Management of Orbital Subperiosteal Abscess in Children

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Objectives: To present guidelines for the management of an orbital subperiosteal abscess (SPA) in children and to assess the efficacy and safety of transnasal endoscopic drainage of an orbital SPA.

Setting: Tertiary care children’s hospital.

Patients: Nineteen patients treated for an SPA between July 1997 and December 1999. The age of the patients ranged from 17 months to 14 years (mean, 6 years). The male-female ratio was 10:9. Treatment modalities included transnasal endoscopic drainage (n=11), external drainage (n=3), and intravenous antibiotics alone (n=5).

Results: Bilateral pansinusitis was the most common cause. All patients received an initial trial of intravenous antibiotics. Based on the Fisher exact test, no statistically significant differences were detected for age, sex, presence of gaze restriction, and radiographic findings. Based on multiple logistic regression, degree of proptosis was the only significant multivariate predictor of surgery ($P = .003$). The estimated probability of surgery was 6% when there was no proptosis, and 92% for 2 mm of proptosis. The location of the SPA determined the route of surgical drainage. Eleven patients with a medially based SPA underwent drainage via the transnasal endoscopic approach, and 3 with a superior SPA underwent drainage externally. The external approach was associated with a longer hospital stay (median, 7 days) than either the endoscopic or the intravenous antibiotic approach (median, 5 days).


A CUTE SINUSITIS of the ethmoid and maxillary complex is the most frequent cause of a subperiosteal abscess (SPA). The incidence of an SPA in orbital infections is about 15% in children. The close anatomic relation of the orbit to the paranasal sinuses predisposes to the contiguous spread of infection through the ophthalmic venous system, which anastomoses freely with the facial, pterygoid, and cranial venous system. Retrograde spread of infection can lead to complications such as endophthalmitis, cavernous sinus thrombosis, meningitis, cerebritis, brain abscess, or death. In the preantibiotic era, 20% of patients with peri-orbital cellulitis had permanent loss of vision, and 17% died from central nervous system complications. Today, despite antimicrobial and surgical management, 15% to 30% of patients with an SPA develop various visual sequelae.

Treatment of an SPA remains controversial. The role of an initial therapeutic trial of intravenous (IV) antibiotics and the timing and methods of surgical drainage are not well established. This report presents some guidelines for the diagnosis and treatment of an SPA based on clinical, ophthalmologic, and radiographic findings, and evaluates the efficacy and safety of endoscopic drainage of an orbital SPA.

RESULTS

PATIENTS

Nineteen patients were included in this study. The age range was 3 to 11 years (mean, 7.3 years) for the external drainage group, 2 to 11 years (mean, 5.4 years) for the IV antibiotics group, and 17 months to 14 years (mean, 5.8 years) for the endoscopic drainage group. The male-female ratio was 10:9 (Table 1). The most common clinical presentations were upper respiratory tract infection, fever, and eye swelling. There was no significant medical history in any patient, and immunizations were up-to-date in all.
PATIENTS AND METHODS

Nineteen patients with clinical and radiographic evidence of an orbital SPA secondary to sinusitis were treated at The Children’s Hospital, Boston, Mass, between July 1997 and December 1999. All patients underwent a complete head and neck examination by the otolaryngology and ophthalmology services. The results of a computed tomographic (CT) scan were reviewed for all patients. All patients received an initial trial of IV antibiotics. Five patients were treated with IV antibiotics alone. Fourteen patients underwent surgical drainage: 3 via an external approach and 11 via transnasal endoscopic drainage of the SPA.

Endoscopic drainage was performed under general anesthesia. The nasal cavity was packed with oxy-metazoline hydrochloride-soaked cotton for several minutes, and 0.5% lidocaine with 1:200,000 epinephrine was used for local anesthesia. The middle turbinates was medialized, and the uncinate process was removed. A middle meatus maxillary antrostomy and complete ethmoidectomy were performed. The lamina papyracea was identified, and a Freer elevator was used to make an opening in the inferior aspect of the bone. The opening was enlarged to permit drainage of the SPA, and appropriate cultures were obtained. The nasal cavity was irrigated with copious amounts of isotonic sodium chloride solution and then coated with a watersoluble antibiotic ointment. No packing was used.

The variables analyzed included age, sex, clinical presentation, ophthalmologic manifestation, imaging findings, treatment modality, length of the hospital stay, complications, and microbiological specimens collected.

Patients requiring surgical intervention (by either procedure) were compared with those whose abscesses resolved with IV antibiotics based on sex, age, and clinical manifestations. Because of the small number of patients studied, we used nonparametric statistical methods for all comparisons. The Fisher exact test was used to evaluate differences in the distribution of sex, presence or absence of gaze restriction, and radiographic findings of (1) orbital fat involvement, (2) degree of rim enhancement (RE) of the SPA, and (3) number of ocular muscles involved. Patients’ age, abscess volume, and degree of proptosis were compared with the Wilcoxon rank sum test. Length of the hospital stay associated with each type of intervention was compared using the Kruskal-Wallis test. A multiple stepwise logistic regression analysis was performed to identify the variables independently predictive of surgical intervention and to generate theoretical probability curves. For all statistical tests, results were considered significant if P<.05 (2-tailed). Data analysis was performed using SAS statistical software, version 6.12 (SAS Institute Inc, Cary, NC).

