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Indicators for imaging in periorbital cellulitis secondary to rhinosinusitis

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Abstract

Purpose Our objective was to identify the clinical indicators for subperiosteal orbital abscess (SPOA) among patients who present with periorbital cellulitis secondary to rhinosinusitis, and to evaluate the need for performing a computerized tomography (CT) scan.

Methods A retrospective cohort study of all patients admitted to our tertiary care emergency department between 2006 and 2014 was conducted. Included were healthy patients with acute periorbital cellulitis secondary to rhinosinusitis. Variables analyzed included age, gender, duration of symptoms, previous antibiotic therapy, highest recorded temperature, physical examination findings, ophthalmologist's examination results, laboratory results, and interpretation of imaging studies, when performed.

Results Of the 123 identified patients, 78 (63%) were males, with a mean age of 4 years (range 1–70). 68 patients were categorized as Chandler's 1 disease, 2 as Chandler's 2, and 53 as Chandler's 3. 68 patients underwent a CT scan, of those 53 had SPOA. Proptosis and ophthalmoplegia were strongly associated with the presence of an abscess ($P<0.001$). However, 14 patients with no ophthalmoplegia or proptosis who underwent a CT scan were older (mean age, 10 years; $P<0.028$), and had higher neutrophil count of 78 versus 59% ($P=0.01$). This group of patients had a clinically rapidly progressive disease, receiving wider broad-spectrum antibiotics or had their antibiotic treatment replaced to broader spectrum antibiotics through their course of treatment (48.2% compared to only 6.1%).

Conclusions We confirmed that patients with proptosis and/or limitation of extraocular movements are at high risk for developing SPOA, yet many do not have these predictors. Other features can identify patients who do not have proptosis and/or limitation of extraocular movements but do have significant risk of SPOA, and in these cases performing an imaging study is strongly suggested.

Keywords Acute rhinosinusitis · Orbital complication · Computerized tomography · Subperiosteal orbital abscess

Abbreviations

SPOA	Subperiosteal orbital abscess
OA	Orbital abscess
OC	Orbital complications

Introduction

Periorbital cellulitis is a relatively common clinical condition, encountered mainly in the pediatric population [1]. The Chandler's classification of orbital complications (OCs) secondary to acute rhinosinusitis (ARS) was introduced in the early 1970s is clinically based and is the most popular classification used for staging of OC secondary to ARS [2]. These complications can deteriorate, and eventually result in permanent blindness or even death, if not treated promptly and appropriately [3].

Subperiosteal orbital abscess (SPOA) typically presents as a collection of purulence in the space between the periorbit and the lamina papyracea, adjacent to the infected paranasal sinuses. The reported prevalence of SPOA is estimated to be between 12 and 17% of all the orbital infections

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that require hospital admissions [4]. It can deteriorate to a rapid elevation of orbital pressure, causing visual impairment, due to which the management of SPOA is crucial, and constitutes a medical and surgical emergency. Despite the accumulative data from recent studies that favor conservative treatment, especially in children, surgical drainage is still suggested in several cases, including failure to improve under medical treatment for 48 h, when visual compromise is confirmed, and in large abscesses [1, 5, 6].

The presenting symptoms and signs might be equivocal regarding the presence of a post-septal infection, and computerized tomography (CT) scan is the standard of care for diagnosis and defining the extent of the infection in the periorbital region and the paranasal sinuses [7].

Although CT scanning is a valuable diagnostic tool, it does involve exposure to radiation, and it is widely accepted that the radiation exposure from head and neck CT scan, especially in the pediatric population, can lead to an increased risk for malignancy, and thus should be selectively used, with strict indications [8, 9].

Only few guidelines address the role of imaging studies in the management protocols of OC secondary to ARS. The aim of this study was to identify clinical and laboratory indicators for SPOA among patients who presented with periorbital cellulitis secondary to ARS, and to evaluate the need for performing a CT scan.

