Endoscopic Drainage of Subperiosteal Abscess in Children: A Pilot Study

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ABSTRACT

Subperiosteal abscess is a serious orbital complication of sinusitis that occurs predominantly in children. Infection may spread to the orbital site through a preexisting defect in the lamina papyracea or by means of a thrombophlebitic process. Although the traditional approach to treating a subperiosteal abscess has been drainage through an external incision, we treated this serious complication with functional endonasal sinus surgery. Ten pediatric patients with clinical and CT evidence of orbital subperiosteal abscess underwent endoscopic surgery at LeBonheur Children's Hospital in Memphis, Tenn., between July 1990 and June 1992. The four girls and six boys were between 3 and 12 years of age at the time of surgery. Despite 2 to 4 days of intravenous antibiotic therapy, their signs and symptoms progressed, and axial and coronal CT scans demonstrated orbital subperiosteal abscess. Seven patients had bilateral ethmoid and maxillary sinusitis, and the remaining three patients had unilateral ethmoiditis. Ophthalmologic assessments were performed for all patients immediately after hospital admission. The patients were started on regimens of high-dose intravenous cefuroxime sodium to subdue infections and pediatric decongestant nasal spray to facilitate drainage. All 10 patients with the confirmed diagnosis of subperiosteal abscess were treated with endoscopic surgery to drain the site of infection. All 10 patients improved significantly 12 to 24 hours after surgery and were discharged from the hospital to their homes 48 to 72 hours after surgery. Patients were continued on a regimen of broad-spectrum oral antibiotics and beclomethasone nasal spray for 2 weeks beyond the final examination. Follow-up endoscopic examinations were performed under general anesthesia in the operating room 2 to 3 weeks after surgery. No complications or adverse sequelae occurred. Our study appears to confirm that endoscopic drainage of subperiosteal abscess offers the patient an alternative to incisional surgery. The endoscopic approach prevents an external scar without increasing morbidity or length of hospitalization. (American Journal of Rhinology 10, 11–15, 1996)

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Orbital infections are the most common complications of sinusitis, with most cases occurring in the pediatric age group. Orbital infections include periorbital cellulitis, orbital cellulitis, subperiosteal abscess, orbital abscess, and cavernous sinus thrombosis. Other possible sequelae include meningitis, intracerebral abscess, and blindness.[1]

Orbital subperiosteal abscess is collection of pus between the medial orbital wall (lamina papyracea) and the periosteal covering (periorbita) of the bone. Infections from the ethmoid sinus can spread to the orbit through congenital defects or through preformed pathways, such as natural bony deficiencies in the lamina papyracea. More commonly, infections spread to the orbit through a thrombophlebitic process that involves the vessels communicating with the nose, paranasal sinuses, orbits, and the cavernous sinus.

The diagnosis of orbital subperiosteal abscess should be suspected if a patient with orbital cellulitis has progressively worsening orbital signs despite medical therapy. In most cases, the diagnosis is documented with the aid of high-resolution computed tomography (CT) scans of the sinuses, orbits, and brain. Although the CT scans do not always

differentiate a phlegmon from tissue liquefaction, it is the most reliable diagnostic tool available.[2–5]

Surgical intervention is required to drain the abscess. If untreated, orbital subperiosteal abscess may lead to serious orbital sequelae, such as blindness, or potentially fatal intracranial complications.[6,7] The traditional approach to treatment has been external ethmoidectomy, but with the introduction of functional endonasal sinus surgery for pediatric patients,[8] it became possible to achieve excellent visualization of the ethmoid cavity and abscess drainage using an endoscopic approach. Our results support the opinion that this procedure may become the treatment of choice for drainage of subperiosteal abscess.

PATIENTS AND METHODS

Patients

Ten pediatric patients with clinical and CT evidence of orbital subperiosteal abscess were treated with functional endonasal sinus surgery between July 1990 and June 1992. The four girls and six boys were between 3 and 12 years of age at the time of surgery, performed at LeBonheur Children's Hospital.

Four patients were referred to our care from another hospital after their signs and symptoms progressed despite 2 to 4 days of intravenous antibiotic therapy. The CT scans performed immediately after admission to our hospital demonstrated orbital subperiosteal abscess, and surgical drainage was performed. The orbital signs of the other 6 patients in our hospital progressed despite 24 to 48 hours of therapy with intravenous cefuroxime sodium. For each of these patients, axial and coronal CT scans demonstrated an orbital subperiosteal abscess, which appeared as a convex mass with an enhanced rim in the medial aspect of the affected eye (Fig. 1). Seven of 10 patients had bilateral ethmoid and maxillary sinusitis, and the remaining 3 patients had unilateral ethmoiditis.

