CURRENT APPROACH TO SINUSITIS

Sinusitis is one of the most common upper respiratory tract infections presenting in general practice.

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One of the most common infectious diseases encountered by medical practitioners is respiratory tract infection. Most are caused by viruses and are called viral rhinosinusitis (VRS). The average child will suffer 3 - 8 and the average adult 2 - 3 episodes of VRS per year. Bacterial infections complicate only about 0.5 - 2% of these viral infections. The dilemma that we are facing is that it is very often virtually impossible to distinguish between the two. This leads to the diagnosis of bacterial sinusitis being made too often and patients are prescribed an antibiotic that is not only ineffective against the viral disease, but also leads to the development of bacterial resistance to the antibiotic.[1] Very often antibiotics are used against bacterial infections without taking their efficacy against the specific pathogens into consideration. This leads to treatment failure and the possibility of complications of bacterial sinusitis. It is therefore imperative that we do our utmost to make the correct diagnosis and choose the correct antibiotic therapy.

ACUTE SINUSITIS

Acute sinusitis is a bacterial infection of one or more of the paranasal sinuses. It should rather be called acute bacterial rhinosinusitis (ABRS) because it rarely occurs without concurrent rhinitis.[2]

Pathophysiology

Sinusitis is initiated by impairment of normal drainage and aeration of the sinuses, i.e. obstruction of the sinus ostia. The most common cause is inflammation caused by a preceding VRS. Other causes are listed in Table I.[3] Certain conditions predispose individuals to sinusitis (Table II). Inflammation causes increased secretions and oedema of the sinonasal mucosa. This in turn leads to obstruction of the sinus ostia. Secretions are retained due to the obstruction as well as ciliary dysfunction and the antigravitational placement of the ostia, particularly that of the maxillary antrum. Thus a favourable environment for bacterial growth is created. The most common area affected is the osteomeatal complex that is the communal drainage area of the frontal, maxillary and anterior ethmoid sinuses (Fig. 1). Sinusitis may also result from local spread of particularly a dental infection.

Table I. **Common factors initiating sinusitis**

Viral infection
Allergy
Barotrauma
Deviated nasal septum
Nasal polyps
Tumour
Nasal packing
Nasogastric tube
Foreign bodies

Table II. **Factors predisposing to sinusitis**

Allergy
Smoking
Asthma and aspirin sensitivity
Diabetes mellitus
Immotile cilia, i.e. Kartagener's syndrome
Cystic fibrosis
Immunodeficiency
Sarcoidosis

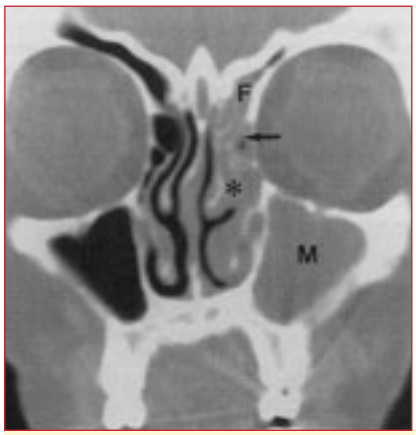

Fig. 1. Ostiomeatal complex pattern of sinusitis. Ostiomeatal complex in left middle meatus (*) obstructed by inflammation, resulting in opacification of the frontal (F), maxillary (M) and anterior ethmoid (arrow) sinuses.

Microbiology of ABRS

The most common bacterial isolates from the maxillary sinuses of patients with ABRS are *Streptococcus pneumoniae, Haemophilus influenzae* and *Moraxella catarrhalis*. In a small percentage of cases other streptococcal species, anaerobic bacteria and *Staphylococcus aureus* are found.[4] Although fungal elements are present in the noses of many patients with sinonasal problems, the clinical significance in immunocompetent hosts is not completely clear.

