Personal Practice

Acute Sinusitis

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Acute sinusitis in children is difficult to diagnose, but dangerous to overlook, due to its potential for life-threatening complications. Sinusitis is estimated to complicate one in two hundred cases of upper respiratory tract infection (URTI) (1). Since most children average 6 to 8 URTIs a year, acute sinusitis is probably quite common in the pediatric population(2).

Sinusitis is inflammation of the paranasal sinuses, which are cavities of the bones surrounding the nose. The maxillary and frontal sinuses are paired sinuses located in the bones of the same names. The ethmoidal sinuses are multiple air cells located lateral to the nasal cavity, and are divided into anterior and posterior groups. The sphenoidal sinus is located in the sphenoid bone. All sinuses drain into the nasal cavity by means of ducts opening on the lateral wall. The frontal sinus and the posterior ethmoid air cells drain into the superior meatus. The ostia of the maxillary sinus, sphenoid sinus and the anterior ethmoidal sinuses open into the middle meatus.

In early childhood, only the maxillary and ethmoid sinuses are clinically important as they alone are large enough to harbor infection(3-5). The ethmoid sinuses are present and pneumatized at birth, and during infancy, are at least as vulnerable as the maxillary sinuses to develop infection(3,5). After the age of three or four years, the maxillary sinus is most commonly infected. As the frontal and sphenoidal sinuses are poorly developed in early childhood, they are rarely affected before the age of five years.

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Etiopathogenesis

The sinuses are lined by ciliated epithelium. A layer of protective mucus lies on this and traps bacteria and other pathogens. This mucus layer is continually moved towards the sinus ostia by the beating of the cilia. Sinusitis occurs when this clearance mechanism fails for any reason. The maxillary sinus (also called the maxillary antrum) is particularly prone because its ostium is high up in its wall, making gravity drainage impossible.

Many viral infections have a cytopathic effect on the epithelium, whereby they disrupt ciliary function. This leads to accumulation of secretions and mucus exudate that becomes secondarily infected by bacteria. The mucosal swelling produced by allergic rhinitis, trauma and polyps can also cause obstruction of the ostia. The mucosal transport system can also be disrupted by disorders of ciliary function like the Kartagener and Young syndromes.

Obstruction of the ostia causes a rise in intrasinal pressure and reduced ventilation of the sinus. The raised intrasinal pressure reduces the blood supply to the mucosa, and the hypoxia so caused impairs ciliary function. Alteration in the quality of the mucus, as in allergic disorders and cystic fibrosis also impairs ciliary activity. Once secondary infection has set in, the

collection of purulent material in the sinus further inhibits ciliary function.

Sometimes the sinuses can get infected without predisposing respiratory factors. The nasopharynx is usually heavily colonized by bacteria, and sneezing, sniffing, and vigorous nose blowing may force these organisms into an otherwise normal sinus. The upper molars and premolars have their roots in close relation to the floor of the maxillary antrum, and infection of these teeth can lead to sinusitis, though this is very uncommon in children.

Nasal foreign bodies are a common occurrence in children, which often lead to an infective rhinitis. This, in turn, can give rise to sinusitis. Other common childhood disorders like measles, whooping cough, and influenza are known to precipitate sinusitis. Swimming underwater, jumping in feet first without holding the nose or diving into the water during the prodromal stage of a coryza puts the patient at high risk of developing sinusitis as these activities may drive catarrh into middle ear as well as sinuses(6).

Microbiology

The most common bacteria isolated from infected sinuses in children are *Streptococcus pneumoniae, Haemophilus influenzae,* and *Branhamella catarrhalis,* which together account for 70% of cases(7). Other bacteria often involved are Group A Streptococci and alpha-hemolytic Streptococci. Staphylococcus is isolated from the nasal cultures as many as 30% of the population, but is a rare cause of sinus infection. *Pseudomonas aeruginosa* is common in patients with nasal polyps and cystic fibrosis. Anaerobic bacteria are rarely causative organisms of acute sinusitis, in contrast to chronic sinusitis, where they are commonly isolated. However, they are responsible for many cases of sinusitis secondary to dental sepsis; this latter condition is rare in child hood.

Over two hundred viruses have been implicated in the pathogenesis of sinusitis(8). The common ones are Rhinovirus, Parainfluenzae I and II, Echo 28, Coxsackie A21 and respiratory syncytial virus. Fungi often lead to sinusitis in diabetic and immunocompromized hosts.

