MINI-REVIEW

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Surgical or medical management of subperiosteal orbital abscess in children: a critical appraisal of the literature*

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SUMMARY

Objective: *Subperiosteal orbital abscesses (SPOA) are a complication of sinusitis. Traditional treatment of SPOA is surgical. Recently, a number of studies report successful medical treatment. To our knowledge, it is unclear which patients can benefit from medical management alone. Therefore, we questioned (1) what is the outcome of medical versus surgical treatment? (2) which patients can be cured with antibiotics alone? (3) what are the absolute criteria for surgical treatment?*

Methods: *A structured search was conducted in PubMed, EMBASE and the Cochrane Library for relevant papers which were critically appraised.*

Results: *Five studies addressing our clinical questions were included, one prospective case series and four retrospective studies. Evidence levels varied from 2b to 3. Overall, a high cure rate was achieved with combined modality treatment (95.3-100%). The cure rate of medical treatment alone varied between 26% and 93%. The outcome of medical treatment improved after prior selection of surgical cases. In general, responders to medical treatment had a medial abscess associated with ethmoid sinusitis. Criteria for initial surgical or medical management differed among authors. Most authors agreed upon initial surgical treatment for patients with non-medial abscesses, decreased visual acuity and signs of systemic involvement. Surgery was also indicated when lack of improvement or worsening of symptoms and signs after 48-72 hours of medical treatment were observed.*

Conclusions: *The outcome of surgical versus medical management of SPOA within and between studies could not be compared. Higher cure rates were observed when both modalities were combined. There is some evidence that medical treatment can cure medially located SPOA. Loss of visual acuity, non-medial abscess, clinical detoriation and failure to improve within 48 hours of antibiotic treatment can be considered as criteria for surgical treatment. In the absence of these criteria a trial of antibiotic treatment can be considered with close monitoring of the patient.*

Key words: orbital disease, sinusitis, abscess, child, treatment outcome

INTRODUCTION

Subperiosteal orbital abscess (SPOA) in children is an uncommon, serious complication of sinusitis, defined as a pus collection between the lamina papyreacea and the periosteum of the orbit (periorbita). If left untreated, SPOA can result in blindness or death. Usually SPOA arises secondary to acute ethmoiditis, but it may also arise after acute or chronic frontal sinusitis. Spread of infection from the paranasal sinuses can occur directly through bone dehiscence of the lamina papyracea, or along ethmoid vessels and nerves. Retrograde haematogenous spread can also occur through the ophthalmic venous plexus. The incidence of SPOA as an orbital complication of sinusitis is some 9 % [(1)].

Traditionally, SPOA is treated surgically. The rationale for surgical management is based on presumed poor penetration of antibiotics due to encapsulation of the abscess. Surgical options include the external approach to the orbit via “Lynch” incision, the transcaruncular external approach and, more recently, the transnasal endoscopic drainage. However, the role of antibiotics in the treatment of acute and chronic rhino sinusitis and its orbital complications is increasing [(2,3)]. A number of studies report that patients with SPOA were successfully treated with antibiotics [(4-8)]. To our knowledge, it is unclear which subset of patients can be cured with medical management. Therefore, we questioned 1. What is the outcome of

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medical versus surgical treatment? 2. Which patients can be cured with antibiotics alone? 3. What are the absolute criteria for surgical treatment? To answer our clinical questions, a structured literature search according to the evidence based medicine guidelines was conducted and relevant studies were critically appraised.

METHODS

Search strategy

The MEDline, EMBASE and Cochrane databases were searched for evidence up to June 2007. The search strategy is given in Table 1. A list of synonyms was created for domain (children with SPOA), determinant (medical and surgical treatment) and outcome (cure, morbidity, mortality). All synonyms in each group were combined using the standard Boolean system.

In- and exclusion criteria

All articles were screened for title and abstract. Inclusion criteria were domain, determinant and outcome as previously mentioned, original articles, articles written in English, Dutch or German and relevant studies found via related articles. Exclusion criteria were animal studies, papers that were not available in full text and reviews. Duplicates were removed. Remaining articles after primary screening were screened full text (Figure 1).

Table1. Search strategy.

