

A 13-year report on childhood sinusitis: Clinical presentations, predisposing factors and possible means of prevention*

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SUMMARY

Two hundred and nineteen children with sinusitis treated as in-patients at Huddinge University Hospital during the period 1980-1992 have been reviewed. Epidemiological data, the clinical picture, treatment and complications are described. The prevalence of significant predisposing conditions (such as upper airway allergy, asthma, and immunoglobulin deficiency) has been estimated. Serious sinusitis complications are few, surgery is only rarely required, and previously-recognized important predisposing paediatric conditions are not significantly more common than in the general juvenile population. Improved medication and prevention may have reduced the incidence of serious sinus infections in risk groups today. Children with cystic fibrosis have been reviewed with regard to the necessity of both sinus and nasal polyp surgery. Aggressive medical therapy appears to have reduced their need for sinus surgery as well as polypectomy.

Key words: allergy, bacteria, cystic fibrosis, in-patient, nasal polyp

INTRODUCTION

It has been estimated that some 5-13% of the general population may have experienced sinusitis during childhood (Wald et al., 1991), but the exact incidence of acute or chronic sinusitis in children is not known. There is one obvious reason for this: diagnosis is usually based on a combination of signs and symptoms and sometimes also on plain radiographs (Cuyler and Monaghan, 1989), but only rarely confirmed by more sophisticated imaging techniques, histopathology, direct endoscopy or bacterial culture from the affected sinuses. Features generally considered to indicate acute sinusitis include cough (particularly nocturnal), nasal congestion and secretion, and fever (Kogutt and Shwachman, 1973). Headache and facial pain are symptoms less frequently seen in children than in adults. When the diagnosis of sinusitis is established in a child, symptoms often persist for more than the 7-10 day period, that is typical for uncomplicated upper airway infections (Fireman, 1992). The principal conditions which in the literature are regarded to predispose for or co-exist with sinusitis are: airway allergy (Kogutt and Shwachman, 1973; Crockett et al., 1987; Åberg et al., 1987; Rachelefsky et al., 1988; Savolainen, 1989; Fireman, 1990; Orobello et al., 1991; Furukawa et al., 1992; Rachelefsky et al.,

1992), asthma (Kogutt and Shwachman, 1973; Slavin, 1984; Crockett et al., 1987; Minor and Lockey, 1987; Orobello et al., 1991; Rachelefsky et al., 1992), immunodeficiency syndromes (Shapiro et al., 1991; Orobello et al., 1991; Rachelefsky et al., 1992) and cystic fibrosis (Shapiro et al., 1982; Stern et al., 1982; Reilly et al., 1985; Ceporo et al., 1987; Crockett et al., 1987; Cuyler and Monaghan, 1989; Drake-Lee and Morgan, 1989; Ramsay and Richardson, 1992).

The most severe cases of paediatric sinusitis seen at Huddinge University Hospital, i.e. those requiring in-patient hospital care, during the past 13 years have been reviewed and evaluated in this paper. This investigation gives a summary of the presently seen clinical presentations in this patient group at our hospital and updates the relative importance of certain conditions known to predispose for sinusitis in children.

MATERIAL AND METHODS

Two hundred and nineteen children with sinusitis (aged 4 months to 15 years) treated at the Department of Otorhinolaryngology (n=191) and the Department of Paediatrics (n=22) at Huddinge University Hospital during the period 1980-1992 were included in this retrospective study. The ENT specialist on

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duty judged whether they required in-patient hospital care, based upon the severity of symptoms from acute (pain, affected general condition, fever, oedema of eyelids or suspected orbital engagement), or chronic sinusitis (prolonged symptoms, requiring extended examination or surgery). The diagnosis - bacterial infection of the sinus mucous membrane - was based on disease history, clinical findings and, in the majority of patients, also on radiographs. In all cases, the diagnosis was confirmed by an experienced consultant.

The patients were divided into three major groups with regard to symptom duration and the severity of sinus infection: (1) acute fulminant ethmoiditis, with extension of the infection to the peri-orbita and/or the orbita (group E); (2) less severe forms of acute or subacute sinusitis (group O); and (3) chronic sinusitis, with symptoms persisting at least for three months before admission (group C).