Symptoms

Very few symptoms are specific for the diagnosis of sinusitis, especially in children. Sinusitis is usually preceded by an upper respiratory infection, and the symptoms of the two are exceedingly difficult to differentiate. The most frequent symptoms are nasal discharge and cough. The nasal discharge may be watery, mucoid, or purulent. The cough of sinusitis is always present in the daytime, though it may be worse at night. A cough present only at night is a frequent residual of a URTI, and does not indicate sinus disease(2).

Headache and pain on the face are common in sinusitis in adults, but children below five years rarely complain of these. Unilateral maxillary pain is fairly specific for sinusitis(9), as is facial pain that increases on bending forwards. Fever is often, but not always, present, though most patients feel unwell.

A unilateral purulent discharge from the nose is suggestive of sinusitis. In cases where the ostium of the affected sinus is totally obstructed, there may be no discharge at all. Due to the build up of pressure inside the infected sinus, and retention of infected secretions, these patients have more severe and prolonged symptoms.

Older children may describe a sensation of fullness or pressure, and tenderness on tapping the face or teeth. Altered smell sensation is highly predictive of sinusitis, but is rare(9).

There may be loss of resonance of the voice, due to filling of the sinuses with fluid(l0). Parents sometimes describe a painless swelling around the eyes that appears in the mornings only.

Signs

Examination of the nose is important. Factors which predispose to sinusitis, *e.g.,* polyps, deviated nasal septum, hypertrophied turbinates, *etc.* can be visualized. Pus seen issuing from a sinus ostium is diagnostic of sinusitis, but is very rarely so documented(9,ll). Pus seen in the middle meatus indicates infection of the maxillary, frontal or anterior ethmoidal sinuses, whereas pus in the superior meatus points to the sphenoidal or posterior ethmoidal sinuses.

Palpation and percussion of the maxillary sinuses may reveal tenderness if they are infected(ll). Similarly, tapping of the maxillary teeth may be painful in maxillary sinusitis. The tenderness of frontal sinusitis is present near the floor of the sinus, just above the inner canthus, and can be elicited by percussion on the supraorbital ridge.

Malodorous breath is not common in children. A mucopurulent or purulent post-nasal discharge may be seen on throat examination. Most of these signs are also seen in rhinitis and naspoharyngitis. Flushing and swelling of the cheek, sometimes involving the lower eyelid, is seen in maxillary sinusitis. Frontal sinusitis can cause a similar swelling of the upper eyelid.

Clinical Diagnosis

The most important step in the clinical diagnosis is to suspect it. There are very few specifically diagnostic symptoms and signs; it is only the duration and severity of an URTI that gives a clue. Uncomplicated colds usually improve in 4-6 days; symptoms persisting beyond a week should lead to a suspicion of sinusitis. Also, a cold that seems more severe than usual, significant fever, copious purulent discharge and associated periorbital swelling and facial pain should raise suspicion.

No single sign or symptom is reliably diagnostic of sinusitis(12), and the overall clinical impression, consisting of a combination of various historical and examination points, is more accurate. Some workers have gone so far as to state that physical examination is worthless in the diagnosis of sinusitis(13).

Transillumination

A bright, cold light source is placed either on the rim of the orbit or against the hard palate. The test is carried out in a dark room, and the transilluminance of the maxillary sinus is judged. Only normal or absent transilluminance are reliable; "reduced" or "dull" estimates are quite unreliable(2). Since the test requires the cooperation of the patient, it is not useful in young children, in whom thick soft tissues make it difficult anyway. Transillumination of the frontal sinuses is difficult to interpret because of variable and asymmetrical development of these sinuses in childhood(ll). Transillumination offers an advantage over radiography in differentiating crypts of the maxillary sinus from sinusitis. Radiography will show both conditions as an opacified sinus, but the former is brilliantly transilluminant.

Investigations

The reference standard for diagnosing acute infection of a sinus is puncture of the sinus and demonstration of pus, with culture of pathogenic bacteria from the sinus aspirate. Since this invasive procedure cannot be done in all patients suspected of sinusitis, simpler and more acceptable tests are commonly used.