Patients and methods

Study design and population

The study was approved by the Institutional Review Board.

A retrospective study of all cases of OC secondary to ARS admitted to our Otolaryngology-Head and Neck Surgery Department between 2006 and 2014 was carried out.

Included were all consecutive patients who were referred to our institute and hospitalized to any of our Medical Center's Departments with periorbital cellulitis, presenting with symptoms and physical findings suggestive of ARS including nasal and/or postnasal drainage, nasal congestion, facial pressure/pain, hyposmia or anosmia, fever, cough, fatigue, maxillary dental pain, and ear pressure and/or fullness. Patients with a history of local trauma, insect bite, foreign bodies, allergic reactions and conjunctivitis, and those who were not hospitalized were excluded.

Management protocol

All patients were admitted after confirmation of OC secondary to ARS was made by the on-call otolaryngologist, and evaluation of the ophthalmology service. Ocular examination included assessment of vision, when possible, pupillary function, periorbital edema, periorbital erythema, chemosis, proptosis, intraocular pressure, and retinal appearance. Ophthalmologic and otolaryngologic consultations were routinely conducted regarding the need for CT scan and surgical intervention, according to the patient's clinical status. All CT scans were reviewed by a senior radiologist that confirmed the OC Chandler's status.

We collected data on age, gender, symptoms, physical findings, including ophthalmologic examination, body temperature, complete white blood count and differential, C-reactive protein (CRP) levels, CT findings, treatment before and during admission, surgical treatment, outcome and the final diagnosis.

Statistical analysis

Categorical variables were expressed as number and percentages. Distribution of continuous variables was assessed using histogram and was described using median and interquartile range (IQR). Categorical variables were compared using Chi-square test or Fisher's exact test and continuous variables by Mann–Whitney test. A two-tailed $P < 0.05$ was considered statistically significant. The area under the receiver operating characteristic (ROC) curve was used to evaluate the discrimination ability of the continuous predictors. Youden's Index was used to identify the optimal threshold value of the combination of sensitivity and specificity.

Results

Demographics

123 patients with OC secondary to ARS were identified during the study period. There were 78 (63%) males and 45 (37%) females, with an average age of 4 years (IQR 1–11). 16 patients were over 18 years of age. 68 patients (55%) were diagnosed with Chandler's 1 disease, 2 (2%) with Chandler's 2 disease, 53 (43%) with Chandler's 3 disease, and none with an orbital abscess or a cavernous sinus thrombosis.

Clinical presentation

All the patients arrived to the Emergency Department due to periorbital erythema and edema, 107 patients (87%) presented with rhinorrhea, 50 (80.6%) with headache, 96 (78%) with fever, 33 (27%) with ophthalmoplegia and 27 (22%) with proptosis. 54 patients (43.9%) received systemic antibiotic treatment prior to admission, either due to symptoms and signs of ARS or the appearance of periorbital edema, 18 (17.3%) received cephalexin, 16 (15.4%) amoxicillin, 16 (15.4%) amoxicillin/clavulanic acid, three ceftriaxone (2.9%) and one received ciprofloxacin. The right eye was

Table 1 Demographics and clinical presentation of OC, according to Chandler's status

	Chandler's 1 and 2	Chandler's 3	*p* value
Total, *n* (%)	70 (57)	53 (43)	
Males, *n* (%)	45 (64.3)	34 (64.2)	NS
Mean age, (IQR)	2.0 (1.0–9.25)	5.0 (2.0–11.5)	0.021
Right side, *n* (%)	32 (45.7)	18 (34.0)	NS
Fever, *n* (%)	50 (71.4)	46 (86.8)	0.041
Swell red, *n* (%)	70 (100)	53 (100)	NS
Rhinorrhea, *n* (%)	64 (91.4)	43 (81.1)	NS
Headache, *n* (%)	28 (82.4)	22 (78.6)	NS
Cough, *n* (%)	32 (57.1)	19 (38.0)	0.049
Ophthalmoplegia, *n* (%)	3 (4.3)	30 (56.6)	< 0.001
Proptosis, *n* (%)	1 (1.4)	26 (96.2)	< 0.001

involved in 50 patients, compared to 73 with left eye involvement. There was no bilateral ocular involvement.

