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Review Article

Current concepts in the management of paediatric rhinosinusitis

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Abstract

It is well recognized that adenoid hypertrophy and allergic rhinitis are common in children and that recurrent upper respiratory tract infections are a fact of life. The main causes of symptoms associated with rhinosinusitis in children are rhinorrhoea, nasal obstruction, mouth breathing, hyponasal speech and snoring. Most children grow out of adenoid hypertrophy and recurrent colds by the age of eight to 10 and this means that the main treatment strategy should therefore be conservative and not surgical. An explanation to anxious parents, simple non-invasive measures such as teaching nose-blowing, the use of saline sprays or a trial of allergen avoidance and age-appropriate topical nasal anti-inflammatory sprays should be tried before surgery is even contemplated. Because repeated infections are so common, antibiotics given for chronic nasal discharge often have only short-lived effects.

Rhinosinusitis in children is not a surgical disease and 'watchful waiting' is advised. Any treatment should first of all be safe, as even without any intervention the problem usually resolves with time. It is likely that growth and maturation of the immunological response to pathogens play a major role in resolution of the disease. There are few exceptions to this principle: nasal polyps (indicating possible cystic fibrosis), and periorbital cellulitis where an assessment of vision, parenteral antibiotics, and if there is concern about the possibility of a subperiosteal abscess, computerized tomography (CT) and drainage of any pus is indicated.

Key words: Child; Rhinitis; Sinusitis, Surgery, endoscopic; Radiology

Introduction

Rhinorrhoea, snoring, mouth breathing, nasal obstruction and hyponasal speech are very common problems in childhood. Children with these symptoms cannot be labelled as having either sinusitis or rhinitis as the nasal mucosa is a continuous lining which runs between the nasal passages and the paranasal sinuses (van Buchem *et al.*, 1992; Kaliner *et al.*, 1997; Mackay and Durham, 1997) and one is rarely affected without the other. This is illustrated by Gwaltney's findings that 95 per cent of subjects with a history of a recent viral upper respiratory tract infection, with no preceding problems, had changes in their sinuses on CT scans (Gwaltney *et al.*, 1994).

Definition

One fundamental problem is the lack of agreement about the definition of sinusitis in children (Younis and Lazar, 1990; Willner *et al.*, 1994; Wald, 1995) as it is neither a clinical nor a pathological distinct entity and it is likely that factors as yet unrecognized play a role. 'The primacy of infection as the pathophysiological explanation for continued inflammation of the paranasal sinuses is quite unlikely' (Wald, 1995). Druce and Slavin, (1991) half jokingly called for an institute of *Non*-allergy and *Non-infectious* diseases to advance our understanding of paranasal sinus disease. Even the classification into acute, subacute and chronic sinusitis varies. Some categorize acute sinusitis as seven to 10 days (Hopp and Cooperstock, 1997) 10–30 days (Wald, 1992a), subacute >21 days (Hopp and Cooperstock, 1997), more than six weeks as chronic sinusitis (Hopp and Cooperstock, 1997; Orobello and Park, 1991), more than eight weeks (Van Der Veken *et al.*, 1992), more than 12 weeks (Lusk and Stankiewick, 1997; Garcia *et al.*, 1994; Otten and Grote, 1988).

Aetiology

The main aetiological factors appear to be the frequency of upper respiratory tract infections and the relatively immature immune system in children,

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the prevalence of allergic rhinitis, and adenoidal hypertrophy. All these conditions are common and infection on its own is not an adequate explanation for the protracted inflammation which some children have in their paranasal sinuses (Wald, 1995).