Diagnosis of ABRS

Patients with VRS usually present with a combination of the following symptoms: sneezing, rhinorrhoea, nasal congestion, hyposmia/anosmia, facial pressure, postnasal drip, sore throat, cough, ear fullness, fever and myalgia. After a few days of a viral infection the nasal secretions will become mucopurulent due to an influx of neutrophils. A change of colour of nasal secretions is thus not a specific sign of bacterial infection.

Clinical judgment is needed to decide whether a bacterial infection is present. The symptoms associated with ABRS include those typical of a viral infection, but are usually more severe and protracted. A diagnosis of ABRS may be made in a patient with a VRS that has not improved after 10 days or worsens after 5 - 7 days accompanied by the typical symptoms listed in Table III. Examination reveals nasal congestion and discharge, with purulence at the specific sinus ostia on endoscopy. There is also more localised tenderness over the affected sinuses. Specific findings of a bacterial infection, like fever, facial erythema, swelling and severe pain might also be present.[1]

Physical examination thus provides limited information in the diagnosis of ABRS and is open to individual interpretation. Transillumination of the sinuses is unreliable. Ultrasonography can only assess the maxillary sinus and cannot distinguish between viral and bacterial sinusitis and so has limited utility. X-ray examination of the sinuses can demonstrate opacification and fluid levels in the maxillary, frontal and sphenoid sinuses, but does not visualise the ethmoids well and does not determine the extent of the disease.[3] A negative radiograph does however have diagnostic value.[1] CT scans will clearly demonstrate abnormalities within the sinuses but are not specific for bacterial disease. The majority of patients with VRS will have abnormalities of the sinuses on CT scan and MRI that will clear up without any treatment,[5] so these investigations are not indicated in uncomplicated cases of ABRS.[1]

Positive cultures from sinus aspirates are the gold standard in the diagnosis of ABRS.[4] This is however invasive and requires special skills and equipment and is not indicated in uncomplicated cases. Cultures from nasal and nasopharyngeal swabs do not correlate with the bacteriology of cultures from sinus aspirates and are therefore not recommended.[6] Endoscopic middle meatal cultures correlate better and can be performed in selected cases when the necessary equipment is available.[4,7]

Treatment of ABRS

Acute sinusitis may be thought of as an abscess. Treatment should be aimed at providing adequate drainage and eradication of local infection. In most patients drainage can be accomplished medically. Topical vasoconstrictors (for less than 7 days), systemic decongestants and mucolytics often provide adequate drainage. Saline irrigation of the nose and steam inhalation are very helpful. Bacterial eradication is the ultimate aim of treatment and this can only be accomplished by adequate antibiotic therapy. The decision to give antibiotics should not be taken lightly, to prevent both over-treatment of patients with viral infection and future antimicrobial resistance. The less than satisfactory clinical diagnosis of ABRS puts the practitioner under a lot of pressure as patients are often very demanding. Furthermore we are faced with the possible complications

Table III. **Symptoms associated with bacterial rhinosinusitis**

Nasal drainage (purulent)
Nasal congestion
Facial pain/pressure (especially when unilateral and focused)
Headache
Postnasal drip
Hyposmia/anosmia
Halitosis
Fever
Cough lasting more than 7 days
Fatigue
Maxillary dental pain
Ear fullness/pressure
Some/all of above in patient with viral rhinosinusitis that has not improved after 10 days or worsens after 5 - 7 days

Table IV. **Diagnosis of ABRS and the need for antibiotic therapy**

Purulent nasal discharge
Maxillary tooth or facial pain
Unilateral/bilateral sinus tenderness
Above symptoms for 7 - 10 days or worsening after initial improvement

of untreated sinusitis. The diagnosis of ABRS and therefore the need for antibiotic therapy can usually be made in patients with the following clinical picture: purulent nasal discharge, maxillary tooth or facial pain (especially when unilateral), unilateral or bilateral sinus tenderness for 7 - 10 days or worsening symptoms after initial improvement (Table IV).