For all patients the records were reviewed for previously or currently diagnosed or suspected allergic disease, asthma, cystic fibrosis, immunodeficiency syndrome, and ciliary dysfunction. Several clinical parameters were also taken into consideration: body temperature, erythrocyte sedimentation rate, C-reactive protein, white blood cell count, and bacterial culture from the nasopharynx by routine laboratory procedure at the time of admission. Drug therapy during hospitalization, the period of time with elevated temperature ($>38^{\circ}\text{C}$) after initiation of therapy, duration of hospitalization, any ophthalmological complications, and surgical intervention were also registered. In addition, patient data of all in-patient sinusitis children were checked with the 1994 accumulated register of cystic fibrosis (CF) patients at the Stockholm Cystic Fibrosis Centre (Department of Paediatrics, Huddinge University Hospital). This was done in order to reveal any patients who may have received the diagnosis of CF after their sinusitis episode.

In a parallel study, 28 children in the same age group who during 1980-1992 were treated as in-patients for nasal and choanal polyposis, were reviewed in a similar way for the prevalence of predisposing conditions. The data obtained were compared statistically with Chi-square test (age and monthly incidence) and with Student's t-test (prevalence relation to pre-existing epidemiological data).

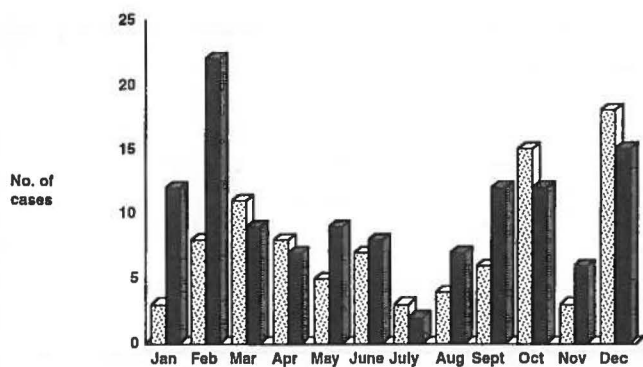


Figure 1. The cumulative monthly incidence of fulminant ethmoidal (group E, spotted columns) or other acute sinusitis (group O, filled columns) during the period 1980-1992. There is a significant difference in monthly incidence within both groups (Chi-square test, $p < 0.001$).

RESULTS

Among the 219 children, boys outnumbered girls by 126 to 93. The age range was 4 months to 15 years (median: 11 years; mean: 8.3 years). The number of children who require hospital care due to sinusitis amounted to 24 per 100,000 inhabitants (up to the age of 15) annually in this region during the period studied. Median time in hospital was 2.5-3 days, for the chronic group 4 days. The seasonal distribution of patients is shown in Figure 1.

Group distribution

Ninety children suffered from acute ethmoiditis with extension to engage peri-orbital tissues (group E): age ranged from 4 months to 14 years (median: 2 years; mean: 3.9 years). Boys outnumbered girls by 50 to 40. Radiographic examination was performed in only 20 out of the 67 patients, aged ≤ 4 years.

Chronic sinusitis (group C) existed in seven patients, aged 8-15 years (median: 12 years; mean: 12.4 years). All of these children had suffered from recurrent or persistent sinusitis symptoms for more than 1 year or had pathological sinus X-ray findings recorded for more than 1 year.

The remaining 122 patients suffered from other kinds of sinusitis (group O), such as acute or sub-acute pansinusitis, polysinusitis, frontal sinusitis or maxillary sinusitis. Their age was 5-15 years (median: 13 years; mean: 11.2 years). Boys outnumbered girls by 71 to 51. Children with non-fulminant ethmoiditis were also included in this group.

A more detailed display of the age distribution in groups E and O is given in Figure 2.

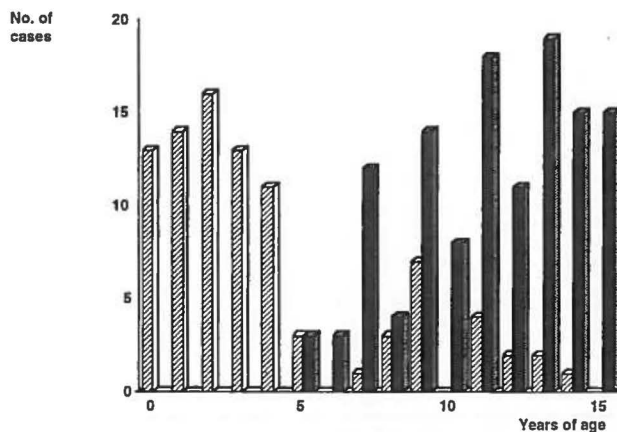


Figure 2. Age distribution of the children in group E (striped columns) and group O (filled columns).

Body temperature

The mean body temperature upon admission to the hospital is given in Table 1. In group E, 74% of the children had a temperature of 38.0°C or higher, compared to 50% in group O. The mean duration of elevated temperature ($>38^{\circ}\text{C}$) during hospital care was 0.9 days, both in group E (range: 0-4.5 days) and group O (range: 0-12 days).