It is worth knowing that two to five-year-old children average eight upper respiratory tract infections a year (Fireman, 1992; Wald, 1992a). In a Dutch study, parents of 228 per 1,000 children reported that their child had had a cold or flu during the single three-week study period (Bruijnzzeels *et al.*, 1998). Awareness of these figures alone will often do much to reassure parents. In an acute viral rhinitis there is often a fever, malaise and possibly a cough with a serous nasal discharge at first, which then becomes mucopurulent before settling spontaneously in approximately 10 days. However, up to 13 per cent aged one to three years will have symptoms for more than 15 days (Wald *et al.*, 1991a). Acute bacterial involvement of the sinuses produces similar symptoms but with a more marked fever, and in older children there can be facial pain. The common pathogens are *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Moraxella catarrhalis*. Children in day care have more respiratory tract infections and of longer duration which is probably due to bacterial superinfection (Wald *et al.*, 1988; Wald *et al.*, 1991b). The majority of bacterial infections resolve spontaneously. If the child remains pyrexial, as well as having a mucopurulent discharge and sometimes pain, then an empyema of the sinuses should be excluded (van Buchem *et al.*, 1992). Under these rare circumstances a plain sinus radiograph can be done to support the diagnosis, as drainage with an antral washout is required.

Prevalence

The prevalence of allergic rhinitis in children is approximately 10–20 per cent (Table I). While most parents recognize hay fever or seasonal allergic rhinitis, few are aware that many children who have allergic rhinitis have symptoms all the year round because they are allergic to perennial allergens such as house dust mite (Viner and Jackman, 1976). Sibbald and Rink (1991) found a prevalence of perennial symptoms in 13 per cent of the paediatric population and Hattevig and Kjellman (1990) found that eight per cent of seven-year-olds had perennial symptoms. There has been an increase in the prevalence of rhinitis over the last 50 years and while environmental factors such as pollution and exposure to house dust mite have been implicated (Holt, 1996), the epidemiological evidence to support this is limited (Department of Health, 1995; Durham, 1997; Gungor and Corey, 1997).

Adenoidal hypertrophy is common with a tendency to spontaneous involution by the age of eight to 10-years-old. In spite of the wide use of adenoidectomy there is little evidence to show that children who have undergone adenoidectomy have fewer nasal symptoms than those who have not, neither in the short-term nor the medium- or long-term.

Symptoms

The symptoms and signs which parents mention include snuffles in a baby, snoring, mouth breathing, feeding problems, bad breath, cough and hyponasal speech. It is often striking how concerned the parents are whilst the child often appears unconcerned about their symptoms. Facial pain and headache are rare symptoms in children with rhinosinusitis (Shapiro and Rachelefsky, 1992). Symptoms and signs are not specific in paediatric sinusitus (Willner *et al.*, 1994).

How persistent have symptoms to be before they become significant? One useful question is 'Does the child have any periods when their nose is clear, or do they have persistent symptoms week after week?' If they have periods when they are clear it is more likely that they fit into the category of having multiple upper respiratory tract infections (Fireman, 1992; Wald, 1992a). If they are never clear then it is worth asking about symptoms which indicate that perennial allergic rhinitis may be part of the problem. Do they have asthma, sneeze a lot, have itchy eyes or is there a family history of atopy, as these features are associated with allergic rhinitis (Van Arsdel and Motulsky, 1959; Sibbald and Rink, 1991; Bahna, 1992; Wright *et al.*, 1994). Another common factor contributing to persisting symptoms is adenoidal hypertrophy but it is difficult to differentiate this from perennial allergic rhinitis on the basis of symptoms alone. A child who mouth-breathes is often labelled as having adenoidal hypertrophy but a child with turbinate hypertrophy

TABLE I
THE PREVALENCE OF SEASONAL ALLERGIC RHINITIS IN CHILDREN

Study	Number	Age range	Country of source	Seasonal rhinitis
Dold *et al.* (1992)	3,984 Quest	9–11	Germany	9.5
Weiland *et al.* (1994)	2,050 Quest	13–16	Germany	22.7
Astarita *et al.* (1988)	915 Quest	9–15	Italy	13.1
Okuma (1994)	10,13 Quest	6–15	Japan	12.9
Dotterud *et al.* (1994)	551 Quest	7–12	Norway	20.6
Breborowicz *et al.* (1995)	Quest	6–15	Poland	16.7
Aberg *et al.* (1995)	2,481 Quest	7	Sweden	13
Burr *et al.* (1989)	965 Exam	12	UK	14.9
Ninan and Russell (1992)	1,989 Quest	8–13	UK	11.9
Wright *et al.* (1994)	747 Quest	6	USA	42

