

Introduction

Orbital complications account for 74-85% of all complications from acute sinusitis.¹ It can affect all age groups, but is more frequent in pediatric populations.² This is commonly attributed to the incomplete immunological development and underdevelopment of the paranasal sinuses, septum, and thin lamina papyracea in children compared to adults.^{3,4} Complications can occur as subperiosteal abscesses, orbital phlegmons, orbital or periorbital cellulitis, or intraorbital abscesses. The Chandler classification is one of the classification schemes for orbital cellulitis which is based on specific clinical findings, which today are used in conjunction with CT to determine stage (Table 1). Devastating consequences of acute sinusitis can result including blindness which can occur in up to 10% of patients with orbital complications, and intracranial extension.¹ Therefore these patients require prompt diagnosis and proper management.

While multiple risk factors, criteria, and characteristics have been discussed in the literature, there are no established guidelines specific to the management of orbital cellulitis in the pediatric population. However, no comprehensive algorithm exists addressing all stages of orbital cellulitis and their subsequent surgical vs. medical management. In particular, the role, need, and timing of surgery vs. conservative treatment for subperiosteal abscesses in children have varied in the literature. We present a proposed literature based algorithm to guide management (Figure 1).

Methods and Materials

The PubMed/MEDLINE and Google Scholar databases were searched for relevant studies using search terms "orbital cellulitis", "subperiosteal", "intraconal abscess", "cavernous sinus thrombosis" or "orbital abscess", and "management", limited to the period 1985 through October 2016, English literature, human subjects, and children 0-18 years old (or, in studies that included both children and adults, clear descriptions of each subgroup). Titles and abstracts were reviewed for relevance. Any study that reported on the medical and/or surgical treatment of pediatric patients with orbital cellulitis and its complications, and also included outcomes, morbidity and/or mortality was eligible for inclusion. Animal studies, editorials, letters, and other reviews were excluded. Studies which did not differentiate results by stages of Chandler criteria (for instance, the outcomes of patients with orbital cellulitis and subperiosteal abscesses were combined) were also excluded. Ultimately 66 articles were identified for this review.