The clinical presentations included a variety of signs and symptoms, which are summarized in Table I. An ophthalmologic consultation was obtained for every patient immediately after admission to our hospital, because it is essential to evaluate visual acuity, the degree of proptosis, and the limitation of extraocular motility. Visual acuity usually was measured hourly by an experienced nurse using an eye card, and the patients were closely observed by an ophthalmologist.

All patients were started on regimens of high-dose intravenous cefuroxime sodium to subdue infection and pediatric decongestant nasal spray (i.e., Afrin or Neo-Synephrine) to reduce mucosal swelling and to enhance drainage. We obtained high-resolution axial and coronal CT scans with and without enhancement of the sinuses, orbits, and brain. All 10 patients with the confirmed diagnosis of subperiosteal abscess were treated with endoscopic surgery to drain the sites of infection.

Surgical Technique

The technique and principles of the endoscopic procedure for treating subperiosteal abscess are essentially the same as those applied in pediatric functional endonasal sinus surgery. The initial goal is to secure optimal vasoconstriction, because bleeding may be a major problem.

Figure 1. A high-resolution computed tomography scan assists in diagnosing subperiosteal abscess and in planning surgery for drainage of the abscess.

TABLE I

Clinical Manifestations of Subperiosteal Abscess

Clinical Features	Number of Patients
Orbital edema	8
Proptosis	10
Gaze restriction	7
Lateral and downward deviations of gaze	6
Decreased visual acuity	8
Headache	6
Fever	8
Rhinorrhea	8

An ethmoidectomy is performed. Visualization and surgery may be difficult because of bleeding from the acutely inflamed mucosa or from severely inflamed polyps and pus in the ethmoid cells. Surgical dissection therefore should be meticulous and performed slowly. To dry the surgical field and facilitate dissection and visualization, 6-mm Cottonoid pledgets soaked in a solution of 1:10,000 epinephrine are repeatedly packed in the ethmoid cavity for 2 to 3 minutes.

After the ethmoidectomy is completed, the frontal recess area may be inspected and cleaned out, and maxillary antrostomy may be performed if indicated. The lamina papyracea and roof of the ethmoids are then identified. If a bony dehiscence exists in the lamina papyracea, the pus can be suctioned through the defect. The periorbita, a white, smooth, glistening, fibrous, avascular layer, should not be violated.

If the lamina papyracea is intact, a horizontal cut through the inferior aspect of the lamina papyracea is made using a Freer elevator. The incision can be extended vertically and anteriorly. Pus can be drained by slightly elevating the lamina papyracea medially while carefully avoiding entrance into the periorbita. The procedure can be terminated at this point unless the opposite side requires surgery. Neither packing nor stents are used.

RESULTS

Eight of the 10 patients had no history of sinus problems. Intraoperatively, we found a bony dehiscence in the lamina papyracea in two of 10 patients. Seven patients had significant polyposis and pus in the ethmoid sinuses. Cultures of pus from the abscess sites obtained during surgery identified *Streptococcus pneumoniae* in 4 patients, *Haemophilus influenzae* in 2 patients, and *Streptococcus pyogenes* in 3 patients; there was no growth of any pathogen from the specimen obtained from one patient.

Proptosis, orbital swelling, visual acuity, and gaze limitation improved significantly 8 to 12 hours after surgery, and there were no postoperative orbital sequelae. All patients were discharged from our hospital to their homes 2 to 4 days after surgery and continued on a regimen of broad-spectrum oral antibiotics and beclomethasone nasal spray until approximately 2 weeks after the last follow-up examination.

Endoscopic nasal examinations of all patients were performed under general anesthesia in the operating room 2 to 3 weeks after surgery. Eight of the 10 patients had clean ethmoid cavities and intact lamina papyracea. Two patients had some granulation tissue in their ethmoid sinuses, but had intact lamina papyracea.