Exam = Examination usually involving the use of skin tests
Quest = Questionnaire

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due to an allergic rhinitis can look the same. If snoring is a major problem it is worth asking if the child regularly stops breathing for more than 10 seconds, even when they do not have an active respiratory tract infection, as this would indicate sleep apnoea and need further investigation and referral. For some unknown reason parents often omit to mention apnoeic episodes but there is obvious recognition and relief when they are described to parents whose children have them.

With a unilateral nasal discharge a foreign body should be excluded. There is often some excoriation around the nostril.

Gastro-oesophageal reflux has recently been implicated as a possible contributing factor in rhinosinusitis (Barbero, 1996), but this has yet to be proven as both conditions are common and their coexistence may be coincidental. Nasal symptoms do not cause eating problems which would directly reduce a child's intake, although a loss of sense of smell reduces their ability to taste.

Signs

The signs which are associated with the broad category of rhinosinusitis include a blocked and running nose in a child who mouth breathes. The colour of the nasal discharge is clear in the early stages of a viral rhinosinusitis and soon becomes yellow which does not necessarily imply a current infection as it is often stained by white cells in the recovery phase (non-infective) of a viral or bacterial infection or by eosinophils in an allergic rhinitis. Purulent rhinitis alone is not equivalent to sinusitis (Newton, 1996). It is said that very pale or boggy bluish turbinate mucosa is indicative of an allergic rhinitis but this is an unreliable sign and does not allow differentiation between the allergic, infective or post-infective state. Bilateral nasal polyps are rare in children and are usually found in cystic fibrosis. A neonate or infant with a unilateral polyp should have detailed radiology to exclude an encephalocoele while an antrochoanal polyp is commoner in an older child.

Mucosal hypertrophy can cause mouth-breathing and snoring whether it is due to allergic, infective or post-infective rhinosinusitis, but so can adenoid and tonsillar hypertrophy. As long as there is no apnoea these symptoms cause no harm and usually settle by eight to 10 years old.

The adenoid can be examined using an angled mirror but a strong gag reflex or a frightened child may prevent this from being done. It often helps to tell a child that you want to look at their teeth as they understand this and open their mouths. A lateral soft tissue plain radiograph is the most reliable method of assessing adenoid size (Hibbert and Whitehouse, 1978; Maw *et al.*, 1981) but in any event this is unlikely to influence the management in most children. Signs such as 'dark rings around the eyes' and pallor are weak and not indicative of any worrying disease.

Investigations

Investigations are unnecessary in the first instance unless there are signs of the complications of rhinosinusitis such as periorbital swelling or the presence of nasal polyps.

If allergy is suspected, skin tests can be carried out in children after the age of four years. The skin prick test involves the most minimal discomfort as only the epidermis should be breached and it should be so superficial that there is no bleeding. This test has very good specificity and moderately good sensitivity. It not only helps the clinician but illustrates to the parents and older child the allergens which are responsible. It illustrates that surgery will not cure this aspect of the problem. The main perennial allergens are from the house dust mite and pet proteins (Durham, 1997). If the prospect of a skin test is unacceptable and allergy is suspected then a trial of a safe topical nasal steroid taken daily for six weeks can be diagnostic in itself if it helps and with the symptoms returning when the spray stops. An alternative is to test for specific IgE especially in children who are taking antihistamines or who have eczema or dermatographism.

Nasal endoscopy has been advocated in adults, but 'more studies need to be performed to document its clinical usefulness in children' (Fireman, 1992). It is difficult to perform under the age of six years. Ultrasonography is inefficient (Evans *et al.*, 1975; Shapiro *et al.*, 1986; Jensen and Von Sydow, 1987) and transillumination is of no value in diagnosing rhinosinusitis (Lusk and Stankiewick, 1997).

