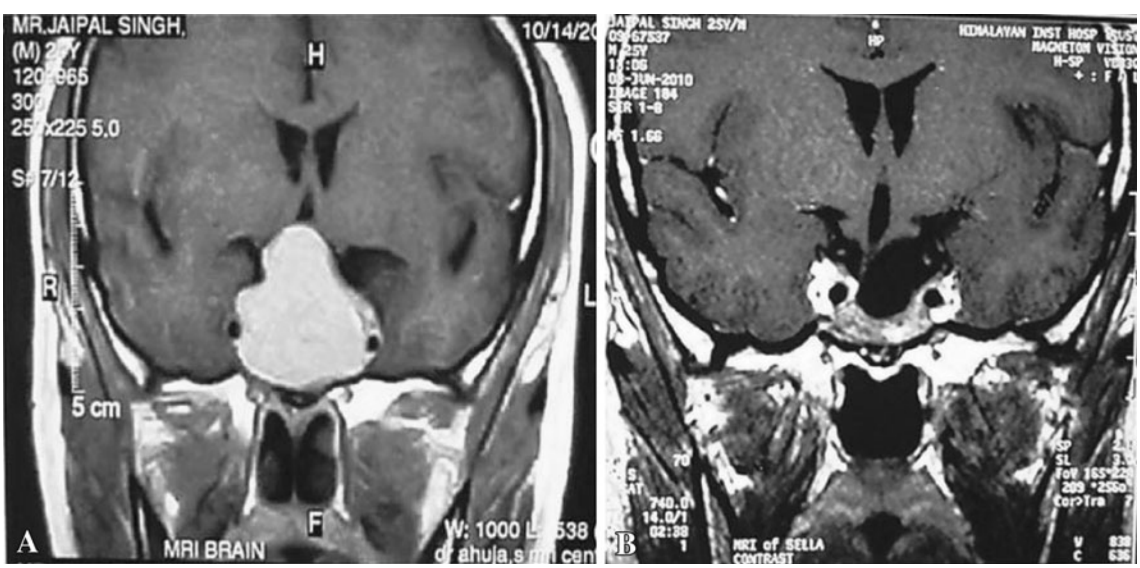

Fig. 4 Pre op. MRI (**a**) and Post op. MRI (**b**) after 6 months

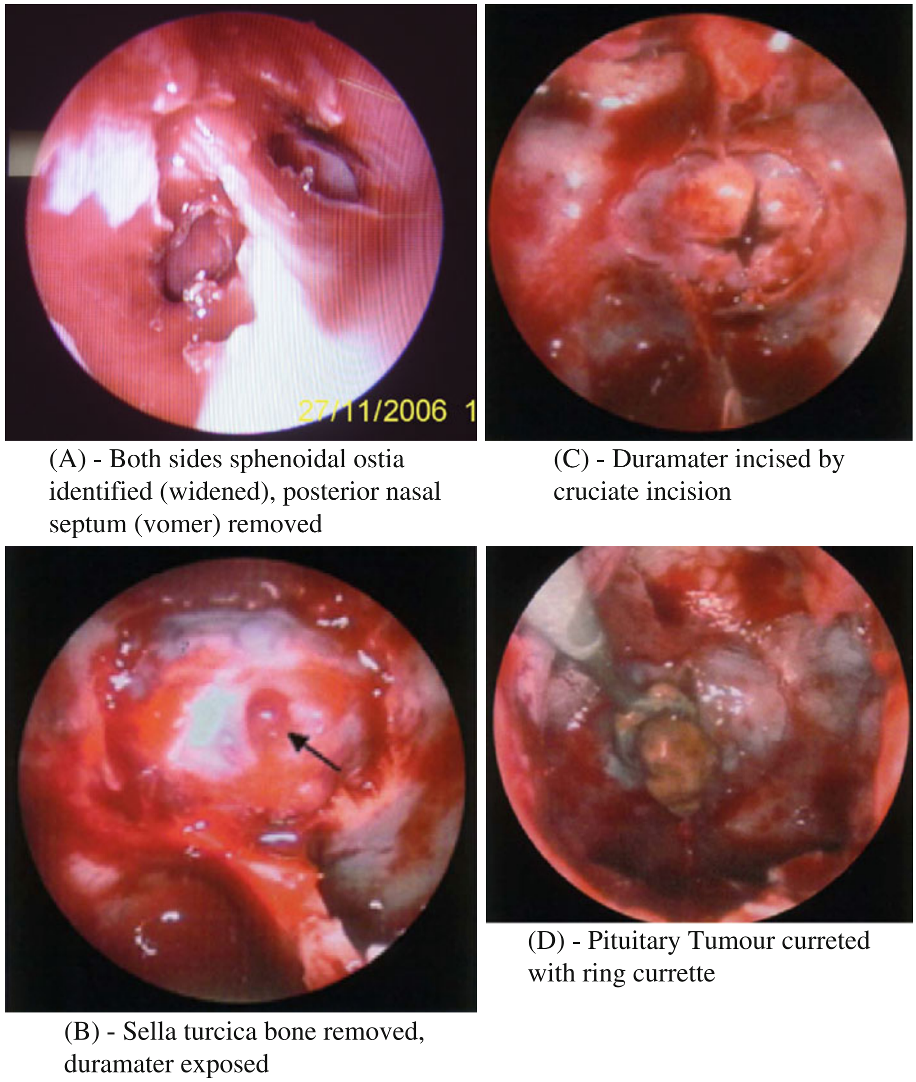

Fig. 5 **a** Both sides sphenoidal ostia identified (widened), posterior nasal septum (vomer) removed, **b** Sella turcica bone removed, duramater exposed, **c** Duramater incised by cruciate incision, **d** Pituitary Tumour curreted with ring currette. Surgical steps **a**. Identification of bilateral sphenoidal ostia; **b**. Sella opened wide, meninges cut as cruciate incision and tumour curreted with ring currete; **c**. Duramater incised by cruciate incision; **d**. Pituitary Tumour curreted with ring currette

the patients nasal passageway a 4 mm endoscope is used. The video monitor is positioned behind the patient's shoulder directly opposite the surgeon's line of vision. The 0° endoscope is used to guide the intranasal dissection and initial tumor resection. Initially sphenoid ostia is identified and sphenoidotomy is done (infero- medially), sella turcica is identified, mucosa over sella is removed and sella bone is removed (using sickle knife/periosteal elevator/drill). Exposed duramater is cauterized and cut in a cruciate manner. After taking tissue for histopatholy, tumor resection is carried out using a suction device and ring curettes of varying diameter and orientation (Fig. 5).

All operations are performed via a single/double nostril approach. Once tumor resection is complete or residual tumor is outside the field of view, the 0° endoscope is withdrawn and a 30° endoscope is inserted. The angled lens of this endoscope provides excellent exposure of the