Chandler's 1 versus Chandler's 3 OC

Throughout this section, patients with Chandler's 3 disease were compared with patients who had Chandler's 1 and 2 stages, as Chandler's 2 was found only in 2 cases (Table 1). Patients with Chandler's 3 disease were found to be older, with a mean age of 5 years compared to 2 years in the other group ($P = 0.021$). The key clinical findings differentiating Chandler's 1 or 2 from Chandler's 3 stage of OC were ophthalmoplegia and proptosis. Limitation of the ipsilateral globe movement was observed in 30 patients (56%) with Chandler's 3 disease, compared with just 3 patients (4.2%) with Chandler's 1 disease ($P < 0.001$). Proptosis of the involved globe was associated with the presence of Chandler's 3 disease in 26 out of 27 Chandler's 3 patients ($P < 0.001$) (Table 1).

Fever was also found to be significantly more frequent in patients with Chandler's 3 disease, in 46 (86.8%) patients, compared to 50 patients (71.4%) with Chandler's 1 disease ($P = 0.041$).

Complete blood count and C-reactive protein were available in 114 and 95 patients, respectively. Despite the lack of correlation between the white blood counts and the stage of the orbital complication, we found that Chandler's 3 disease patients had higher neutrophil counts ($P < 0.05$), lower lymphocyte counts ($P = 0.002$) and higher mean C-reactive protein levels ($P = 0.01$) than Chandler's 1 and Chandler's 2 disease patients (Table 2; Fig. 1).

Indication for imaging analysis

68 (55.3%) patients underwent a CT scan, of those 53 (78%) were proven to have Chandler's 3 disease. Limitation of ipsilateral globe movement and proptosis were the main indications for performing a CT scan.

However, 14 patients out of 79 with no ophthalmoplegia or proptosis underwent a CT scan. This group of patients

Table 2 Correlation between complete blood count, differential, CRP and orbital findings

	Chandler's 1 and 2	Chandler's 3	*p* value
Eukocytosis, median (IQR)	12 (10–17)	15 (11–19)	0.219
Leutrophilia (%), median (IQR)	59 (42–73)	71 (61–82)	0.001
LLymphocytosis (%), median (IQR)	28 (18–42)	19 (12–29)	0.002
CRP, median (IQR)	35 (13–81)	68 (47–126)	0.01