Blood tests

The mean erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and white blood cell (WBC) count are shown in

Table 1. In group E, 65% had an increased ESR (>20 mm) and 86% had an increased CRP (>10 g/l). In group O, an increased ESR and CRP were found in 45% and 83%, respectively. In group E, 73% had an increased WBC count ($>10 \times 10^9$ cells/l) versus 41% in group O. In the 58 cases of acute or sub-acute sinusitis (groups E and O together) in which both WBC and CRP were analysed, either or both of the two tests showed elevated values in 95% of the cases.

Table 1. Clinical data recorded in the two acute sinusitis groups on admission to hospital, expressed as arithmetical means (range within parenthesis).

	group E	group O
age (years)	3.6 (4 months-14)	11.2 (5-15)
body temperature ($^{\circ}$ C)	38.6 (36.7-40.3)	38.2 (36.6-41.0)
ESR (mm)	32 (2-210)	23 (1-94)
CRP (g/l)	66 (<10 -205)	53 (<10 -120)
WBC ($\times 10^9$ cells/l)	14.7 (3.8-37.5)	9.8 (2.4-26.0)

ESR: erythrocyte sedimentation rate; CRP: C-reactive protein; WBC: white blood cell count

Bacteriology

Nasopharyngeal cultures were set up from 141 of the 219 children before any antibiotic treatment was initiated. Fifty-nine cultures proved negative for bacterial growth, showed normal respiratory flora, or only sparse colony growth. Among the recognized pathogens, *Haemophilus influenzae* was isolated from 49 patients, *Streptococcus pneumoniae* from 20 patients, *Moraxella (Branhamella) catarrhalis* from 20 patients, and haemolytic Streptococci group A or B from 10 patients. Anaerobic Gram-positive cocci were found in one patient. The relative prevalences of bacterial pathogens are shown in Figure 3. In three patients, culture samples were obtained directly from the sinuses at surgery. *S. pneumoniae* was isolated in one case, *H. influenzae* in one, and no growth in one case.

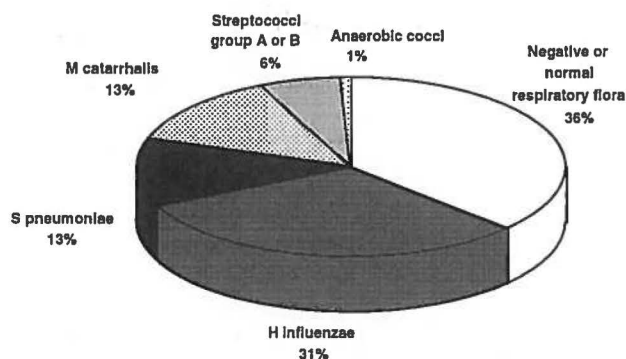


Figure 3. Bacteriological findings in nasopharyngeal cultures from 141 children with sinusitis, before any antibiotic therapy was instituted.

Ophthalmology

In group E, 31 of the 90 patients were seen by an ophthalmologist. Only three of these patients presented any significant disturbance in eye function. One patient (4 years of age) had a protrusion of the bulb and two patients (both 13 years old) had diplopia. In all three cases, the eye complications abated rapidly

within 2-3 days with ampicillin-amoxicillin or cefuroxime medication, and surgery was not required.

In group O, 5 of the 122 patients were seen by an ophthalmologist. One 13-year-old girl presented disturbance of the eye movement in the form of diplopia. Computerized tomography revealed right-sided frontal and ethmoidal sinusitis. Surgery in the form of external trepanation of the frontal sinus (preferred procedure at that time) and endoscopic ethmoidectomy was carried out and antibiotic treatment (ampicillin and chloramphenicol) was given as well. Her diplopia then resolved within 5 days, but some peri-orbital oedema persisted for weeks.

Medical therapy

In decreasing order, the antibiotic drugs prescribed for the children with acute sinusitis were: amoxicillin or ampicillin (54%), phenoxymethyl-penicillin or benzyl-penicillin (29%), cefuroxime (8%), trimethoprim-sulfamethoxazole (3%), erythromycin (2%), amoxicillin/chloramphenicol (2%), cefotaxime (1%), cefaclor (0.5%), and doxycycline (0.5%). The preference pattern for antibiotic use was not significantly changed over the study period. Routinely, α -adrenergic agonist (oxymetazoline or xylometazoline) decongestants were administered in the form of nasal drops or sprays, and children aged 9 years were also treated with cotton swabs soaked in naphazoline-lidocaine applied in the middle meatus, 2-3 times daily. Maxillary sinus irrigation was performed under local anaesthesia in 30 patients above the age of 9 years, by puncture of the medial sinus wall from the inferior meatus.