The Royal College of Radiologists (1995) have advised that plain sinus radiographs have no place in the routine management of rhinosinusitis, as 'thickened mucosa is a non-specific finding and may occur in asymptomatic patients'. There is good evidence to support this as plain sinus X-rays have poor sensitivity and low specificity with 30–50 per cent of plain sinus radiographs being abnormal in asymptomatic children (Maresh and Washburn, 1940; Fascenelli, 1969; Shopfiner and Rossi, 1973; Kovatch *et al.*, 1984; Diament *et al.*, 1987). This is similar to the 52 per cent found in asthmatic children (Rachelefsky *et al.*, 1978). This may be due to the fact that after most upper respiratory tract infections, whether viral or bacterial, mucosal changes may be produced that take a variable length of time to settle. The correlation between plain radiographs and CT is poor (McAlister *et al.*, 1989; Lazar *et al.*, 1992; Waid, 1993) as 40–46 per cent of those with a normal plain radiograph have an abnormal CT, and 35–36 per cent of those with an abnormal plain radiograph have a normal CT. Even using the strict criteria of Shapiro and Rachelefksy (1992) of mucosal thickening, air fluid level or opacification involving at least 50 per cent of the maxillary antrum, Garcia *et al.* (1994) found that 24 per cent of cases with significant disease were negative on a Waters view.

When Kovatch *et al.* (1984) excluded children with any respiratory symptoms within two weeks of having a plain radiograph and examination of the nasopharynx they found only two of 31 subjects had

an abnormal film. Therefore, the belief that radiographic changes indicate a bacterial sinusitis (Diament, 1992) lacks a sound basis. These changes are a radiological sign, not a pathological diagnosis. A fluid level may indicate retained uninfected mucus or tears (Silverman, 1985) and thick mucosa is more likely to be an aftermath of a viral rhinosinusitis.

So are plain sinus radiographs obsolete? No, they do have a role in the management of acute maxillary and frontal sinusitis which is unresponsive to medical treatment prior to drainage. They may also help where a radio-opaque foreign body is sought. In acute sinusitis, without complications, CT will provide little further relevant information. CT may provide better images but there it has four problems: the dose of radiation, the need for sedation, the cost, but, most important of all, the significance of CT image findings. CT is not much better at diagnosing rhinosinusitis than plain sinus radiographs. This point is demonstrated by the prevalence of mucosal changes found incidentally in asymptomatic control groups (Figure 1). In asymptomatic children there is a high rate of mucosal thickening or opacification on CT, 48 per cent (Glasier *et al.*, 1989), 41 per cent (Lesserson *et al.*, 1994), 47 per cent (Manning *et al.*, 1996). In adults the incidence of incidental changes on CT is not dissimilar (Havas *et al.*, 1988; Lloyd, 1990; Bolger *et al.*, 1991; Calhoun *et al.*, 1991; Jones *et al.*, 1997). In children with symptoms of rhinosinusitis for longer than two to three months approximately 60–70 per cent have mucosal abnormalities involving their sinuses (Van Der Veken *et al.*, 1992; Garcia *et al.*, 1994) and the extent of sinus involvement falls as children get older. Anatomical variations appear to play little, if any, role in the prevalence of paediatric sinusitis and this is shown in a study by Willner *et al.* (1997) who found that more anatomical 'abnormalities' correlated with decreasing numbers of diseased areas. The same has been shown in adults (Jones *et al.*, 1997). Lusk *et al.* (1996) found that on CT the distribution of disease tended to be symmetrical leading to the conclusion that chronic sinus disease is more likely to be related to systemic disease than local factors.