suprasellar and parasellar regions. Rotating the 30° endoscope clockwise and counterclockwise provides visualization of suprasellar and parasellar tumor extension, including invasion into the cavernous sinus if present. Any residual tumor is resected, eliminating areas of potential tumor recurrence. Once tumor resection is complete, the area is irrigated and hemostasis is obtained.

An abdominal fat graft is harvested and used to reconstruct the sellar defect, which is then sealed using surgicel and abgel. Nasal packing is done with merocel which is removed after 48 h [23].

Conclusion

Currently, the Transnasal—Transsphenoidal (TNTS) hypophysectomy approach represents the standard approach by which the vast majority of pituitary adenomas are surgically resected. This report suggests and demonstrates that the fully endoscopic transnasal procedure may result in improved rates of complete tumor removal and a reduced incidence of complications. The results of this fully endoscopic transnasal series are quite encouraging. We echo the statements of Jho regarding the challenges to successful outcomes: "Certainly, a learning curve exists for a surgeon who is not familiar with the endoscope. A surgeon inexperienced with this technique may become frustrated if the two instruments consistently strike each other in the small operating space [9]. We believe that the inherent advantages of endoscopic visualization, along with continued refinement of the endoscopic technique and instruments will allow this method to become the future gold standard surgical approach to pituitary adenomas.

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