Endoscopic Nasal and Anterior Craniotomy Resection for Malignant Nasoethmoid Tumors Involving the Anterior Skull Base

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ABSTRACT

Objectives: The traditional approach to sinonasal tumors involving the skull base has been the anterior craniofacial resection. The first report by Ketcham et al (*American Journal of Surgery*, 1963;106:698–703) documented their experience with 17 anterior craniofacial resections for malignant tumors of the sinonasal tract. Later experience with this technique at several centers has resulted in the publication of many refinements of technique and further reduction in the morbidity and mortality associated with this procedure. In our hands, endoscopic techniques have allowed us to approach the intranasal aspect of skull base lesions without external incisions and yet still achieve an en bloc resection. The type of lesions suitable for this approach and the associated technical issues are discussed in this article. **Methods:** Between 1999 and 2004, 18 patients with malignant nasoethmoid tumors underwent endoscopic nasal and anterior craniotomy resections. The average age of the patients 60.2 years, with a male-to-female distribution of 15 to 3. Mean follow-up period was 25.1 months. **Results:** Two patients died from postoperative complications, three died from recurrent disease and two from unrelated causes. Eleven patients are free of disease with a mean survival of 19.8 months. **Conclusions:** Although we do not consider this approach a replacement for the traditional anterior craniofacial resection, it is an important adjunct in the skull base surgeon's armamentarium.

KEYWORDS: Cranionasal, endoscopic, malignant tumors

The conventional surgical approach for nasoethmoid tumors that involve the anterior skull base is a combined craniofacial resection. In the literature, the main cause of poor outcome is local recurrence. Anterior craniofacial resection was introduced in 1963 by Ketcham and colleagues.¹ His technique allowed an en bloc resection (oncologic box) of the cribriform plate superiorly and the lamina papyracea laterally and this led to improved local control of disease. Traditionally, this approach is performed through a frontal craniotomy combined with a transfacial approach (lateral rhinotomy or midface degloving).

Recent refinements in endoscopic techniques together with the development of related surgical instruments allows complete radical resection of complex anatomical structures through combined transcranial and endonasal approaches without compromising any oncological principles. This approach was first proposed by Yuen² in 1997, who pioneered the resection of esthesioneuroblastoma infiltrating the ethmoidal cribriform plate. Two years later, Thaler and associates³ published the Pennsylvania University experience of just four patients with sinonasal tumors involving the anterior skull base. The largest experience reported in the literature is that of Devaiah and coworkers,⁴ who reported the outcomes of seven patients with esthesioneuroblastoma (3 Kadish A, 1 Kadish B, and 3 Kadish C) who underwent cranioendoscopic resection with a mean follow-up of 62.3 months. This innovative surgical approach avoids osteotomies of the face and so reduces postoperative morbidity and the risk of complications following radiotherapy. We report our experience of cranioendoscopic resection from 1999 to 2004.

PATIENTS AND METHODS

Between 1999 and 2004, 18 patients were admitted to our institution with malignant lesions of the sinonasal complex that involved the anterior skull base. This group of patients consisted of 15 males

and 3 females with mean age of 60.2 years (ranging from 35 to 74 years). Five of them had already undergone surgery elsewhere and had recurrent disease. The most frequently encountered malignant lesions were adenocarcinoma and squamous cell carcinoma, and the most common clinical stage was T4b-N0-M0⁵ (Table 1).

Preoperative evaluation consisted of CT and MR scans, multiple nasal biopsies, and a screen for metastatic disease.

The combined technique was performed simultaneously through a transcranial and endonasal endoscopic approach under general anesthesia with the patient in a slightly head-up position.

The *transcranial surgical approach* was performed through a frontal craniotomy that varied in size and shape according to the individual patient's need. Inferior osteotomies were made a few millimeters above the superior orbital ridge so that

Table 1 Follow-Up of Patients Treated with Cranioendoscopic Approach

N		+ Margins	NED	DOD	DOC
Adenocarcinoma					
1	rT1	–	1	–	–
3	T3	–	2	–	1 (36 m)
1	T4a	–	1	–	–
4	T4b	–	3	–	1*
1	rT4b	1	–	1 (12 m)	–
Squamous cell cancer					
1	rT1	–	1	–	–
1	T4b	–	1	–	–
1	rT4b	–	1	–	–
Melanoma					
1	rT4a	–	–	1 (16 m)	–
1	T4b	1	–	1 (13 m)	–
Ectomesenchymoma					
1	T4b	–	1	–	–
Fibrosarcoma					
1	T1	–	–	–	1 (18 m)
Neuroendocrine cancer					
1	T4b	–	–	–	1*
N TOT					
18		2	11	3	4

*Died postoperatively; m, months; NED, no evidence of disease; DOD, died of disease; DOC, died from other causes; r, recurrence; + Margins, positive margins; N, number of patients; N TOT, total number of patients.

good exposure of the lesion parallel to the anterior skull base could be achieved without excessive brain retraction. This approach was entirely extradural in 15 patients and intradural in 3 patients. Again, this was entirely determined by the stage of the disease (Table 1). Osteotomies were made with a high-speed drill along the margins of the ethmoidal planum through the craniotomy, so that the ethmoid box could be defined and outlined from papyracea to papyracea and from the posterior portion of the sphenoidal planum to the anterior wall of the frontal sinus.