OPHTHALMOLOGIC EXAMINATION

All patients were examined by the ophthalmology service for (1) degree of periorbital or eyelid edema and erythema, (2) gaze restriction, (3) degree of proptosis, (4) visual acuity, and (5) fundoscopic examination. All data were reviewed and interpreted by a single ophthalmologist (R.A.P.). All patients presented with marked eyelid edema and erythema, and were divided into those with complete eye closure and those with partial eye closure. Gaze restriction was noted in 10 of 11 patients in the endoscopic drainage group, 2 of 3 in the external drainage group, and 2 of 5 in the IV antibiotics group. All patients who underwent surgical drainage had proptosis, ranging from 2 to 5 mm (mean, 2.7 mm) for the endoscopic drainage group and 1 to 4 mm (mean, 2.3 mm) for the external drainage group. Only 1 patient from the IV antibiotics group had proptosis (2 mm). Visual acuity was normal in all patients. The fundoscopic examination revealed mildly dilated retinal vessels in only 2 patients from the endoscopic drainage group.

IMAGING FINDINGS

The CT images were reviewed by a single neuroradiologist (C.D.R.) blinded to the treatment modality. The CT scan was reviewed for (1) number and location of sinuses involved; (2) location, size, and RE of the SPA; (3) radiographic evidence of orbital fat and muscle changes; and (4) anatomic abnormality of the sinuses and adjacent structures (Figure 1).

Bilateral pansinusitis was the most common presentation. It was noted in 8 of 11 patients in the endoscopic drainage group, 2 of 3 in the external drainage group, and 4 of 5 in the IV antibiotics group. All other patients had involvement of more than 2 sinuses ipsilateral to the SPA. Maxillary and ethmoid sinuses were involved in all patients (Table 1).

The location of the SPA was described based on the medial axis of the orbit on coronal and axial images. Medial SPA was the most common location, noted in 10 of 11 patients in the endoscopic drainage group and in all 5 patients in the IV antibiotics group. One patient from the endoscopic drainage group presented with an inferior-medial SPA. Three patients presented with a superiorly based SPA. An estimated volume of the SPA (superior-inferior × transverse × anterior-posterior dimension) was recorded based on the largest superior-inferior, transverse, and anterior-posterior dimension on the axial and coronal CT images (Table 2).

The contralateral medial rectus muscle was used as a point of reference for describing the degree of radiographic RE of the SPA (1 indicates less; 2, equal; and 3, more). All patients showed RE equal to or greater than that of the medial rectus muscle, except for 3 from the IV antibiotics group, 1 from the external drainage group, and 2 from the endoscopic drainage group, who showed RE less than that of the medial rectus muscle. All patients showed orbital fat enhancement on CT, except 2 from the IV antibiotics group and 1 from the external drainage group.

Swelling and enhancement of at least 2 extraocular muscles were noted in all patients. Medial rectus, superior oblique, and superior rectus muscles were most commonly involved (Table 1). No specific anatomic abnormalities predisposing the patients to an SPA were noted.
TREATMENT

All patients received IV antibiotics and oxymetazoline nasal drops as the initial treatment. Visual examinations were performed twice daily by the ophthalmology service. Five patients responded well to IV antibiotics alone within the first 24 to 36 hours: 4 received a combination of ampicillin sodium and sulbactam sodium (Unasyn), and 1 received a combination of oxacillin sodium and cefotaxime sodium. The length of the hospital stay ranged from 2 to 6 days (mean, 5 days) for this group. All 5 patients were discharged home from the hospital with a prescription to take a combination of amoxicillin and clavulanate potassium (Augmentin) for an average of 14 days. The other 14 patients received IV antibiotics (ampicillin sodium–sulbactam sodium or clindamycin) for 1 to 5 days (mean, 2 days) before surgical drainage. The principle indication for surgery was worsening of ophthalmologic examination results. Three patients with a superior SPA underwent external incision and drainage. The length of the hospital stay ranged from 7 to 14 days (mean, 9 days) for the external drainage group. One patient was discharged home from the hospital with a 1-week prescription of oral clindamycin, and 2 were discharged with a 10-day prescription of amoxicillin–clavulanate potassium.

Table 1. Characteristics of the Patients Studied

<table>
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<tr>
<th>Patient No./ Sex/Age, y</th>
<th>Hospital Stay, d</th>
<th>Follow-up, mo</th>
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<th>Radiographic Finding</th>
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Vision and fundi were normal in all patients. IV indicates intravenous; CEC, complete eye closure; R, restricted; B, bilateral; M, maxillary; E, ethmoid; S, sphenoid; RND, frontal not developed; SI, superior obliterator; SR, superior rectus; MR, medial rectus; PEC, partial eye closure; F, frontal; NL, normal; U, unilateral; LR, lateral rectus; and IR, inferior rectus.