	Search Strategy
MEDline	(subperiosteal[Title/Abstract] OR abscesses[Title/Abstract] OR abscess[Title/Abstract] OR spoa[Title/Abstract]) AND (orbit*[Title/Abstract]) AND (conservative[Title/Abstract] OR antibiotics [Title/Abstract] OR operation [Title/Abstract] OR "medical management" [Title/Abstract] OR "surgical management" [Title/Abstract] OR medical[Title/Abstract] OR surgical [Title/Abstract] OR nonsurgical [Title/Abstract] OR nonmedical [Title/Abstract] OR management [Title/Abstract]) AND (vision [Title/Abstract] OR "visual impairment" [Title/Abstract] OR complication [Title/Abstract] OR morbidity [Title/Abstract] OR mortality [Title/Abstract] OR "quality of life" [Title/Abstract] OR qol [Title/Abstract])
EMBASE	('surgery'/exp AND [embase]/lim OR 'antibiotic agent'/exp AND [embase]/lim OR 'conservative treatment'/exp AND [embase]/lim OR 'management'/exp AND [embase]/lim OR 'therapy'/exp AND [embase]/lim) AND (('orbit'/exp AND [embase]/lim) AND (('abscess'/exp AND [embase]/lim) OR ('cellulitis'/exp AND [embase]/lim)))
Cochrane	'orbit*'

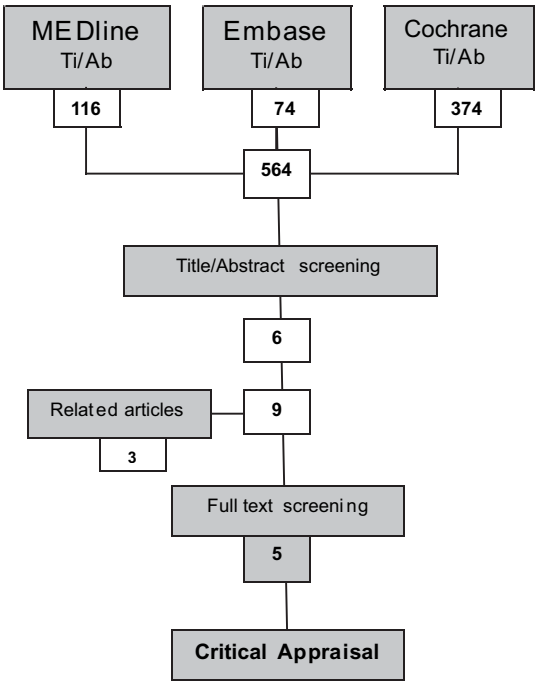

Figure 1. Results of the search strategy.

Critical appraisal

The validity of the final studies and relevance with respect to the clinical questions was critically appraised. Validity was assessed on the following criteria: representation of domain, number of patients, length and completeness of follow-up, clear distinction of subgroups and whether or not the outcome was objective [9,10].

Analysis

In papers remaining after critical appraisal, we analysed the outcome of treatment strategies. An attempt was made to compare the outcome of antibiotic versus surgical treatment.
Furthermore, we analysed the group of patients that responded well to medical treatment with respect to possible relevant variables such as age, presenting symptoms, site and size of the abscess, type of sinusitis, and antibiotic regimen. Finally, we reviewed the criteria for surgical treatment as used in the studies.

RESULTS

Search strategy and description of papers

The search resulted in a total of 564 hits (116 in MEDline, 74 in EMBASE, 374 in Cochrane). After primary selection nine articles remained and were screened full text (Figure 1). Four papers were excluded. The study of Ikeda et al. [11] also included adults. The study of Handler et al. [12] mainly focused on radiological findings instead of treatment outcome. The study by Pereira et al. [13] only concerned the diagnostic process and endoscopic drainage of medial SPOA. We also excluded the review by Howe et al. [14].

Table 2. Study characteristics.

