Endoscopic Craniofacial Approach for Intracranial Polyposis: The “Blue-Sky Technique”

Gady Har-El, M.D., F.A.C.S.^{1,2} and Roxanne Todor, M.D.²

ABSTRACT

Massive sinonasal polyposis associated with skull base dehiscence and intracranial extension is a difficult disease to treat. Conventional transnasal or transfacial techniques can result in dural injury, cerebrospinal fluid (CSF) leak and infection. We describe our experience with a combined neurosurgical-endoscopic technique that protects the meninges. Five patients with massive sinonasal polyposis extending intracranially through skull base dehiscence were reviewed retrospectively. The minimum follow-up was 2 years. A frontal craniotomy was performed through a bicoronal approach. The dura was carefully separated from all infectious material at the floor of the anterior cranial fossa. The frontal lobe with the intact meninges was elevated off the anterior cranial floor. A sheet of blue plastic material was inserted under the frontal lobe from the craniotomy site to the planum sphenoidale. Next, a transnasal endoscopic ethmoidectomy, sphenoidectomy, and frontal sinusotomy were performed to remove the inflammatory processes. The blue plastic material was visible through any existing or potential skull base dehiscence, thus providing visual protection for the dura and brain. All gross disease was removed from the frontal, ethmoid, and sphenoid skull base regions in the 5 patients without dural injury. None of the patients developed a CSF leak or meningitis. Two patients developed recurrent polyposis limited to the sinuses without intracranial extension. The endoscopic craniofacial approach with the “Blue-Sky” protective technique offers a safe method for completely removing massive sinonasal polyposis associated with an intracranial extension.

KEYWORDS: Sinonasal polyposis, craniofacial resection

Skull Base, volume 13, number 4, 2003. Address for correspondence: Gady Har-El, M.D., Department of Otolaryngology, SUNY-DMC, Box 126, 450 Clarkson Ave., Brooklyn, NY 11203. Departments of ¹Otolaryngology and ²Neurosurgery, State University of New York–Downstate Medical Center, Brooklyn, New York. Copyright © 2003 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA. Tel: +1(212) 584-4662. 1531-5010,p;2003,13,04,235,240,ftx,en;sbs00363x.

Anterior craniofacial resection has become a "gold-standard" technique in anterior skull base surgery. It is most commonly used to resect malignant tumors but occasionally it is performed to manage benign tumors and tumor-like lesions. The classic anterior craniofacial resection includes a frontal craniotomy performed through a bicoronal scalp flap incision and a transfacial incision, most commonly a lateral rhinotomy. In the past 15 years, modifications of this classic approach have been described and include the subcranial approach, the midfacial degloving approach, endoscopic approaches, and endoscopic-assisted approaches.

We describe an endoscopic anterior craniofacial resection. The cranial portion of the procedure is performed with a formal craniotomy through a bicoronal flap approach. The transfacial portion is done endoscopically. When we performed this approach to treat massive polyposis associated with multiple intracranial extensions of the polyps, pyoceles, or both (Fig. 1), we add a protective visual

barrier between the brain and the anterior bony skull base to prevent injury to the dura or brain.

PATIENTS AND METHODS

Between 1994 and 2001, five patients (3 females, 2 males; age range, 14 to 51 years) underwent endoscopic anterior craniofacial resection for massive polyposis associated with intracranial extensions with multiple small mucocoeles and pyoceles. The minimum follow-up was 2 years.

SURGICAL TECHNIQUE

The procedure was performed with patients under general anesthesia with a lumbar subarachnoid drain in place. After a bicoronal flap was elevated and the

Figure 1 Coronal (A) CT and (B) MRI showing massive nasal and pansinus polyposis with intracranial extension.

frontal bone was exposed, a low frontal craniotomy was performed, the lumbar drain was opened, and the frontal lobe was allowed to relax away from the anterior cranial floor. The dura was elevated from the anterior cranial floor unilaterally or bilaterally, depending on the extent of the polypoid process. The dura was gently dissected and separated from all inflammatory and infectious material. Mucoceles and pyoceles were separated from the dura. The dura is elevated in an anterior-to-posterior direction until a normal skull base without dehiscence and without intracranial polyposis is reached. Pre-operative CT helps to determine the posterior extension of the dissection. In most cases, minimal lumbar drainage of CSF is required. However, if the inflammatory process extends to the sphenoid sinus, more aggressive drainage may be required to allow exposure.