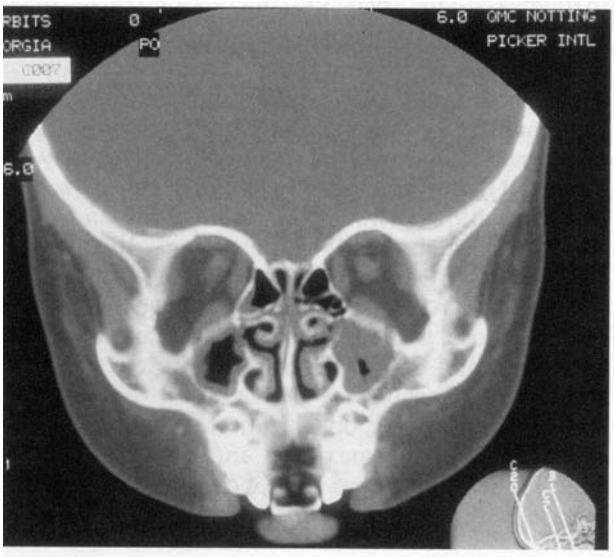

FIG. 1
Incidental mucosal thickening in CT scans in children are common

Magnetic resonance imaging (MRI) in children requires prolonged patient cooperation and often sedation, is expensive and the prevalence of incidental changes is high (Cooke and Hadley, 1991) making it of little use except in the investigation of nasal tumours.

An interval paranasal sinus CT study along with clinical parameters may help our understanding of the significance of these radiographic findings. It is likely that the mucosal abnormalities seen on X-ray in most children reflect ongoing or resolving upper respiratory tract viral or allergic inflammation (Manning *et al.*, 1996).

Culture swabs of the nasal airway are frequently contaminated by commensals from the nasal vestibule. Obtaining an antral specimen for culture requires a general anaesthetic and an antral washout which in itself has not been shown to be of therapeutic benefit. There is a poor correlation between cultures from antral washouts and organisms cultured from the nasopharynx (Wald *et al.*, 1981; Orobello and Park, 1991).

Treatment

In children who do not respond to conservative management or who repeatedly fail to improve, even temporarily, with medical management, it is worth considering whether there is an immunological defect. The majority of children with an immunodeficiency who have severe sinusitis have inadequate humoral defences rather than cell-mediated problems (Polmar, 1992). As many immunodeficiency diseases are hereditary it is worth asking about first-degree relatives, or whether the patient has also had recurrent pneumonias, cellulitis, candidiasis, chronic diarrhoea or failure to thrive. In one study 56 per cent of patients refractory to treatment were found to have reduced IgG subclass levels or a poor response to pneumococcal antigen (Shapiro *et al.*, 1991).

Over two-years-old the antibody response to pneumococcal polysaccharide provides more information about immunity. The commonest immunodeficiency due to a lack of antibodies is common variable immunodeficiency (CVID) where there is a reduction in IgG subclasses although the number of B lymphocytes is usually normal. In X-linked agammaglobulinaemia, disorders of IgG subclass deficiency and CVID, treatment with immunoglobulins may be effective where antibiotics on their own are not (Eibl and Wedgewood, 1989; Chapel *et al.*, 1994). Prolonged courses of antibiotics with anaerobic cover are needed such as amoxycillin with clavulanic acid, cefuroxime axetil or cefixime. Measurements of CD4 lymphocytes and neutrophil function tests occasionally uncover other abnormalities which may present with recurrent unresponsive sinusitis.

If a child has persistent lower as well as upper respiratory tract problems it is worth testing the peak flow in case they have asthma. If they develop bronchiectasis and persistent purulent sinusitis, primary ciliary dyskinesia should be considered. The most simple and practical test of cilial function is the saccharine clearance test which is done by placing a quarter of a saccharine tablet under the anterior end of the inferior turbinate. If the saccharine clearance test is abnormal when the patient is in the most uninfected state which can be achieved, a brushing or biopsy looking at ciliary movement or electron microscopic appearance should be taken from an area of healthy looking mucosa.