Author	**Souliere et al.** [4]	**Garcia et al.** [6]	**Rahbar et al.** [7]	**Greenberg et al.** [5]	**Oxford et al.** [8]
Year of publication	**1999**	**2000**	**2001**	**1998**	**2006**
Study type	Retrospective	Prospective	Retrospective	Retrospective	Retrospective
Number of patients	10	37	19	25	43
Follow-up (months)	≥ 18	≥ 6	≥ 12 (mean 19.3)	ns	6 (1 day-7.5 yrs)
Lost to follow-up	ns	ns	none	ns	27.9%
Mean age	8.9 yrs (3 - 24 yrs)	≤ 9 yrs	6 yrs (17 months - 14 yrs)	5.6 yrs (0.75 - 13 yrs)	7.2 yrs (7 months - 17 yrs)
Evidence level	3	2b	3	3	3

Table 3. Characteristics of patients cured with medical management.

Author	**Souliere et al.** [4]	**Garcia et al.** [6]	**Rahbar et al.** [7]	**Greenberg et al.** [5]	**Oxford et al.** [8]
Year of publication	**1999**	**2000**	**2001**	**1998**	**2006**
Number of patients	5	27	5	12	18
Age, average (range)	6.4 yrs (3-11)	< 9 yrs	5.4 yrs (2-11)	2.9 yrs (0.75-6.0)	6.1 yrs (8 months-17 yrs)
Acute/chronic	ns	Acute	ns	ns	ns
Presenting symptoms	Proptosis (2), restriction of gaze (3)	ns	Eyelid edema and erythema (all), gaze restriction (2), proptosis (1)	* Periorbital erythema and edema, proptosis, chemosis, conjunctival infection, decreased EOM, fever, pain	Chemosis (2), proptosis ≥ 2 mm (10), severe limitation of EOM (1), vision loss 20/40 (1), severe edema (4), severe erythema (2)
Abscess site	Medial	Medial	Medial	Medial	Medial
Sinusitis	Pansinusitis (1) ethmoid sinusitis (3) maxillary-ethmoid sinusitis (1)	Not frontal	Bilateral pansinusitis (4), ipsilateral pansinusitis (1). (All maxillary, ethmoid, sphenoid. Two also frontal)	Ethmoid sinusitis	ns
Abscess size	ns	Not large	Volume median 600 mm^3 (range 160-1008)	Small (6), moderate (5), large (2)	ns
Antibiotics	Broad spectrum iv days, antibiotics for 10 empirically selected	- Broad spectrum iv antibiotics (ampicillin/sulbactan), minimum of 4 days. - After discharge 3 weeks oral Augmentin.	Iv antibiotics (ampicillin/ sulbactam (4), oxacillin/ cefotaxime (1) - After discharge 14 days oral Augmentin.	- 3rd generation cephalosporins iv - Discharged with oral cephalosporins	Iv antibiotics
Additional treatment	Nasal decongestants	None	Oxymetazoline nasal drops	Nasal vasoconstrictors +/- nasal steroids	None

* Not all signs were present in all patients and were highly variable in intensity, ns: not stated, EOM: extra-ocular motility, iv: intravenous

The characteristics of the five original articles that were included are shown in Table 2. Four retrospective studies and prospective study were found.

Souliere et al. [4] retrospectively reviewed 10 children with SPOA documented on CT scan, mean age 8.9 years (range 3-24 years). The aim was initial treatment with empirically selected intravenous broad spectrum antibiotics and nasal decongestants and regular (two hourly) examination of symptoms and signs, reserving surgery as second-line treatment (Table 4). Two patients, however, required surgery upon admission, due to total ophthalmoplegia. Eight patients received antibiotic treatment. Five out of 8 patients clinically improved within 48 hours, with full recovery after 10 days of intravenous antibiotics. Patient characteristics are given in Table 3. The remaining 3 patients did not respond adequately to medical therapy alone and therefore surgical intervention was required. All but one surgical patients fully recovered. One of the patients with initial surgery developed an epidural abscess.

The study by Garcia et al. [6] is the only study that prospectively studied 37 patients with the diagnosis of SPOA on the basis of specific clinical and CT findings. Patients were treated medically if criteria for initial surgery were absent (Table 4). Eight patients fulfilled initial surgical criteria and were operated. Twenty-nine patients received initial medical treatment. In 27 cases (93.1%) SPOA resolved without surgery. Two out of 29 required surgical drainage. Reasons for surgery in one patient was persisting fever after 42 hours of intravenous antibiotics. The other patient developed decreased visual acuity despite 48 hours of intravenous antibiotics. In all cases SPOA resolved without sequelae.