After the dura is separated from the skull base, an appropriately sized sheet of blue plastic material (usually cut from a Mayo stand cover) is inserted under the dura to sit on top of the bony skull base, covering the inflammatory process extending from the sinuses (Fig. 2). The brain is allowed to "sit" on the blue plastic material. The bicoronal flap is temporarily replaced on the cranium, and attention is directed to the transnasal component of the procedure. The endoscopic procedure may include a com-

Figure 2 A blue plastic material is inserted between the brain and the anterior bony skull base.

Figure 3 Endoscopic view of skull base dehiscence in the frontoethmoid and sphenothmoid regions.

plete ethmoidectomy, frontal sinusotomy, and sphenoidotomy, depending on the extent of the inflammatory process. The blue plastic material provides an excellent visual indication of where the skull base is located (Fig. 3). It also prevents the dura and brain from being injured because the surgeon can easily identify the sheet as the superior limit of any surgical manipulation (hence the "blue-sky" technique).

When the transnasal endoscopic procedure is completed, the bicoronal scalp flap is reflected inferiorly and the blue sheet is removed. A pericranial or pericranial-galeal flap is developed unilaterally or bilaterally, depending on the extent of the skull base defect (Fig. 4). This flap is thin and reliable and routinely used as the reconstructive workhorse during a classic anterior craniofacial resection. The pericranial flap is placed under the dura and on top of the skull base to cover any skull base defects. The lumbar drain is closed and the frontal lobe slowly returns to its normal position on the reconstructed skull base. The craniotomy bone flap is replaced and fixated, and the bicoronal flap is closed. Routine postsinus surgery packs are used (Figs. 5 and 6).

Figure 4 Elevation of a unilateral pericranial-galeal flap.

RESULTS

Each patient had between 1 and 3 areas of complete dehiscence of the anterior skull base. Two of the patients had aggressive, nonallergic, fungal sinusitis. Both patients were immunocompetent. The other 3 patients had the classic manifestations of Samter's triad. Eight years before presenting to us, 1 patient had undergone a craniotomy and external ethmoidectomy.

There were no intraoperative or postoperative complications. Two patients had recurrent dis-

ease. One patient had recurrent ethmoid sinusitis and polyposis. She failed medical treatment and required revision endoscopic sinus surgery. Preoperative CT showed no evidence of an intracranial extension. During surgery, a routine ethmoidectomy was performed without the need to violate the skull base. A second patient had persistent maxillary sinusitis with polyposis, which was controlled with aggressive medical treatment. In the future, however, she may require revision endoscopic maxillary and anterior ethmoid surgery.

DISCUSSION

Anterior craniofacial resection has become a "gold standard" in anterior skull base surgery. Recently, endoscopic modifications of the procedure have been described. Carrau et al¹ described their endoscopic removal of a juvenile angiofibroma. In at least one of their cases, it was combined with craniotomy. Yuen et al² described the combination of a frontal craniotomy with an endoscopic transnasal approach to manage an esthesioneuroblastoma. Thaler et al³ used endoscopic anterior craniofacial resection to manage four patients with sinonasal tumors (ade-

Figure 5 (A) Axial and (B) coronal CTs of a 20-year-old woman, with massive nasal and pansinus polyposis with intracranial extension and multiple mucocele formation.

Figure 6 Postoperative coronal CTs of the (A) frontoethmoid and (B) posterior ethmoid regions of the patient in Figure 5. The left skull base is reconstructed with a pericranial flap (arrow).

nocarcinoma, meningioma, squamous cell carcinoma, and inverted papilloma).

Our technique is very similar to those described earlier. In addition to using this technique to manage anterior skull base tumors, we have also used it to manage massive polyposis with intracranial extension. We added a visual barrier to assist with the endoscopic part of the procedure and to prevent dural and brain injury. This technique has allowed our endoscopic surgery to be aggressive and comprehensive. It may be argued that the entire surgery could have been done endoscopically. We believe that the risk of dural injury by pulling on intranasal polyps (which are attached to the dura with inflammatory reaction) is significant and may cause CSF leakage (even without the actual placement of instruments above the skull base). Using endoscopic anterior craniofacial resection with protection of the dura prevents this potential risk.

Massive polyposis, especially with Samter's triad, carries a significant incidence of recurrence. Therefore, a very close endoscopic and radiologic follow-up is required in these cases. Early diagnosis of recurrence and aggressive medical management are used as the first-line treatment for a recurrence.

However, if revision surgery is required, the pericranial flap can provide complete separation between the sinonasal cavity and the brain without extension of the recurrent disease intracranially as it did in two of our patients.

CONCLUSIONS

Endoscopic anterior craniofacial resection with the use of a visual protective barrier provides a safe and dependable technique for managing massive sinonasal polyposis with intracranial extension.

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