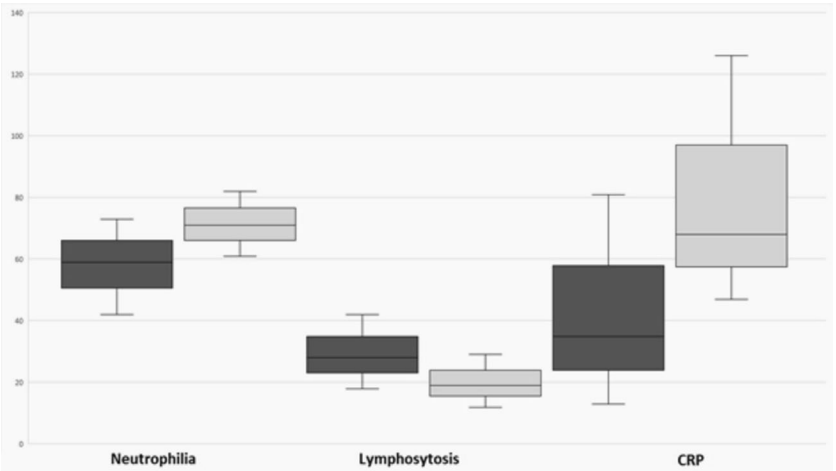

Fig. 1 Laboratory tests, according to Chandler's stage of OC

were older, with a mean age of 10 years, compared to the group of patients who did not present with ophthalmoplegia or proptosis (mean age: 2 years) ($P < 0.028$). The sensitivity and specificity of having SPOA in this group of patients over the age of 11 was found to be 50 and 80%, respectively. This group of 14 patients had higher neutrophil counts of 78 versus 59% ($P = 0.01$) (sensitivity 46.2%, specificity 92.2%), and a lower lymphocytic count. This group of patients who underwent a CT scan despite of presenting with neither ophthalmoplegia nor proptosis probably had a clinically malignant disease progression, as patients in this group were more likely to initially receive a more wider broad spectrum antibiotics (i.e., vancomycin and ceftazidime), or had their antibiotic treatment replaced to a broader spectrum antibiotics during their course of treatment (48.2% compared to only 6.1%), a decision that might indicate a more clinically severe/acute disease progression necessitating further investigation, i.e., performing a CT scan (Table 3).

Discussion

Because of the potential serious outcomes of OC secondary to ARS, the management of SPOA is crucial, and constitutes a medical and surgical emergency. Consultation of an otolaryngologist and an ophthalmologist and a timely mannered performance of a justified CT imaging study is an early goal for these children. Surgical drainage has traditionally been recommended for SPOA, although accumulative data from recent studies are generally in favor of conservative treatment, especially in children, while surgical drainage is usually indicated in cases of failure to improve under medical treatment for 48 h, or when visual compromise is suspected [1, 4, 6, 10].

Although several published studies dealt with the indications for surgery in the more advanced Chandler stage patients, the indications for CT scan studies to exclude ARS-associated OCs needing surgical intervention were not well established. The most reported indicative clinical symptoms and signs for SPOA are proptosis, ophtalmoplegia and impaired extraocular mobility, when presented on examination [11]. However, these findings do not completely differentiate between orbital cellulitis and orbital abscess [12]. CT is also required when intracranial complications are suspected, or when signs and symptoms of post-septal inflammation progress over a period of 24–48 h despite conservative therapy [13].

However, several studies have drawn attention to the fact that a high proportion of patients with advanced Chandler's classification, and mainly those with SPOA, might present with no pathological ocular signs. Rudloe et al. reported that 56 patients (50.5% of their cohort) did not present with proptosis or ophthalmoplegia, but did have CT disease staged 3 or higher [14]. Rahbar et al. [15] also reported that SPOA can present with only swelling and erythema, as was found in 26% of patients with SPOA in our cohort. The percentage of patients with an abscess who lacked proptosis and ophthalmoplegia is concerning. Most of the latter patients will have a CT scan due to unresponsiveness to conservative treatment, or in cases with malignant disease progression with no clear indication. Moreover, one cannot ignore the fact that due to the above-mentioned reasons, 15 patients out of 68 who underwent a CT scan (22%) in our cohort, did not have SPOA necessitating emergent drainage, and therefore, were irradiated in vain.

We showed that ophthalmoplegia and proptosis are very strong predictors of SPOA, as it has previously been suggested [11]. However, we also suggest other predictors for SPOA presence among ARS patients who presented without these classic symptoms or clinical findings. Our results show that a higher neutrophil count, older age, and a malignant disease progression necessitating broad spectrum antibiotic use are reliable predictors of an orbital abscess, and the use of a CT scan should be strongly considered in these patients (Fig. 2).