Rhabar et al. [7] retrospectively reviewed 19 cases with clinical and radiological evidence of SPOA secondary to sinusitis. The mean age was 6 years (range 17 months-14 years). All patients received intravenous antibiotics and oxymetazoline nasal drops as the initial treatment. Five patients responded well to intravenous antibiotics within the first 24 to 36 hours and were discharged with a prescription of amoxicillin and clavulanate potassium (Augmentin®) for an average of 14 days. The other 14 patients required surgical drainage after intravenous antibiotic treatment for 1 to 5 days (mean 2 days). The main indication for surgery was worsening of ophthalmologic examination results (Table 4).

Greenberg et al. [5] retrospectively reviewed 25 cases of SPOA documented on CT scan, mean age 5.6 years (range 0.75-13 years). Patients were divided into three groups; 1. patients with medial SPOA and initial medical treatment (n=13), 2. patients with medial SPOA and initial surgical treatment (n=5), 3. patients with non-medial abscesses (n=7). Patients in group 3 were all treated surgically. Allocation to surgical treatment in group 2 was based on physicians' preference in four patients, and recurrent abscess on CT scan in one patient. In the first group, one patient was readmitted for recurrent abscess and was treated surgically, all other 12 patients fully recovered. Patient characteristics are given in Table 3. In the second group, one patient underwent repeated drainage within one month, all other SPOA's resolved completely. In the third group one patient had a simultaneous epidural abscess with significant hemiparesis after craniotomy. Another patient underwent second drainage because the abscess reaccumulated.

Oxford et al. [8] retrospectively reviewed 43 cases of SPOA diagnosed by clinical presentation and CT scan, mean age 7.2 years (range 7 months-17 years). All patients received intravenous antibiotics during their hospitalization. In eighteen (43%) patients the infection resolved with medical treatment only. Twenty-five (58%) of children underwent surgical drainage. Criteria for allocation to surgery were unclear. The recommended surgical criteria described in Table 4 were postulated after retrospective analysis of the results. Surgery was performed upon admission or on the subsequent day in 24 patients. One patient received surgery after 48 hours of medical therapy due to progression of ocular signs and abscess size.

Outcome

Overall, combined modality treatment resulted in 95.3-100% cure. The cure rate of medical treatment alone was 26-93%. The lowest cure by antibiotic treatment only was found in the study of Rhabar [7]. The studies in which medical treatment was applied when patients did not fulfil criteria for initial surgery had a 62-93% cure rate [4-6].

It was not possible to compare the outcome of medical versus surgical treatment within and between studies, because both groups were not comparable with respect to clinical characteristics, allocation to treatment, treatment protocols and definition of outcome.

Responders to medical treatment

The characteristics of patients who were cured with medical treatment are given in Table 3. The clinical variables age, type and site of sinusitis, presenting symptoms, site and size of abscess, antibiotic regimen and additional treatment were reviewed. All patients had a medial abscess that was often associated with ethmoid sinusitis. Numerous patients displayed proptosis or ophthalmoplegia. There was only one patient with loss of vision. Most patients were younger (< 11yrs). The other variables were ill-defined or too diverse to detect clues as to prognosis.

Criteria for surgery

Criteria for surgery differed among authors (Table 4). Most authors agreed upon surgical treatment for patients with non-medial abscess, decreased visual acuity and signs of systemic involvement at presentation and failure to improve or worsen-

Table 4. Criteria for surgery.

Author	Souliere et al. [4]	Garcia et al. [6]	Rahbar et al. [7]	Greenberg et al. [5]	Oxford et al. [8] †
Year of publication	**1999**	**2000**	**2001**	**1998**	**2006**
Criteria for initial surgical treatment	- Visual acuity < 20/60 - Opthalmoplegia - Intracranial involvement	- ≥ 9 years - Acute optic nerve or retinal compromise - Frontal sinusitis - Chronic sinusitis - Non-medial abscess - Large abscess - Suspicion anaerobic infection - Dental origin	- Visual impairment - Sign of systemic involvement - Inability of ophthalmologic examination - Immunocompromised patient	- > 6 years - Physician's opinion - Non-medial abscess	- Abnormal vision, pupil, retina - Significant ocular findings - Ophthalmoplegia - IOP > 20 mmHg - Proptosis ≥ 5 mm - Width ≥ 4mm on CT
Criteria for surgery after initial antibiotic treatment	- Worsening ocular motility - Failure to improve < 48 hours	- Recurrence after drainage - Persisting fever > 36 hours - Clinical detoriation > 48 hours - No clinical improvement > 72 hours	- Worsening visual examination results (periorbital erythema or edema, proptosis, restriction of gaze) - Lack of response to AB	- Recurrent abscess	- Progression of ocular signs - Failure to improve > 48 hours