Because cultures of the sinuses are rarely obtained, the organisms that are present in a geographical area and the patterns of resistance of these organisms should be considered when selecting an antibiotic (Table V).[4,8]

It is important for an antibiotic to provide adequate cover against *S. pneumoniae* due to the possibility of serious intracranial and extra-sinus complications.[8] Gram-negative cover against *H. influenzae* and *M. catarrhalis* is also important. Antibiotics should also achieve an adequate concentration in the mucus of the infected sinus to be able to fight the infection. The following points should be noted:[1]

- **Amoxicillin:** considered the most active oral B-lactam against streptococci. Reaches high concentrations in the sinuses. Intermediate resistance may be overcome to a large extent by increasing the dose. Not active against B-lactamase-producing Gram-negatives and *Staphylococcus*.
- **Amoxicillin/clavulanate:** clavulanate enhances amoxicillin's activity against B-lactamase-producing Gram-negatives but has no effect on the activity against drug-resistant *S. pneumoniae* — one can also increase amoxicillin dose to overcome this. Active against anaerobes. Twice daily dosing not exceeding 10 mg/kg clavulanate per day reduces gastrointestinal side-effects.
- **Cephalosporins:** oral agents are not effective against penicillin-resistant *S. pneumoniae*. Cefuroxime and cefpodoxime are very effective against *H. influenzae*. Only parenteral agents achieve high concentrations in the sinus cavity.
- **Lincosamides (clindamycin):** excellent coverage against *S. pneumoniae* as well as many anaerobes but no activity against *H. influenzae* or *M. catarrhalis*.
- **Macrolides:** ineffective against penicillin-resistant pneumococci. Selection of class resistance against macrolides is a problem. *In vivo* effectiveness against *H. influenzae* is doubtful.
- **Fluoroquinolones:** newer quinolones very effective against respiratory pathogens *in vitro*. *In vivo* success probably not as good. Emergence of class resistance has been a problem in certain areas, thus not for first-line therapy unless allergic to penicillin. Ciprofloxacin does not provide adequate pneumococcal cover and is not recommended. Currently not approved for use in children.
- **Ketolides:** show promise of having a low potential to select for resistance. Active against most pathogens implicated in URTI.

Table V. **Susceptibility of *S. pneumoniae* in URTI in SA**

	Johannesburg	Pretoria	Durban
Number of isolates	626	312	207
Penicillin			
Susceptible	40%	35%	64%
Intermediate resistant	55%	64%	32%
Highly resistant	5%	1%	1%
Macrolides			
Susceptible	46%	48%	53%
3rd generation cephalosporins			
Susceptible	93%	95%	97%
Intermediate resistant	5%	5%	0%
Highly resistant	2%	0%	3%
Quinolones			
Susceptible	100%	100%	99%

Recent antibiotic therapy puts the patient at risk of carrying resistant organisms and thus affects the choice and dosage of the antibiotic chosen to treat the current infection.[8] The predicted efficacy of antibiotics using a mathematical model of ABS is as follows:[1,8]

Adults:

- > 90% (amoxicillin-clavulanate, gatifloxacin, levofloxacin and moxifloxacin)
- 80 - 90% (high-dose amoxacillin, cefuroxime axetil, cefpodoxime proxetil)
- 70 - 80% (clindamycin (Gram +), cefprozil, azithromycin and clarithromycin)
- 50 - 60% (cefachlor, loracarbef).

Children:

- > 90% (amoxicillin-clavulanate, high-dose amoxicillin)
- 80 - 90% (cefuroxime axetil, cefpodoxime proxetil, clindamycin (Gram +), azithromycin and clarithromycin)
- 70 - 80% (cefproxil)
- 60 - 70% (cefachlor, loracarbef).

