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Original Research Article

Retrospective Assessment of the various Factors That Influence the Outcomes of Therapy in Children Hospitalized with Orbital Complications Caused by ARS

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Abstract

Aim: To identify the factors that influence the outcomes of therapy in paediatric patients with acute rhinosinusitis resulting in ocular problems.

Material and Methods: Retrospective cross-sectional research was carried out in the Department of ENT, Madhubani Medical College and Hospital, Madhubani, Bihar, India from May 2022 to April 2023. Throughout this time, all children hospitalized with orbital complications caused by ARS were included in the study. Clinical and radiological examination, Microbiological analyses and Surgical intervention were studied. Patients with visual impairment and those who failed medical therapy required surgical intervention. Fever despite 2 days of antibiotic therapy, increasing symptoms, and worsening of inflammatory markers were all considered as treatment failure.

Results: The research included 78 children who were hospitalized for orbital complications after ARS. Prior to admission, the 54 patients (69.2%) had orbital complications of Chandler grade I or II. Seventeen (21.8%) of the patients developed SPOA (grade III), and seven (8.9%) had an orbital abscess (grade IV). There was no evidence of cavernous sinus thrombosis in any of the individuals (grade V). In 62 (85.9%) of the patients, computed tomography of the paranasal sinuses was done. Table 1 shows the demographic and clinical features of the patients. We collected 78 sinonasal secretion samples from all patients and 46 tissue samples from those who had EES. Staphylococcus aureus was cultured in 31 (34.8%) of patients, followed by Streptococcus pyogenes in 26 (29.2%), Streptococcus pneumoniae in 18 (20.2%), Haemophilus influenzae in 9 (10.1 %), and Moraxella catarrhalis in 5 (5.6%). Only 36 (40.4%) of the patients' isolates matched when comparing microbiological growth in syno-nasal secretion and tissue samples. Microbial growth was not seen in six re- hospitalized individuals. The average hospitalization age groups (<7 years verses >7 years) were 7.7 and 13.6 days, correspondingly ($p=0.03$). The 45% of children and 15.8% of younger children who underwent pre-hospital antibiotics therapy developed grade III or IV orbital complications prior to the admission ($p<0.001$). Furthermore, older children required surgery at a higher rate than younger children, 62.5% against 39.5% ($p<0.01$).

Conclusion: In conclusion, orbital complications obtained as the results of acute sinusitis in pediatric population remain highly prevalent and are serious pediatric and surgical problem. Children of age over seven years with acute sinusitis caused stage II or III orbital complications were independent predictors of the failure to antibiotic therapy. Pediatricians should consider patients' age and severity of orbital complications to refer to therapeutic or surgical interventions.

Keywords: Rhinosinusitis, Orbital complications, Age, Severity

Introduction

Acute rhinosinusitis (ARS) is characterized by the inflammation of the mucous membranes in the nasal and paranasal sinuses (PNSs). The typical clinical manifestations of this infection are both mild and self-limiting. The ARS affects about 35 million people annually in the United States and leads to serious morbidity and impairments in the quality of life. [1] The increased use of antibiotics, use of vaccines for bacterial rhinosinusitis (primarily caused by a pneumococcal infection), and easier access to radiological imaging methods, facilitating early diagnosis and treatment, have been accompanied by a reduction in the rate of ARS-related complications. However, these complications are still considered important health issues. Orbital complications related to ARS are commonly seen in paediatric patients. [2-8] First, Hubert and later, Chandler categorized ARS

complications based on their severity. Briefly, in this classification system, the ARS orbital complications were divided into five classes, namely inflammatory oedema (class 1), orbital cellulitis (class 2), subperiosteal abscess (class 3), orbital abscess (class 4), and cavernous sinus thrombosis (class 5), respectively. It has been reported that 5-7% of patients with rhinosinusitis develop orbital complications. Orbital complications related to ARS are often seen in children; however, the prognosis of this disease in paediatric patients is reportedly better than that in adults. [9-11] Several determinants, including age, gender, race, genetic factors, socioeconomic status, and environmental conditions, have been proposed to be responsible for the development of orbital complications related to ARS. The precise cause of ARS-related complications is unknown. The role of anatomical variations and severity of ARS in the development of complications is unclear yet. Furthermore, it is not clear why ARS complications are more common on one side. [12,13]

Material and Methods

Retrospective cross-sectional research was carried out in the Department of ENT, Madhubani Medical College and Hospital, Madhubani, Bihar, India from May 2022 to April 2023 Throughout this time, all children hospitalized with orbital complications caused by ARS were included in the study. Minimal required sample size was calculated as 73 patients taking into account the prevalence of orbital complications about 5%, under random sampling error of 5% with 95% confidence level. To make a diagnosis of ARS we used the criteria of the European position sheet on rhinosinusitis and nasal polyps (EPOS 2012). The orbital complications were classified using the criteria proposed by Chandler. According to the classification first stage (I) involves inflammatory oedema and pre-septal cellulitis, while the second stage involves orbital cellulitis. Patients with subperiosteal abscesses refer to stage III and those with orbital abscess to stage IV. Stage V includes sinus cavernous thrombosis. For those patients with orbital complications stage II or higher the CT scans were performed for the purpose of proper classification. Demographic characteristics of patients, hospitalization time and duration, antimicrobial therapy, symptoms, physical examination, CT scan results, and data on surgical and non-surgical treatment were obtained from patients' medical records from. Data on microbiological analyses were obtained from the database.