Surgery

In 12 out of 219 sinusitis patients, surgical intervention was considered necessary. All seven patients in group C were operated on, but none of the children in group E. The chief intention of surgery was to improve sinus drainage and ventilation by the functional approach. As stated above, one patient was operated on ophthalmological indication.

Besides sinus surgery, two patients also underwent polypectomy, one patient partial inferior turbinectomy, and five patients adenoidectomy. Two patients had previously undergone sinus surgery and two additional patients were operated on after the sinusitis episode because of subsequently diagnosed nasal polyposis. Two of the 12 children treated with sinus surgery later had a recurrence of sinusitis: one needed a second polypectomy and the other was subjected to a Caldwell-Luc operation on the maxillary sinus. No other post-operative complications were recorded.

Possible predisposing conditions

A medical history of significant airway or immunological disorder other than sinusitis was recorded in 55 (25%) of the 219 patients. Table 2 displays the prevalence of such conditions in relation to previous studies.

A history of (seasonal or perennial) allergic disease related to aero-allergens was recorded in 27 patients (12%), mainly rhinitis or conjunctivitis. Seven children had a history of alimentary intolerance problems. Twenty-three children were subjected to

skin prick testing and/or RAST because of suspected allergy, but no additional cases of allergy were diagnosed by these tests. Table 2. Prevalence of conditions predisposing to sinusitis in this study, compared with findings in earlier studies.

	this study	earlier study	reference
allergy	12% ($p < 0.0005$)	25%*	Savolainen (1989)
asthma	5%		no data
allergy+asthma	13% ($p < 0.0005$)	38%	Kogutt and Shwachman (1973)
immunoglobulin deficiency	0.5% ($p < 0.005$)	5%	Kogutt and Shwachman (1973)
ciliary dyskinesia	0%		no data

*: young adults

Five children had a history of non-allergic non-infectious rhinitis, 10 children suffered from asthma, one from recurrent nasal polyposis (group C), one from antrochoanal polyp (group C), and 21 from recurrent acute otitis media with effusion (one of them in group C). Twenty-nine of the children stated they had previously suffered from recurrent acute otitis media, and two from chronic otitis media (one from group C). Fifteen children had previously been affected by recurrent acute subglottic laryngitis. One child had a diagnosed immunological disorder, dys-gammaglobulinaemia type 1 (low serum IgG and IgA). None of the 219 children had a CF or ciliary dyskinesia syndrome diagnosed. Furthermore, none of them was registered as having CF diagnosed up to 1994.

Nasal polyp study

Twenty-seven children (<15 years of age) were operated on at the Department of Otorhinolaryngology (Huddinge University Hospital) during the period 1980–1992, because of nasal polyposis (19 patients) and choanal polyps (8 patients).

Table 3. Prevalence of therapy requiring sinus and polyp disease in CF-children of this study, compared with data from earlier studies.

	this study	earlier study	reference
CF-children with severe sinusitis	0% ($p < 0.0005$)	11%	Ceporo et al. (1987)
sinus surgery in CF-children	0% ($p < 0.0005$)	10–20%	Ramsay and Richardson (1992)
polypectomy in CF-children	6% ($p < 0.005$)	19%	Stern et al. (1982)

Of the 19 patients with nasal polyps, six had CF, of whom two were admitted from other counties (Table 3). The CF-patients operated on were younger (three children aged 3 years, and the other three children aged 6, 7, and 10 years, respectively) than the other 13 children operated on for nasal polyps, who ranged in age from 9 years and upward. Nine patients in the non-CF polyposis group had a negative sweat test, and four patients had not been tested at that time. A history of allergic disease in the non-CF

polyposis group was found in four patients (21%), three of them suffering from asthma and one from rhinoconjunctivitis. Four polyposis patients had a history of recurrent secretory otitis media, two of perennial non-allergic rhinitis, one of chronic otitis media, and three had sinusitis problems (one with chronic sinusitis, and two with acute sinusitis, all three were included in the sinusitis study). Six out of 19 children had a relapse requiring re-operation of their nasal polyposis during the period studied (re-operated within 6 months to 10 years). Two of those were CF-patients.

The eight children who suffered from choanal polyposis were aged 9 to 15 years. One of them had a diagnosed chronic sinusitis (included in the sinusitis study); otherwise, these children were subjectively healthy.