COMMENTS

Orbital infections are the most common complications of sinusitis.[9] Seventy-five percent of orbital infections are caused by sinusitis,[10] and most of the patients with orbital infections are younger than 16 years of age.[11] Infections that involve the orbit arise primarily in the ethmoid sinuses, but frontal or maxillary sinuses may also be the source. Orbital infections can threaten the patient's vision and life. In the preantibiotic era, subperiosteal abscesses were associated with high rates of meningitis, intracranial abscess, and blindness.[6,7]

In 1970, Chandler and colleagues introduced a classification system for orbital infections that has become widely accepted (Table II).[1] Subperiosteal abscess (stage III) is one of the most common orbital infections that may lead to severe complications if not treated promptly and adequately. The introduction of advanced radiographic modalities, widespread use of antibiotics, reduction of anesthetic risks, advances in surgical techniques, and increased awareness have markedly decreased the incidence and morbidity of sinusitis with complications. Periorbital cellulitis (stage I) or orbital cellulitis (stage II) can be treated medically, but subperiosteal abscess usually requires surgical intervention for drainage. Few reports have confirmed resolution of suspected small abscesses using only broad-spectrum intravenous antibiotic therapy.[12]

The cornerstone of radiographic evaluation is carefully performed axial and coronal high-resolution CT scans of the sinuses with and without enhancement.[3,4,13] Although a CT scan is the best diagnostic tool available, false-negative and

TABLE II

Classification of Orbital Infections

Stage	Classification
Stage I	Periorbital cellulitis
Stage II	Orbital cellulitis
Stage III	Subperiosteal abscess
Stage IV	Orbital abscess
Stage V	Cavernous sinus thrombosis

With permission from Chandler JR, Langenbrunner DJ, Stevens ER. The pathogenesis of orbital complications in acute sinusitis. Laryngoscope 9:1414–1428, 1970.

false-positive results are possible,[14] and the CT findings should be used in conjunction with a clinical assessment of the progression of orbital signs, such as proptosis, gaze restriction, and visual acuity to determine the need for surgical intervention. Ophthalmologic consultation and closely observing the patient to detect any progression of orbital signs are mandatory components of patient management and surgical planning.

Ultrasonography may be helpful in diagnosing an abscess formation.[15,16] Used with CT, B-scan ultrasound is 90% effective in detecting abscesses in the anterior orbit or along the medial wall.[9,11] However, ultrasound does not add any information to the CT findings and has poor resolution at the orbital apex. CT scans can more accurately identify the posterior extension of the abscess.[9,11]

An attempt should be made to identify the pathogenic organism. Nasal, nasopharyngeal, or conjunctival cultures are usually nonspecific.[17] Direct culture of the pus from the abscess or middle meatus and blood cultures are more likely to reveal the organism. In a review of 134 patients with orbital complications of acute sinusitis, Schramm and colleagues observed that *Haemophilus influenzae* and *Streptococcus pneumoniae* were the most commonly cultured organisms.[10] In another study of 30 patients, Shedros and coworkers found *Streptococcus pneumoniae* in 38% of the cultures, *Streptococcus pyogenes* in 33%, and *Haemophilus influenzae* in 14%.[18] *Moraxella catarrhalis* was not isolated, and anaerobic bacteria were isolated from only one patient. Determining the offending organism is important in selecting effective antimicrobial therapy.

Surgical drainage of subperiosteal abscess is recommended if the orbital signs are progressing and the CT findings are positive. High doses of broad-spectrum antibiotics with prompt surgical drainage can be curative.

After its introduction by Gamble in 1933, external ethmoidectomy provided the most direct route and best method for evacuating a subperiosteal abscess for most surgeons.[19] However, the development of the rod-lens telescope and fiberoptic light source has provided an excellent surgical alternative. The endoscopic technique provides improved visualization and direct access to the diseased areas of the ethmoid sinuses. The endonasal approach is not indicated for a superior or lateral periorbital abscess.

Similar to other reports, our series of 10 patients with subperiosteal abscesses were successfully treated by endoscopic drainage and without complications. Manning[20] reported a series of five patients who were successfully treated with endoscopic surgery, as did Lusk[21] (8 patients).

The advantages of the endonasal approach over the more traditional method include avoidance of a facial scar, faster resolution, and a low morbidity rate. However, this procedure should only be considered by a surgeon who is skilled in the technique and comfortable with performing endonasal sinus surgery in children. The pediatric sinonasal anatomy is more complex than that of adults.

Obtaining maximal vasoconstriction is crucial. Vasoconstriction is obtained by lidocaine and epinephrine injection, packing with 4% cocaine-soaked pledgets before surgery, and frequent packing during surgery with cottonoid pledgets soaked in a solution of 1:10,000 epinephrine is essential.

Although additional studies with larger groups of patients are advocated, endonasal drainage using an endoscope appears to have excellent results and to offer a reliable alternate approach for drainage of subperiosteal abscess. The endoscopic procedure requires training, experience, skill, and patience.

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