Clinical and Radiological Examination

All patients were examined by an otolaryngologist on admission to confirm the diagnosis. Samples from sinonasal secret were assessed visually, and pus samples were taken for the purpose of culturing and further microbiological investigation. All patients underwent ophthalmological and neurological examination for clinical identification of orbital complications. Those patients who were found to be abnormal on either of the two examinations underwent additional computed tomography (CT) scanning.

Microbiological Analyses

Before beginning antibiotic medication, as a common technique, all patients underwent sinonasal aspiration. Sinonasal aspiration is an endoscopic collection of samples from the middle nasal meatus that has been found to be accurate in identifying the major bacterial pathogens with a 90% concordance with cultures. Excretions from the sinuses were also obtained from surgical patients, and a pus sample from a drained abscess was sent for microbiological testing. Analyses allowed to detect of gram stain of the bacterial pathogens, and establish the respiratory characteristics of the bacteria such as aerobic versus anaerobic and antibiotic susceptibility.

Surgical Intervention

Patients with visual impairment and those who failed medical therapy required surgical intervention. Fever despite 2 days of antibiotic therapy, increasing symptoms, and worsening of inflammatory markers were all considered as treatment failure. Endoscopic sinus surgery (ESS) aimed to expose the lamina papyracea (ethmoid labyrinth) in order to identify probable dehiscence and remove diseased tissue. As a result of significant dehiscence, it was essential for the partial deletion of the lamina papyracea.

Statistical Analysis

To investigate demographic data and clinical symptoms, descriptive statistics were used. The categorical variables were given as frequencies and percentages. Continuous data were displayed as absolute numbers and their correspondent percentages (%). The Mann-Whitney test was used to compare groups for continuous variables and the chi-square test for categorical variables. We examined the use of pre-hospital antibiotic medication with the orbital complications and clinical outcomes to assess the impact of antibiotic treatment prior to hospitalization in the prevention of orbital complications. All outcomes were examined between children aged up to 7 and older (>7 years). R-studio version 3.6.2 used for all analyses.

Results

The research included 78 children who were hospitalized for orbital complications after ARS. There were 44 male patients (56.4 %), with a sex ratio of 1.29:1. The average age was 7.45 years (8 months-18 years), with 48.7 % being under the age

of seven. A total of 70 (89.7%) patients developed fever, and 4 (5.1%) experienced vision impairment. Prior to admission, the 54 patients (69.2%) had orbital complications of Chandler grade I or II. Seventeen (21.8%) of the patients developed SPOA (grade III), and seven (8.9%) had an orbital abscess (grade IV). There was no evidence of cavernous sinus thrombosis in any of the individuals (grade V). In 62 (85.9%) of the patients, computed tomography of the paranasal sinuses was done. Table 1 shows the demographic and clinical features of the patients.

Four patients (5.1%) required prompt surgical intervention due to vision impairments and limited eye mobility. The remaining 74 patients (94.9%) were first treated with antibiotics, and 41 patients (52.6%) who did not respond to medicine were referred for subsequent surgical treatment. A third-generation cephalosporin and metronidazole were the most often utilized therapy combinations in this group, accounting for 90% of cases. The majority of patients who did not respond to the treatment by the major antibiotics required surgery, with 41 (52.6%) having orbital complications of stage II or III, while 30 (38.5%) had stage I or II. A total of forty-six patients underwent ESS, with 93.5 percentages responding well to operative drainage and 3 requiring subsequent eye operation. After therapy, all patients recovered successfully with the no long-term effects.

We collected 78 sinonasal secretion samples from all patients and 46 tissue samples from those who had EES. Bacterial growth was found in 89 of the samples (86.4%). Of these, 53 (67.9%) were found in nasal samples and 36 (94%) in tissue samples. Overall, 71 patients had one strain (79.8%), six patients had two strains (6.7%), two patients had four strains (2.2%), and eight patients had multiple strains (8.9%). Staphylococcus aureus was cultured in 31 (34.8%) of patients, followed by Streptococcus pyogenes in 26 (29.2%), Streptococcus pneumoniae in 18 (20.2%), Haemophilus influenzae in 9 (10.1 %), and Moraxella catarrhalis in 5 (5.6%). Only 36 (40.4%) of the patients' isolates matched when comparing microbiological growth in syno-nasal secretion and tissue samples. Microbial growth was not seen in six re- hospitalized individuals. (Table 2) Antibiotics were administered to 94.9% (74/78) of the children prior to hospitalization. Amoxicillin, metronidazole, and third-generation cephalosporins were the most often given antibiotics. The 52.6% of patients who received antibiotics prior to admission required surgical intervention. Overall, 83.5% of these individuals' isolates were resistant to preclinically indicated medications. Pre-clinical antibiotic administration had no significant influence on illness severity at the time of presentation ($p=0.38$) or treatment during hospital admission ($p=0.33$). However, a relationship was discovered between age at admission and disease severity (Table 3). The average length of hospitalization discovered was 9.2 days (range 4-21 days). The average hospitalization age groups (<7 years verses >7 years) were 7.7 and 13.6 days, correspondingly ($p=0.03$). The 45% of children and 15.8% of younger children who underwent pre-hospital antibiotics therapy developed grade III or IV orbital complications prior to the admission ($p<0.001$). Furthermore, older children required surgery at a higher rate than younger children, 62.5% against 39.5% ($p<0.01$). There were no recurrences in older children, but three recurrences were found in children under the age of seven. These three individuals were hospitalized many times and required surgical intervention.