The predicted spontaneous resolution rate for untreated bacterial sinusitis

Table VI. **First-line antibiotic recommendations for ABS**[1,8]

Adults	Children

First-line therapy (oral)
• Amoxicillin 1.5 - 3.5 g/day
  • Patients with no prior antibiotic use
• Amoxicillin 3 - 3.5 g/day
  * Areas with high incidence of penicillin-resistant pneumococci
  • Patients who received antibiotics during previous month
• Beta-lactamase-stable antibiotics
  • Areas with high prevalence of beta-lactamase-producing bacteria
  • Immunocompromised patients
• Fluoroquinolones
  • Beta-lactam-allergic patients
	First-line therapy (oral)
	• Amoxicillin 40 - 50 mg/kg/day
	  • Patients with no prior antibiotic use
	  • Areas with low resistance
	• Amoxicillin 90 mg/kg/day
	  • Areas with high incidence of penicillin-resistant pneumococci
	  • Patients who received antibiotics during previous month
	• Beta-lactamase-stable antibiotics
	  • Children less than 2 years
	  • Immunocompromised patients
	  • Areas with high prevalence of beta-lactamase-producing bacteria

If no improvement after 72 hours: proceed to second-line therapy or refer for further evaluation.

varies from 46.6% in adults to 49.6% in children.

The current recommended antibiotic therapy for adults and children with sinusitis is outlined in Tables VI and VII.[7] In summary one can say high-dose amoxicillin will cure most pneumococcal infections. If treatment fails the infection is most probably due to a beta-lactam producing *H. influenzae*. The addition of clavulanate is the first choice in these cases due to the high concentrations that it reaches in the sinus cavity and its activity against anaerobes. In penicillin-allergic patients quinolones are indicated. The recommended duration of antibiotic therapy is 10 - 14 days.[1,3,8] In selected cases a longer course of therapy might be indicated.

When the infection continues to worsen in spite of appropriate antibiotic therapy or when a complication develops, surgical drainage of the affected sinuses is indicated. A number of techniques are available to the surgeon:

- maxillary sinus: antral washout with trocar via canine fossa or inferior meatus
- frontal sinus: endoscopic or external trephination
- ethmoid or sphenoid sinus: endoscopic or external spheno-ethmoidectomy.

Complications of ABRS

Orbital complications are the most common complication of sinusitis. The Chandler classification gives a clinical approach to orbital inflammation:

- inflammatory oedema (lid oedema)
- orbital cellulitis (diffuse oedema)
- subperiosteal abscess (displacement of globe inferolaterally) (Fig. 2)

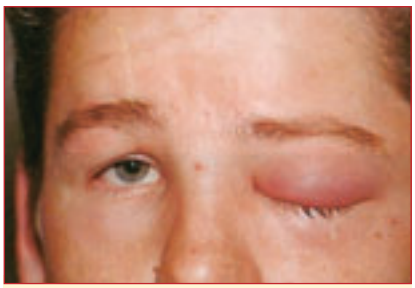

Fig. 2. Subperiosteal abscess.

- orbital abscess (proptosis, chemosis, ophthalmoplegia, decreased vision)
- cavernous sinus thrombosis (bilateral eye findings, meningismus).

Patients with orbital signs need urgent referral to an ENT specialist as well as CT scan and possibly MRI evaluation.

Surgery is indicated for non-responsive cellulitis and for any abscess or loss of visual acuity.

Cavernous sinus thrombosis might be difficult to differentiate from orbital cellulitis or abscess. The most important signs are bilateral orbital involvement, rapidly progressive chemosis and ophthalmoplegia, severe retinal engorgement and high fever. The condition has a high mortality. Treatment includes intravenous antibiotics, drainage of abscess and orbital decompression.

Osteomyelitis of the frontal bone might lead to a subperiosteal abscess or Pott's puffy tumour (Fig. 3). Sinus trephination with or without drainage of the abscess and antibiotics is indicated.