ESR and CRP

In patients with a suggestive clinical picture, ESR and CRP are very useful. A raised ESR is highly predictive, as is a CRP level of more than 10 mg/L(13). The CRP levels can also give a guide to the efficacy of antibiotic therapy.

Radiology

Four views constitute a sinus series, namely, the Caldwell, Waters, lateral and submental-vertex views. Used together, they have a high accuracy (72 to 96%) as compared to sinal puncture and culture. The ethmoidal air cells, however, are poorly visualized.

An air-fluid level is highly predictive of sinusitis(14). Complete opacification is usually associated with acute sinusitis, but may also be seen with polyps, tumors and the bony changes of chronic infection(ll). Thickening of the sinus mucosa to more than 4 mm is often taken as a criterion for sinusitis, but it does not necessarily show active disease(14,15).

A diagnosis of sinusitis should not be made solely on the basis of abnormal radiographs; clinical correlation is necessary. Abnormal sinus radiographs without symptoms of sinusitis are common among children with allergic rhinitis, as well as in healthy children(15,16). A clear picture of a sinus is a valuable negative finding(5).

Ultrasonography

Some studies have found ultrasonography to be highly sensitive and specific in the diagnosis of sinusitis(9). It has the advantage of being non-ionizing in nature. However, in general, it is considered insensitive in detecting fluid in the sinuses(8,17). Ultrasonography is indeterminate in children under the age of four years(2).

CT Scan and MRI

The coronal computed tomography scan has recently become an investigation of choice for suspected patients with sinusitis(18). It gives more information than radiography and is especially valuable in diagnosing subperiosteal and orbital abscesses. It can visualize the ethmoidal sinuses, which are not seen on plain radiographs.

CT scans can also help in the evaluation of a completely opacified sinus, as they can differentiate infection from tumor and polyp. CT scan alone should not be the basis for diagnosis, as a large number of asymptomatic people may demonstrate mucosal disease. Since this investigation is so expensive, it cannot routinely be used and should be reserved for non-responding cases, or where intracranial or orbital complications are suspected.

Magnetic resonance imaging provides high definition scans of soft tissue, and can differentiate inflammatory disease from neoplasm. Unfortunately, MRI also has a high rate of false positive results (8). In one series of 483 MRI scans done for posterior fossa signs, about one-fourth of maxillary sinuses had abnormal appearances (19). MRI has a higher frequency of false positive results than CT scan and is not cost-effective(2).

Sinus Puncture

This is the reference standard investigation in the diagnosis of sinusitis(ll,13) as it is the only one that actually demonstrates purulent material in the sinuses. However, it is an invasive procedure, and is not done for the routine case. In children, it is usually performed under general anesthesia, though in an older, co-operative child, it can be done under local anesthesia as an outpatient procedure. Nasal endoscopy with a rigid endoscope is usually performed to visualize middle meatus and for antral

puncture under vision.

Sinus puncture provides material for culture and sensitivity studies to guide therapy. For diagnostic purposes it is done in: *(i)* Cases who fail to respond to usual therapy; *(ii)* Cases with orbital or cranial complications; and *(iii)* Immuno-compromised hosts.

The organisms usually involved in sinusitis are sensitive to handling and difficult to culture, and the aspirate should, therefore be plated as soon as possible. Usually only one organism is grown in acute sinusitis, in contrast to the mixed growth obtained in chronic sinusitis.

Differential Diagnosis

Viral URTIs have the same symptoms as sinusitis, but last only a few days. Fever is usually present only at the beginning of a viral URTI. Persisting fever and a purulent nasal discharge are indicative of a secondary bacterial infection of the sinuses(21). Other causes of a prolonged nasal discharge are allergic rhinitis, foreign body in the nose, and adenoiditis. Granulomatous disease of nose is not very common in childhood. Persistent cough may be due to hyperreactive airway disease (HRAD), cystic fibrosis, or gastro-esophageal reflux. Like sinusitis, HRAD often follows a viral URTI, but the cough is mainly at night. Facial pain is not a common feature of sinusitis in children. This complaint, in addition to sinusitis, may be cause by dental and alveolar abscesses, dental caries, trigeminal neuralgia, migraine and cluster headache.