Table 1: Baseline demographic and clinical characteristics of the study sample

Variables	**Total=78, n (%)**
Age (years)	7.45 (8 months-18 years)
Sex	
Female	37 (43.6)
Male	41 (56.4)
High fever	71 (91)
Visual impairments	4 (5.1)
Chandler stage	
I	29 (37.2)
II	25 (32)
III	17 (21.8)
IV	7(8.9)
V	NA
Affected sinus (based on CT imaging)	N=62
Maxillary sinus	46 (74.2)
Ethmoidal sinus	62(100)
Sphenoidal sinus	4 (6.4)
Frontal sinus	12 (19.4)

Pre-hospital antibiotic therapy	74 (94.9)
Antibiotic failure	41 (52.6)
Surgical intervention	41 (52.6)
Average hospitalalisation with antibiotic therapy (days)	8.2 (4-17)
Average hospitalalization surgical intervention	12.4 (7-21)

Table 2 Microbiological data

Parameter	Value
Staphylococcus aureus	31 (34.8%)
Streptococcus pyogenes	26 (29.2%)
Streptococcus pneumoniae	18 (20.2%)
Haemophilus influenzae	9 (10.1%)
Moraxella catarrhalis	5 (5.6%)
Matching Isolates in Syno-Nasal and Tissue	36 (40.4%)
Re-hospitalized Individuals with No Growth	6

Table 3: The association between age and clinical characteristics.

Variables	<7 years, N (%)	>7 years, N (%)	Chi-square /Mann-Whitney U test, p value
Total number	38	40	0.76
Stage I and II at presentation	24 (63)	30 (75)	0.19
Stage III and IV at presentation	6 (15.8)	18 (45)	<0.001
Stage V at presentation	0 (0)	0 (0)	NA
Antibacterial therapy	37 (97.4)	37 (92.5)	0.38
Requirement for surgery	16 (39.5)	25 (62.5)	<0.01
Hospitalization (days)	7.7±3.6	13.6±4.5	0.03

Discussion

All of the participants in this research were given antibiotics before being sent to the hospital, yet orbital complications have been reported in two-thirds of them. Despite antibiotic therapy, the majority of the children required surgery. In this research, intravenous antibiotics were effective in most children with stage I or II ocular complications, despite no significant improvement in children with stage II or III complications where obtained strains showed high antibiotic sensitivity. No prior studies had explained the reasonable hypothesis for this phenomenon. Several studies have shown that antibiotics can successfully cure a subset of SPOA patients. [13] In most published research, pharmacological therapy in SPOA had various effectiveness rates. All patients with SPOA in this group did not respond to pharmacological therapy, demanding ESS to halt the pathological process. There is also likely to be a move toward surgery with an increase in age. Furthermore, there is conflicting evidence in the literature, which suggests that age of children is the major determinant of the orbital complications.8,12 Children over the age of seven were much more likely to have stage III or IV complications and were more likely to require surgery in this research compared to those younger age showing better outcomes with antibiotics and lower disease severity. Our findings are in compliance with these data, suggesting higher disease severity and lower success rates with antibiotic therapy in children of age seven or older. [12] S. aureus was the most prevalent microorganism causing severe ethmoiditis in children, followed by Streptococcus pyogenes. [13,14] S. aureus was the most frequently cultivated bacterium in the current investigation. In this cohort, we observed high incidence of S. pneumoniae compared to the other research. Also, our results suggests that CT imaging in children with poor antibiotic therapy outcomes can assist doctors to determine if patients with visual impairment require surgical intervention. The observational methodology as well as the retrospective approach to data collection were the two most significant limitations of this research. Two independent researchers were trained for data collection; however, it is possible that some pertinent information have been overlooked. In addition, in 7 cases microbiological tests and CT scans were performed in private laboratories with possible differences in techniques and technologies used.

Conclusion

In conclusion, orbital complications obtained as the results of acute sinusitis in pediatric population remain highly prevalent and are serious pediatric and surgical problem. Children of age over seven years with acute sinusitis caused stage II or III orbital complications were independent predictors of the failure to antibiotic therapy. Pediatricians should consider patients' age and severity of orbital complications to refer to therapeutic or surgical interventions. Public health systems should adopt an early referral system for children over seven years with ARS caused orbital complications.

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