One of the main reasons for a baby or child having a runny nose is that cilial function is impaired for up to four to six weeks after a viral upper respiratory tract infection (Carson and Calber, 1985). The best way to clear the nose of mucus under these circumstances is nose blowing or saline sprays or douching. Saline sprays are effective at cleaning the nose (Zieger, 1992) and may improve mucociliary clearance (Band *et al.*, 1967; Majima *et al.*, 1983). The saline mechanically removes mucus and helps patient comfort. Saline sprays may also help reduce the tenaciousness of secretions and they can be repeated as frequently as needed to clear the nose without causing any harm. Two recent reviews of the uses of systemic decongestants conclude that there is no evidence to support their use (Katcher, 1996; Zieger, 1992).

Studies of the natural history of persistent rhinorrhoea unresponsive to treatment have produced the useful information that by the age of seven over 95 per cent had resolved without any further action (Mann and Jonas, 1981; Otten *et al.*, 1991; Otten *et al.*, 1992).

One of the most disputed questions is whether antibiotics make any difference. One study of three to 10 year olds with a three-month history of purulent rhinorrhoea compared a 10-day course of amoxycillin with a topical decongestant, and with, or without, maxillary sinus washouts, against a placebo, and showed no difference at six months after treatment (Otten and Grote, 1988). As early as six weeks after treatment there were no significant differences between the groups. Another study of children with 'subacute sinusitis', defined on the basis of symptoms and plain radiographic changes, found no difference between those treated by antibiotics and decongestants for three weeks and decongestants alone although they used the unreliable indicator of clearing of a plain radiograph as a measure of success (Dohlman *et al.*, 1993). In some areas with β-lactamase-producing *Haemophilus* sp., amoxycillin with clavulanic acid would be required (Muntz and Lusk, 1991). Some workers advocate antibiotics for those with chronic symptoms and say that they should be continued until the patient has been asymptomatic for seven days (Seigel, 1987; Wald, 1992c) whilst others recommend a three-week course (Lusk *et al.*, 1989; Lazar and Younis, 1992). Bacterial density in nasal secretions or a sinus aspirate has to exceed 10^4/ml to be categorized as a true infection (Wald, 1992a) but the presence of non-virulent organisms in low titres raises the question about the pathogenesis of mucosal disease in a high proportion of patients (Otten and Grote, 1988). Prophylactic measures such as long-term antibiotics have not been shown to help.

There are advocates of the pneumococcal vaccine in children over two years and an annual influenza immunization over six months, but its benefit has not been proven.

In children with perennial allergic rhinitis, allergen avoidance, primarily using mattress, pillow and duvet covers, has been shown to help (Woodcock and Custovic, 1998). Altering the diet is not usually helpful, although occasionally parents report that avoiding milk products has reduced nasal discharge. For symptoms of nasal obstruction due to allergy, regular age-appropriate topical nasal steroids such as fluticasone propionate help. Sodium cromoglycate needs to be given prophylactically and is not as effective as topical nasal steroids. Antihistamines help the symptoms of sneezing, itching and clear rhinorrhoea. The second generation of H_1 receptor antagonists (loratidine, cetirizine, and astemizole) are preferable because they cause far less sedation than previous antihistamines and they can be taken