AB: antibiotics, IOP: intraocular pressure

† The criteria by Oxford et al. [8] were postulated after retrospective analysis of the results

ing symptoms and signs after 48-72 hours of medical treatment. Other factors were physician's preference, age and presenting symptoms and signs such as proptosis, ophthalmoplegia, elevated intra-ocular pressure, abscess size and suspicion of an anaerobic infection. Rhabar stated that proptosis was the only significant multivariate predictor of surgical intervention [7]. Oxford showed significant differences between the medical versus surgical patients for the following presenting symptoms and signs: chemosis ($p = 0.001$), proptosis ≥ 2mm ($p = 0.025$), elevated intraocular pressure ≥ 20mm Hg ($p = 0.001$), severe restriction of ocular motility ($p = 0.002$). These signs and symptoms were more severe in the surgical treatment group [8]. Greenberg found that the likelihood of intracranial complications was significantly higher with superior abscesses than with medial abscesses ($p<0.01$) [5].

DISCUSSION

Critical appraisal of the literature up to June 2007 resulted in five papers addressing our initial questions, one prospective case series and four retrospective studies. Overall, the cure rate of SPOA arising as an orbital complication of sinusitis was high. Although allocation to and execution of treatment regimens was not uniform, the algorithm for treatment in most studies generally consisted of verifying the abscence of surgical criteria [5,6,8] before starting medical treatment. In two studies [4,7], the aim was initial medical treatment, reserving surgery as second-line treatment. In one of these studies, however, two patients were operated upon admission [4].

Response rate to medical treatment varied between studies. In general, the outcome of medical management seemed to improve after prior selection of surgical cases. Doing, so a cure rate as high as 93% was achieved in the study of Garcia [6], as opposed to a cure rate of 26% in the study of Rhabar, in which all patients received initial antibiotic treatment [7].

The comparison of outcome between the medical versus surgical patients described in the studies could not be made in a methodologically correct manner. As stated, allocation to treatment regimens was poorly defined. Moreover, studies were incomparable because of differences in treatment: in some studies all patients were treated with antibiotics (including surgical patients), whereas in other studies only the 'medical group' received antibiotics. In addition, different antibiotics were used, as were different surgical methods. Finally, the definition of outcome was not always clear. A true comparison of surgery versus antibiotics will only be possible in properly designed clinical trials.

The descriptive analysis of clinical characteristics in the group of responders to medical treatment indicate that site of the abscess, site of sinusitis and age had a possible predictive value with respect to the outcome of medical treatment. It is assumed that the clinical course of SPOA in older children is more severe and therefore justifies surgery early in the clinical course [6]. In some studies, older children were excluded from medical treatment [5,6]. However, the studies that did treat older patients medically did not show a different outcome [7,8]. The relevance of presenting symptoms proptosis, chemosis and ophthalmoplegia and signs as elevated intra-ocular pres-

sure was less clear. Some authors claim that patients displaying these symptoms and signs were more likely to be operated [6,7]. In our descriptive analysis we found that numerous patients with the abovementioned symptoms and signs were cured with antibiotics. There is general agreement that visual loss necessitates surgery as does worsening of symptoms and signs after antibiotic treatment [2].

Thus, there is little consensus in the management of children with SPOA secondary to sinusitus. Recommendations based on the studies described in this paper have a low level of evidence. Nevertheless, there are indications that medical treatment of SPOA is possible for a subset of patients. Loss of visual acuity and non-medial abscess seem to be indicators for primary surgical treatment. In all other patients a trial of intravenous antibiotics could be given, provided the patient is closely monitored. In case of failure to improve within 48 hours or clinical detoriation patients require surgical treatment.

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