Therapy

The aims of therapy are: *(i)* Rapid clinical cure, *i.e.,* relief of symptoms; *(ii)* Sterilization of the sinus; *(iii)* Restoration of ventilation of the sinus, leading to restoration of normal mucociliary function; *(iv)* Prevention of suppurative orbital and cranial compilations; and *(v)* Prevention of chronic sinus disease.

General

The child should be kept in a warm, humidified environment. Rest in bed is not indicated unless the child feels significantly unwell. The child should avoid nose blowing in the acute phase, as this may force infected secretions into the eustachian tube and cause otitis.

Antibiotics

Culture of the nose, throat and nasopharynx are useless in predicting the causative agent of sinusitis(2). A bacteriological diagnosis is only possible by antral puncture and culture of the aspirate. Since this invasive procedure is not done routinely, it is acceptable to start treatment empirically(20).

Amoxycillin is a reasonable initial choice and usually brings about relief of symptoms in 48-72 hours. Patients intolerant of amoxycillin can be given cefaclor or trimethoprim-sulfamethoxazole; the latter drug does not cover group A streptococci. To beta-lactamase producing organisms, augmentin (amoxycillin-clavulanate) is a useful drug. Sinusitis arising from dental sepsis is rare in children. For these cases, a combination of cloxacillin and metronidazole is indicated.

Patients who present with systemic toxicity, or severe symptoms, and those unable to tolerate oral drugs, should be hospitalized. They can be treated with parenteral cefuroxime, which is effective against the organisms commonly causing sinusitis.

Failure to respond in 48-72 hours should lead to re-evaluation. Sinus aspiration may be done at this stage to

provide material for culture and sensitivity studies. Antimicrobials should be given for a minimum of 10-14 days. Twenty per cent of patients remain culture positive after seven days' treatment. If the patient is not fully recovered after ten days treatment, a further week of therapy is indicated(21).

Decongestants, Antihistamines and Steroids

Oral decongestants do not significantly increase the size of the ostia. Topical agents such as oxymetazoline, xylometazoline and phenylephedrine shrink the nasal mucosa, improve drainage and provide symptomatic improvement. However, by reducing blood flow to the mucosa, they reduce the penetration of antibiotics, reduce ciliary motility and hamper clearance of infected material(7,22). Their overall effect on the clinical course and eventual outcome is unknown. If used at all, it should only be for the initial 24-48 hours. Ephedrine and xylometazoloine are least harmful to the cilia.

Local agents should preferably be used as sprays, and in the erect posture. If drops are used, they should be instilled in a position with the head dependant, *i.e.,* hanging over the edge of a bed, or with the patient on elbows and knees with the vertex touching the floor. This prevents immediate drainage of the medication into the pharynx(5).

Antihistamines produce inspissations of secretions and are probably harmful. Topical steroids provide rapid relief of pain but are otherwise ineffective.

Antral Puncture

Antral puncture is reserved for certain specific situations *{Table I).* It is generally done under general anesthesia in children.

TABLE I-*Indications for Antral Puncture*

1. Patients not responding to initial therapy.
2. Patients with severe pain.
3. Patients with significant systemic toxicity.
4. Patients with suppurative orbital or intracranial complications.
5. Immunocompromized host.

The material obtained is used for culture and sensitivity testing. Antral puncture with irrigation removes the infected secretions and produces substantial immediate relief of symptoms. Reduction of intrasinal pressure leads to improvement in blood-flow and oxygenation, thus restoring the compromised defense mechanisms. Antral puncture leads to more effective drainage, which contributes to eradication of infection.

In cases that are slow to resolve, a polythene tube can be passed into the sinus and used for daily lavage and instillation of appropriate antibiotics(6).

Complications

Sinusitis is often a mild disease, and is self curing in 40-45% of cases(21). However, its complications are serious and some of them (orbital or periorbital cellulitis, cavernous sinus thrombosis, meningitis and brain abscess) are life-threatening. The aim of preventing these complications justifies the use of long courses of antibiotics. Before the antibiotic era, 20% of patients with sinusitis became blind due to orbital cellulitis, and 17% died as a result of meningitis or intracranial abscess. Any patient suspected of having one of these suppurative complications should immediately be hospitalized. The organisms usually responsible are *Staphylococcus aureus, Haemophilus influenzae, Streptococcus pneumoniae,* Group A Streptococci and anaerobes. Initial treatment should be started with methicillin and chloramphenicol, till results of CSF and antral puncture culture are available.

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