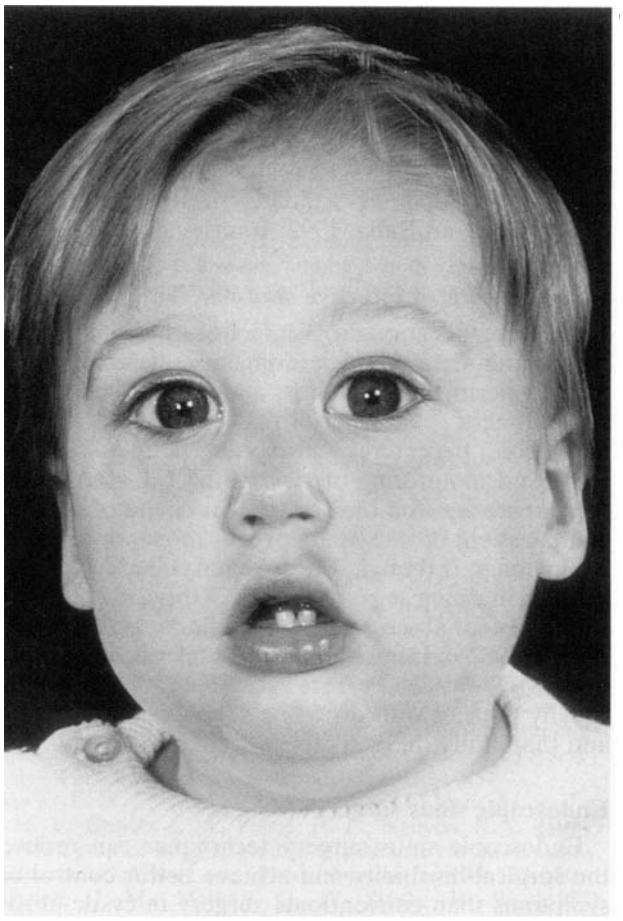

FIG. 2

"Adenoidal faces" may be due to an allergic rhinitis and not adenoidal hypertrophy.

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as required. They are larger molecules and lypophobic and are therefore unable to cross the blood brain barrier. Topical antihistamines such as azelastine and levocobastine have an excellent or good effect in over 50 per cent of patients (Dahl *et al.*, 1995) but five per cent find the taste of these unpleasant.

Some preliminary studies have suggested that adenoidectomy improves symptoms of 'rhinosinusitis' (Rosenfield, 1995) but the evidence supporting its use is very sparse. Many of the children who have been labelled as having 'adenoidal faces' with an open lip posture, prominent upper teeth and a high arched hypoplastic maxilla do not have an enlarged adenoid (Figure 2), and a causal relationship between enlarged adenoids and maxillary abnormality has not been demonstrated (Hibbert, 1987). The adenoid usually shrinks at eight to 10 years so there are limited indications for removing it surgically.

Antral lavage has not been shown to help compared with a placebo (Otten and Grote, 1988). This is probably because much of the pathology found in this group is not due to active bacterial infection.

In cystic fibrosis, abnormal mucus production predisposes the nose to infection and the development of polyps. Surgery often provides good, albeit temporary, symptomatic improvement in the nasal airway. Davidson *et al.* (1995) recommend regular vigorous nasal irrigation to wash away the tenacious secretions followed once daily by topical tobramycin as *Pseudomonas* is often present. There are some encouraging reports of the use of local irrigation with tobramycin or aminoglycosides but a prospective study is needed to validate these observations (Kobayashi and Baba, 1992; Ramsey *et al.*, 1993).

Complications of infective sinusitis

The complications of infective sinusitis occur rarely and their incidence is unpredictable. They include periorbital cellulitis, and frontal subperiosteal abscess. Any periorbital swelling warrants admission, parenteral antibiotics, detailed assessment and monitoring of vision, and CT scanning if there is a suspicion of involvement of the postseptal compartment or if the patient fails to respond within 24-36 hours. If there is a post-septal collection of pus it needs draining as compression in this area due to a subperiosteal abscess can cause blindness (Moloney *et al.*, 1987). Intracranial infection secondary to infective sinusitis is rare and sporadic. Patients usually present with drowsiness, confusion or fitting and thankfully these complications are unusual.