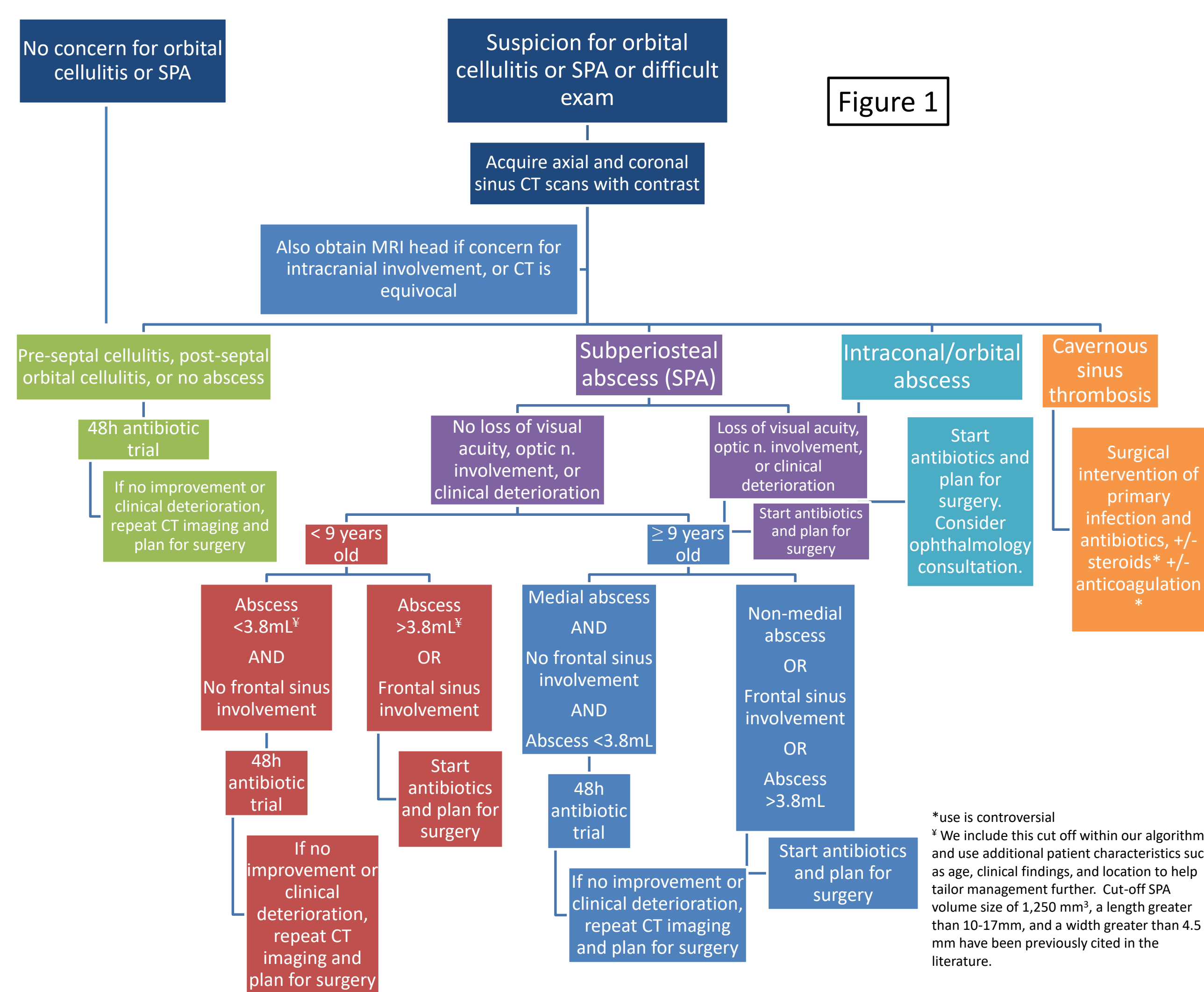
Results

Pre-septal cellulitis

Twelve retrospective chart reviews were identified. Most cases of isolated preseptal cellulitis (aka periorbital cellulitis) can be treated with antibiotics. Most studies report surgery rates ranging from 0-11%, with one retrospective analysis reporting a rate of 29%. Surgery in these settings often consisted of functional endoscopic sinus surgery, external orbitotomies or, when applicable, drainage of preseptal fluid collections that had developed from preseptal cellulitis.

Post-septal Orbital Cellulitis

Thirteen retrospective chart reviews were identified in our literature review pertaining to the management of pediatric post-septal orbital cellulitis. Nonsurgical management success rates reported in the literature for pediatric patients range from 77 to 100%,^{15,16,18,24,25,29-31,33-37} Marchiano et al performed the largest retrospective review, drawing patient data from the Nationwide Inpatient Sample (NIS) database, and found that 6166/6951 (88.7%) pediatric patients with the ICD-9 code for orbital cellulitis were treated non-surgically.³⁸ Several of these studies endorsed a trial of antibiotics before surgical intervention. There should be close monitoring for progression with a low threshold for surgical intervention as the few who do not respond to empiric therapy can progress rapidly over 1.5-2 days.^{39,40} Typically, if there is no improvement by 48 hours, or there is a clinical decline before then, surgical intervention with repeat imaging is recommended.



Results

Subperiosteal Abscess

Twenty five retrospective chart reviews were identified. Four articles endorsed surgical drainage of all cases of subperiosteal abscess: Pereira et al. looked at patients specifically with medial subperiosteal abscess and found that 24 of 24 patients underwent surgical drainage. In the other three articles, Williams & Carruth, Kinis et al, and Welkoborsky et al performed retrospective chart reviews on patients who presented with subperiosteal abscess, in total describing 25 of 27 patients who required surgical intervention.^{16,31,41} Both Williams & Carruth and Pereira et al argue that surgery is indicated because clinical examination can be limited in particularly young patient and be difficult to monitor.^{15,16}

However, several other studies show that surgery is not always necessary, though rates vary widely between 14% to 93% in the literature.^{1,3,12,21,42-49} This exemplifies the fine balance between the ability in some cases to successfully treat SPA without surgical intervention and the necessity of surgery in other cases to prevent potentially devastating complications. Conservative nonsurgical measures have been attempted with some success in the pediatric population, and are indicated if certain criteria are met.^{24-26,43,45,50,51}

Most commonly, younger age was found to be associated with greater success with conservative management, and/or less complications from surgery.^{21,26,38,43,47,52-54} While the exact age cutoff ranges from 2 to 9 years old, 9 years as a cut off was the most commonly studied in the literature and most clinically significant (Table 1).^{38,52-54} Some possible explanations behind why age is such an influential factor include the findings that children less than 9 years of age demonstrate predominance of relatively simple, monomicrobial infections while older children and adults tended to have more complex, polymicrobial infections.⁵²

Other studies describe additional characteristics associated with successful nonsurgical management: normal vision, absence of ophthalmoplegia, minimal or no proptosis, and medial location of the abscess, were the most commonly cited. Furthermore, severe proptosis, worsening visual acuity or motility, worsening orbital clinical findings, elevated intraocular pressure, signs of systemic manifestation or concurrent intracranial involvement, inability to perform a reliable and serial ophthalmologic examination, and poor response to an initial 24-48 hour trial of appropriate IV antibiotics were all common indications for surgery (summary found in Table 2).^{18,33,43,48,49,51,53-58}

Other reports suggest the decision for intervention be based on the sinus(es) involved. Marchiano et al, Harris (1994), and Garcia & Harris found that frontal sinus involvement correlated with prompt surgical treatment.^{38,52,53} Todman & Enzer found that frontal sinusitis correlated with surgical intervention in cases of abscesses $\geq 1250\text{mm}^3$.⁵⁹ Thus, in any patient with frontal sinusitis, strong consideration should be made for surgery.