The endonasal surgical step was performed with 4-mm rigid endoscopes (0 and 45 degrees) with appropriate straight, angled, and double-angled instruments. Sometimes it was necessary to debulk the tumor with a microdebrider, thereby identifying its point of attachment and allowing it to collapse inwards. The sphenopalatine arteries were isolated and coagulated to reduce bleeding and improve visibility. A laser was employed to complete the resection of the nasal mucosa and of the underlying tissues up to the osteal plane, the lateral nasal wall, nasal valve, superior choanal border, and nasal septum.

Multiple biopsies were made anterior to the incision line to check the margins. The nasal septum was transected inferiorly along its entire length and also anteriorly through a vertical incision from the nasal vault at the level of anterior nasal spine. Posteriorly, the nasal septum was separated from the vomer using a drill. This cut was extended superiorly to remove the intersphenoid septum and parts of the sphenoid floor, taking care laterally not to damage the optic nerves or carotid arteries. The posterior resection line was completed at the level of the sphenoidal planum. Once the osteotomies were completed, it was possible to remove the ethmoid box as an en-bloc specimen. In fact, the simultaneous use of an endoscope and an operating microscope displaying their images on one screen gave a superb 360-degree view of the resection margins.

Anterior skull base reconstruction was achieved with a pedicled pericranial graft secured

with interrupted sutures to the sphenoid planum posteriorly and to the orbital roof laterally. This pedicled graft was reinforced with a free graft of temporalis fascia that was placed endonasally and fixed with reabsorbable sponge and fibrin glue.

The patients were kept intubated and ventilated for 24 hours. No lumbar cerebrospinal drainage was required. Anterior nasal packs were kept in place for 2 to 3 days.

RESULTS

Eighteen patients with malignant sinonasal tumors have been treated with the combined anterior cranial and endoscopic transnasal approach. All patients had an en bloc resection of the lesion. Intraoperative biopsies of the surgical margins were positive in two cases. Further resection was not possible in these because of the location of residual disease. Two patients died. Both had large intracranial extensions of their tumors, a T4a-N0-M0 adenocarcinoma and a T4b-N0-M0 neuroendocrine carcinoma. The first patient died from diffuse brain swelling in the postoperative period and the second patient from a large postoperative intracerebral hematoma.

The remaining patients had uneventful recoveries with a mean period of hospitalization of 10 days (minimum 7 and maximum 28 days). Their follow-up consisted of regular nasal endoscopic examination starting 15 days after surgery, then every month for the first year, and then every 3 months for the next 5 years. Neuroradiologic assessments with MRI were made in the postoperative period and again after 6 months.

Seven patients had postoperative radiation therapy alone and one patient had chemoradiotherapy. Two patients had postoperative chemotherapy, and one patient had induction chemotherapy followed by postoperative radiation.

Mean follow-up period of 16 patients was 25.1 months with a range of 3 to 64 months.

Among these 16 patients, 3 died from their disease (one melanoma 16 months later, another melanoma with positive margins 3 months later, and one adenocarcinoma 12 months later), and 2 patients died from unrelated causes after 36 and 18 months (Table 1). Eleven patients are free of disease with a mean survival period of 19.8 months.

CONCLUSIONS

It is reported in the literature that extensive malignant sinonasal tumors can be managed successfully with an en bloc resection through an anterior transfacial-cranial approach. The cranioendoscopic approach allows en bloc resection and respects these oncologic principles. With this technique, all facial incisions are avoided and osteotomies are minimized. We feel that this reduces the period of hospitalization and speeds recovery. Furthermore, intraoperative endoscopy facilitates placement of the osteotomies in the optimal position and improves the likelihood of achieving a complete en-bloc resection with removal of all disease hitherto obscured from vision. Simultaneous use of an operating microscope and endoscope improves the surgeon's visual perspective and gives a 360-degree view of the "box of resection" during its removal and an even more accurate view of the surgical margins. Close and constant cooperation between

the neurosurgeon, otolaryngologist, and pathologist is absolutely necessary, using the skills of each to the benefit of the patient.

Major exclusion criteria for this approach are: (1) tumors involving the lacrimal tract; (2) tumor infiltration of the hard palate; (3) tumors that involve the posterior wall of the sphenoid sinus; and (4) tumor invasion of all but the medial wall of the maxillary sinus.

The transnasal endoscopic approach combined with a bifrontal craniotomy represents an alternative to the traditional transfacial approaches and allows adequate resection with comparable oncologic outcomes.

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