Endoscopic sinus surgery

Endoscopic sinus surgery techniques can reduce the surgical morbidity and achieve better control of symptoms than conventional surgery in cystic fibrosis, allergic fungal sinusitis, antrochoanal polyp, and some mucocoeles. Few studies of endoscopic sinus surgery in children treated for rhinosinusitis report more than an 80 per cent improvement in symptoms (Lusk and Muntz, 1990; Lazar *et al.*, 1993; Parsons and Phillips, 1993; Parsons and Phillips, 1994; Wolf *et al.*, 1995). When these results are compared with the reported improvement which occurs without any treatment (Otten *et al.*, 1991; Otten *et al.*, 1992; Mann and Jonas, 1981), surgery does not compare favourably. Lusk and Stankiewick (1997) list their absolute indications for endoscopic sinus surgery (see Table II). Endoscopic techniques can reduce the surgical morbidity and achieve better symptomatic control than conventional surgery in cystic fibrosis, allergic fungal sinusitis, antrochoanal polyp, and some mucocoeles. The other 'absolute' indications need qualification e.g. the site and size of a CSF leak determines whether it can be repaired endoscopically. These conditions are rare in comparison to the *relative* indications which they have listed which include: subacute rhinosinusitis after failure of optimum medical treatment, chronic rhinosinusitis after failure of optimal medical treatment, and recurrent acute rhinosinusitis occurring frequently enough to require the patient to take antibiotics most of the time. All of these relative indications may be challenged given the medical evidence available.

Wolf *et al.* (1995) retrospectively reviewed 124 children by questionnaire and received replies from 57 per cent of these: 13 per cent were 'dissatisfied' and 17 per cent 'would not have undergone surgery if they had the choice again'; 16 per cent underwent revision surgery. Parsons and Phillips (1993) retrospectively reviewed 52 children at an average of 21.8 months after endoscopic sinus surgery and found nasal obstruction was not improved in 56 per cent, was less in 25 per cent and unchanged in 15 per cent.

Surgeons of all persuasions are united in the need for a very conservative and selective approach when contemplating sinus surgery in children (Poole, 1992; Kaliner *et al.*, 1997). Recently, experimental work on piglets has raised concern that even limited anterior ethmoidal surgery can affect facial growth (Mair *et al.*, 1995). However, no significant disfigurement or asymmetry has yet been found in humans.

More research is needed to help our understanding of the pathological processes going on in children who have symptoms which are labelled as 'paediatric rhinosinusitis', as our knowledge of its

TABLE II

ABSOLUTE INDICATIONS FOR ENDOSCOPIC SINUS SURGERY (LUSK AND STANKIEWICK, 1997)

Complete nasal obstruction from:
Cystic fibrosis
Allergic fungal sinusitis
Antrochoanal polyp
Intracranial complications
Cavernous sinus thrombosis
Mucocoeles
Subperiosteal or orbital abscess
Traumatic injury to the optic nerve
Dacryocystorhinitis from rhinosinusitis
Allergic or invasive fungal rhinosinusitis
Meningoencephaloceles
Cerebrospinal fluid leaks
Tumours of the nasal cavity or sinuses

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natural history is, at best, partial. If surgery is to have a place in the management of paediatric rhinosinusitis 'prospective studies are also needed to evaluate the available surgical modalities' (Lusk and Stankiewick, 1997).

Conclusion

The symptoms associated with rhinosinusitis are usually self-limiting and become progressively less common in older children. There is no evidence that children who have persistent symptoms attributed to rhinosinusitis develop into adults with chronic sinus disease. Therefore, any treatment which is recommended whilst the child's immune resistance is maturing or an enlarged adenoid is shrinking should be free of side-effects. This would hold true even if funds available for medical and surgical treatments were unlimited. The first line treatment should involve harmless measures such as teaching nose blowing, saline sprays, short courses of topical decongestants and probably most of all, an explanation to the parents. Allergen avoidance in children with coexisting allergic mucosal disease will help, as will regular topical nasal steroids for symptoms of obstruction and non-sedative antihistamines for itchy eyes, sneezing and rhinorrhoea. Children with an allergic nasal airway have an increased chance of having asthma and vice versa. If antibiotics are given for persistent purulent rhinorrhoea or postnasal drip they should be given with the expectation that re-infection is likely to occur within the next few weeks. The place of radiology in the management of children with rhinosinusitis is very limited and is confined to the few who develop the complications of sinusitis or in whom a tumour or atypical infection are suspected.

The adage of 'primum non nocere' or 'do no harm' should underlie the management of paediatric sinusitis.

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