†A 1 indicates rim enhancement less than that of the medial rectus muscle; 2, equal to that of the medial rectus muscle; and 3, more than that of the medial rectus muscle.

‡This patient experienced dilation of retinal vessels.
Eleven patients underwent transnasal endoscopic drainage for a medially based SPA. Two of these patients required a second endoscopic procedure because of worsening of ophthalmologic examination results; this examination was performed 24 to 48 hours after the initial surgery. One patient had persistence of a purulent collection within the posterior ethmoid and orbital subperiosteal area. A second patient had a collection of antibiotic ointment, with an organized clot obstructing the surgical opening of lamina papyracea and the ethmoid cavity. Both patients showed improvement within 24 hours after the second procedure. The length of the hospital stay ranged from 3 to 7 days (mean, 5 days; range, 2-6 days) (<i>P</i> = .03). Since patients with larger abscesses also tended to have a higher degree of proptosis, the addition of abscess volume did not improve the predictive value of the model. Using the logistic regression equation, we can estimate the probability of surgery given the degree of proptosis. As illustrated in Figure 2, the estimated probability of surgery is approximately 6% when there is no proptosis (0 mm) and increases to 92% for a proptosis of 2 mm. Of the 2 types of surgical intervention, external excision was associated with a longer hospital stay (median, 7 days; range, 7-14 days) than either transnasal endoscopy (median, 5 days; range, 3-7 days) or IV antibiotics (median, 5 days; range, 2-6 days) (<i>P</i> = .03).

Orbital infection encompasses a wide range of causative factors: bacterial septicemia, penetrating injury, or secondary to skin infection. Sinusitis remains the most common cause of an acute orbital infection. Chandler et al proposed a classification system based on the extension...
of the disease process ranging from perisepetal cellulitis to cavernous sinus thrombosis. Orbital involvement is due to direct extension of infection through a natural bony dehiscence, local thrombophlebitis, or thromboemboli along the valveless venous system. This condition can affect all age groups, but is generally more frequent in the pediatric population.\(^8\)

The management of an “acute orbit” depends on the cause and severity of infection. The typical presentation for perisepetal cellulitis is inflammation of the eyelid, without proptosis or restriction of gaze. Orbital involvement could present as chemosis, proptosis, restriction of gaze, and visual changes. The distinction between preseptal cellulitis and orbital involvement is important, and cannot be made with clinical examination alone. Delay in treatment can result in blindness in up to 10% of patients with an SPA.\(^9\)

The advent and evolution of orbital imaging techniques in the past 2 decades have enhanced the diagnosis of an SPA. The CT scan depicts a localized and homogeneous elevation of the periorbit adjacent to opacified sinuses. The classic CT appearance of an SPA is a convex low-density lesion with an enhancing rim next to the medial orbital wall. The presence of low density or air within the area is suggestive of abscess formation. There is no consensus as to the use of a CT scan as part of the initial medical management of an SPA.22 Based on our data, the possibility of the need for surgical drainage based on the degree of proptosis should also be considered. According to our logistic model, patients presenting with proptosis of 2 and 3 mm had an estimated 92% and 99% chance of requiring surgical drainage, respectively. Therefore, it appears that in patients with proptosis greater than 2 mm, delay in surgical drainage would prolong the hospital stay and recovery periods.

Because of the potential for loss of vision and the devastating morbidity associated with an SPA, we recommend immediate surgical drainage when there is (1) impairment of vision, (2) worsening of the visual examination results (periorbital erythema or edema, proptosis, and restriction of gaze), (3) any sign of systemic manifestation or complication, (4) an inability to perform a reliable and serial ophthalmologic examination, (5) an immunocompromised patient, and (6) a lack of response to an initial trial of appropriate IV antibiotics. In our series, no patient required immediate surgical drainage. The duration of the initial IV antibiotic treatment should be individualized based on the serial ophthalmologic examination results. External drainage of an SPA and ethmoidectomy through a Lynch incision has been the traditional approach. With advances in sinonasal surgery, transnasal endoscopic drainage of SPAs has been popularized, as it reduces the necessity for an external incision and facilitates drainage of sinuses.\(^23,24\)

**CONCLUSIONS**

Prompt diagnosis and appropriate management of an SPA are essential to avoid serious and life-threatening complications. An individualized therapeutic approach should be based on a team decision involving the pediatrician, ophthalmologist, radiologist, and otolaryngologist. An initial trial of IV antibiotics is only appropriate when the visual acuity is normal and close monitoring is possible. Based on our experience, an orbital SPA can be successfully and safely managed by a transnasal endoscopic approach in selected patients. Methods of surgical drainage should be based on the location of the abscess and, most important, the experience of the otolaryngologist.
REFERENCES