Only a couple of other studies in the literature have addressed this issue, suggesting several possible predictors of SPOA. Our suggestions are partly in agreement with those published by Rudloe et al. [14] who have found that leukocytosis and an older age should be considered as predictors of SPOA, as suggested in our study. Rudloe et al. also argued that the severity of the periorbital edema and the use of pre-antibiotic treatment were also predictors for SPOA, and that is in contrary to our results. Another study by Vu et al. [16] suggested that high fever (> 39 °C) should

Table 3 Antibiotic treatment in patients with normal globe movement and no proptosis

Antibiotic treatment	Chandler's 1 and 2 ($n = 65$) (%)	Chandler's 3 ($n = 14$) (%)
IV Amoxicillin clavulanate, *n* (%)	59 (90.8)	11 (78.6)
IV cefuroxime, *n* (%)	1 (1.5)	2 (14.2)
Initial treatment	1 (1.5)	1 (7.1)
Second line	0 (0)	1 (7.1)
IV metronidazole, *n* (%)	0 (0)	1 (7.1)
IV Ceftriaxone, *n* (%)	8 (12.3)	4 (28.5)
Initial treatment	5 (7.7)	1 (7.1)
Second line	3 (4.6)	3 (21.4)
IV Clindamycin, *n* (%)	6 (9.2)	3 (21.4)
Initial treatment	5 (7.7)	1 (7.1)
Second line	1 (1.5)	2 (14.3)
IV Vancomycin, *n* (%)	0 (0)	1 (7.1)
IV Ceftazidime, *n* (%)	0 (0)	1 (7.1)

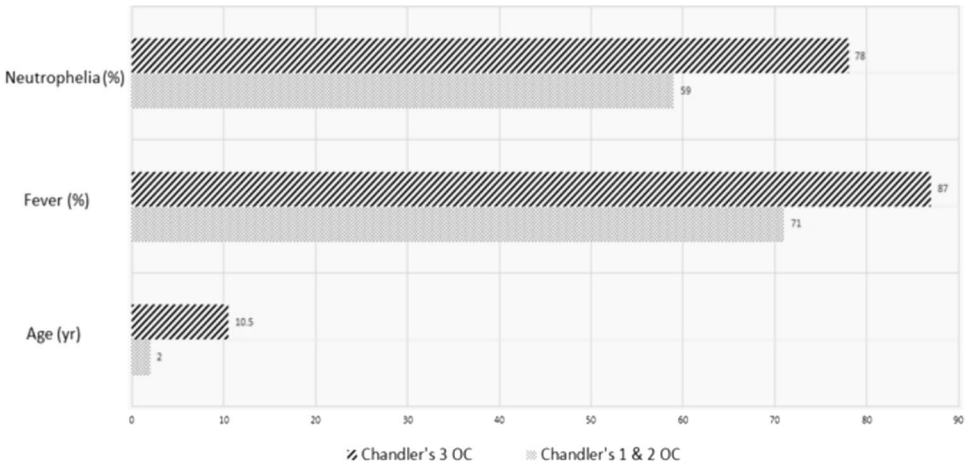

Fig. 2 Significant indicator of Chandler's 3 OC in patients with normal globe movement and no proptosis

also be a predictor of SPOA; however, our data and Rudloe et al. data did not identify fever as a predictor of SPOA, and therefore performing a CT scan is not suggested in these cases, according to our results.

Limitations

Limitations to our study include: first, almost half of the patients in our cohort did not undergo a CT scan, and we did not classify them as Chandler III or worse disease. This assumption cannot be overruled, unless a prospective analysis is performed with all patients are sent to perform a CT scan study. One can argue that an orbital abscess with no ocular signs that did not fulfil our indication criteria could have been missed. Yet, the follow-up of our patients was uneventful.

Second, as this is a retrospective study, it has come to our attention that in several cases it was challenging to completely comprehend the accurate indication for having, and sometimes for avoiding, both imaging and surgery, particularly as these have been multi-disciplinary-treated patients. This limitation is common to other retrospective studies, in which a clear flowchart for treatment was not available.

Conclusions

We confirmed that patients with proptosis and/or limitation of extraocular movements are at high risk for SPOA, yet many do not have these predictors. Other features can identify patients who do not have proptosis and/or limitation of extraocular movements but do have significant risk of SPOA, and in these cases performing an imaging study is strongly suggested.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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