DISCUSSION

The number of in-patient treatment events during these years (24 per 100,000 children annually) imply that by far <0.5% of the population require hospital care due to sinusitis during childhood, and hence the vast majority of children with uncomplicated sinus infections are adequately treated on an out-patient basis or by general practitioners.

The recordings of body temperature and laboratory tests did not provide any important differential diagnostic or prognostic information. CRP was found to be the most useful inflammatory parameter, since it was most often significantly increased and particularly reliable in group E. The high incidence of negative bacterial cultures may in part be the result of insufficient search for anaerobic bacteria (Brook, 1981), but the present finding of aerobic dominance and a high proportion of negative cultures is consistent with the majority of previous studies (Orobello et al., 1991; Wald, 1992). Sinus X-ray imaging (plain or computerized tomography) was performed in 163 (74%) of the sinusitis children and, naturally, all of them were indicative of sinus pathology. These findings were not further evaluated, as they were of little or no help in our group distribution of patients. Furthermore, roentgenography is a highly unselective method to diagnose therapy-requiring sinusitis in children, particularly in the youngest age group (Shopfner and Rossi, 1973; Lesserson et al., 1994). Neither reported allergic symptoms nor allergy tests indicated any significantly increased prevalence of allergy among sinusitis children compared to the general prevalence in this age group in Northern Europe or North America (Kogutt and Shwachman, 1973; Åberg et al., 1987; Crockett et al., 1987; Rachelefsky et al., 1988; Savolainen, 1989; Orobello et al., 1991; Furukawa et al., 1992; Rachelefsky et al., 1992); nor was asthma statistically overrepresented (Kogutt and Shwachman, 1973; Slavin, 1984; Crockett et al., 1987; Minor and Lockey, 1987; Orobello et al., 1991; Rachelefsky et al., 1992). In comparison to previously cited studies, recognized predisposing diseases seem to be less important in this material (see Table 2). Huddinge University Hospital is a well-established centre for the treatment of CF in the central region of Sweden, continuously monitoring about 65 juvenile CF-patients. Therefore, it was somewhat surprising that none of them needed hospital care or surgery because of sinusitis during the studied period. Nasal symptoms from polyps were significantly less

prevalent in CF-patients, and fewer of them underwent polypectomy than previous studies would indicate (Stern et al., 1982). Although this sample is limited in size and the study is affected with the inevitable weaknesses of retrospectivity, certain reflections can be made in the view of the advances of therapy for the airway diseases in question during recent decades. More potent anti-allergic drug therapy with fewer side effects and improved counselling to families with allergic children may have significantly reduced the risk of sinusitis among allergics. The fact that no child in group E needed surgical intervention should in part be credited to effective and appropriate antibiotic therapy, and in part also to the awareness of parents, as severe orbital complications could be avoided when there was no delay in instituting medical treatment.

Of particular interest are the findings concerning the children with CF. The need for surgical intervention in the sinuses of CF-children has been emphasized, particularly by certain American colleagues (Ramsay and Richardson, 1992). The 35 paediatric CF-patients living in Stockholm County (prevalence: 10 per 100,000) are given on average one specialist consultation every month. Bacterial cultures are routinely obtained from the nasopharyngeal cavity of infants and pre-school children and from sputum of older children, in order to chart bacterial colonization of the upper and lower airways. Whenever signs of incipient bacterial infection occur (such as cough, more viscous airway secretion, loss of appetite *et cetera*) antibiotic medication can be initiated, guided in part by the cultures. On average, these patients receive one course of antibiotic treatment of at least 10 days every 2 months. Furthermore, large oral doses of bromhexine as well as administration of salbutamol and acetylcysteine by inhalation reduce the complications of viscous mucus, combined with intensive physiotherapy. Vitamins A and E are administered after checking serum levels of retinol and tocopherol, and 85% of the CF-patients in Stockholm County receive continuous substitution with pancreatic enzymes. Their nutritional status is monitored equally careful. Otolaryngologists are invariably consulted whenever nasal secretion, congestion symptoms or suspicion of polyposis occur. The absence of serious sinus problems in CF-children must be considered as the commendable result of vigorous medical treatment and preventive measures instituted.

CONCLUSION

None of the predisposing conditions was significantly over-represented among the children requiring in-patient hospital care because of sinusitis. Common childhood disorders (such as acute otitis media, secretory otitis media and subglottic laryngitis) were also common in the medical records of the sinusitis children, but probably thanks to improved preventive measures and medical intervention are the previously recognized important predisposing diseases nowadays less inclined to become complicated by serious sinus infection.

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