Further management by imaging: Cut-off SPA volume size of $1,250\text{mm}^3$, a length greater than 10-17mm, and a width greater than 4.5 mm have been previously cited as predictors as to whether patients will require surgical intervention.⁵⁹⁻⁶¹ In a more recent article, Le et al. found that patients with larger SPAs could be successfully treated with systemic antibiotics alone, choosing the abscess cut-off size of 3.8 mL. Specifically, if the SPA volume is $<3.8\text{mL}$, then the probability of surgery is 12%; if the SPA volume is $>3.8\text{mL}$, then the probability of surgery is 71%.³⁶

Table 1

Chandler Group	Chandler Title	Chandler Description
1	Inflammatory edema	Inflammation/edema limited to the eyelid
2	Orbital Cellulitis	Inflammation including contents posterior to septum
3	Subperiosteal Abscess (SPA)	Purulent collection between bony orbit and periorbita
4	Orbital Abscess	Purulent collection within the orbit itself
5	Cavernous Sinus Thrombosis	Retrograde phlebitis

Results

Intraconal or orbital abscess

Cases of intraconal or orbital abscess are relatively rare, with only a few case reports and series in the literature, and even fewer studies that describe pediatric patients specifically. Four retrospective studies describe 13 pediatric patients with orbital abscesses, and all reported surgical drainage.^{1,46,50,62} There are no reports in the pediatric literature of medical management.

Cavernous Sinus Thrombosis

An aggressive approach is typically warranted with involvement of the cavernous sinus. The risks of catastrophic complications are much higher, as cavernous sinus thrombosis can cause cranial nerve dysfunction to those that traverse the sinus (III, IV, V₁, V₂, VI), and when severe, internal carotid artery thrombosis with cerebral infarct.²⁴ Surgical intervention for cavernous sinus thrombosis is generally thought to be mandatory, and is almost always treated via endoscopic drainage of the involved sinuses and collections.⁶³ However, there are only ten pediatric cases of sinusitis associated cavernous sinus thrombosis described in the literature. Frank et al. identified nine pediatric cases of cavernous sinus thrombosis, of which four also had associated orbital cellulitis. All cases were confirmed by magnetic resonance imaging, all had sinusitis, and all nine patients underwent sinus surgery.⁶⁴ Berdai et al describes a case report of a pediatric patient with cavernous sinus thrombosis who ultimately died from septic shock despite surgical intervention, antibiotics, and anticoagulation.⁶⁵ The roles of steroids and anticoagulation remain controversial and debated in the literature, particularly in the setting of infectious etiologies.^{63,65,66}

Discussion

This work includes the most comprehensive and updated review of the literature to date. Due to the retrospective nature and therefore generally low quality of the available studies means that the results must be interpreted with caution. Overall however, there seems to be general consensus that pre-septal and post-septal orbital cellulitis may be first managed conservatively with antibiotics. With regards to subperiosteal abscesses in children, the literature suggests that this is not an absolute indication for immediate surgical intervention as classically thought. Based on our review of studies specifically identifying pediatric patients in their outcomes, conservative measures can be safe and effective if appropriately used, depending on patient characteristics, exam findings, clinical course, and imaging. This review also highlights the dearth of studies evaluating the ideal management of intraconal/orbital abscesses or infectious cavernous sinus thrombosis in the pediatric population. However, based on the few available case reports and series in the literature, surgical management seems to be the most appropriate at this time.

Conclusions

The contribution of this work is to facilitate patient-centered clinical judgment about the appropriateness of medical vs surgical management of pediatric orbital cellulitis, as well as to provide a resource and stimulus for future studies.

Orbital cellulitis, particularly subperiosteal abscesses, in children is not an absolute indication for immediate surgical intervention as classically thought. Conservative nonsurgical measures including close monitoring with antibiotics can be safe and effective if appropriately used, depending on patient characteristics, exam findings, clinical course, and imaging.

Contact

Stephanie Wong
Department of Otolaryngology
University of Rochester Medical Center
601 Elmwood Ave. Box 629
Rochester, NY 14611
Stephanie.Wong@URMC.Rochester.edu
Phone: 585-276-5181

References

Full reference list available upon request