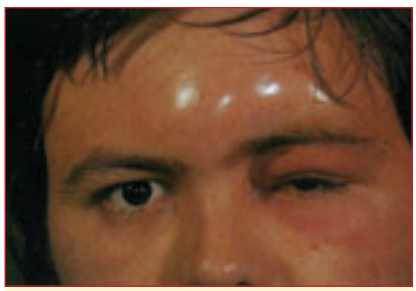

Fig. 3. Osteomyelitis of the frontal bone with abscess formation.

Intracranial complications:
- meningitis
- epidural abscess
- subdural abscess
- brain abscess.

Patients suffering from bacterial sinusitis who present with meningismus, severe headache, intractable vomiting and deteriorating levels of consciousness should be hospitalised and investigated for possible intracranial complication.

Mucoceles might develop long after the acute episode of sinusitis and are characterised by slow growth. The presentation varies depending on the origin of the mucocele. Progressive proptosis is a common feature (Fig. 4). Surgery is usually indicated.

CHRONIC SINUSITIS

There is no generally accepted definition of chronic sinusitis. Signs and symptoms of sinus inflammation persisting after 8 weeks or several recurrent episodes of acute sinusitis within a short time frame may be considered chronic.[3,6] The cause of chronic sinusitis may fall into one of 4 categories:

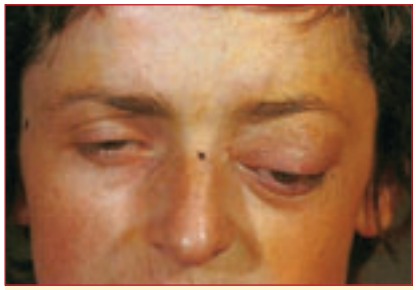

Fig. 4. Mucocele of the ethmoid labyrinth.

- inadequately treated acute sinusitis
- anatomical obstruction of sinus ostia
- pathology of local mucociliary defence mechanism such as cystic fibrosis
- systemic immune problem such as allergic rhinitis.

It is therefore imperative that the infection has been adequately managed medically and that a thorough search has been undertaken for an underlying aetiological factor. When all systemic factors have been excluded, the treatment of chronic sinusitis should include the following: antibiotics for 4 weeks with a second-line antibiotic that provides anaerobic cover or in combination with metronidazole or clindamycin.[3] Intranasal corticosteroid sprays and decongestants should also be used. If a patient fails to respond to medical management or if a clear anatomical reason for obstruction of the sinus exists, surgery is indicated. Sinus drainage with endoscopic approach, sometimes combined with septal surgery, is usually effective. Repeated antral lavage is not indicated as the maxillary sinus is not the focus of the pathology.[3]

SINUSITIS IN CHILDREN

The paranasal sinuses are incompletely developed in children. At birth the maxillary sinus is only a small air cell and the ethmoid sinuses are only beginning to develop. The frontal sinus does not develop until the age of 6 - 8 years. All the sinuses continue to develop well into adolescence.[6] This makes interpretation of signs and symptoms in children presenting with URTI difficult. An URTI associated with pus draining from the middle meatus and pain indicates ABRS. Halitosis,

Table VII. **Second- and third-line antibiotic recommendations for ABS[1,8]**

Adults	Children

Second-line therapy (oral)
• Beta-lactamase-stable antibiotics
  • Amoxicillin/clavulanate (high dose amoxicillin)
  • Cefuroxime axetil 1 g bd
  • Cefpodoxime proxetil 200 mg bd
• Fluoroquinolones
  • Patients intolerant to or recently not responding to beta-lactamase-stable antibiotics
• Azithromycin/clarithromycin 500 mg/day for 10 days
  • Only beta-lactam-allergic patients
• Clindamycin 150 mg qid
  • Beta-lactam-allergic patients
  • Confirmed pneumococcal infection unresponsive to beta-lactams
  • May be used in combination with antibiotics with a good Gram-negative cover
	Second-line therapy (oral)
	• Beta-lactamase-stable antibiotics
	  • Amoxicillin/clavulanate with amoxicillin dose of 90 mg/kg/day
	  • Cefuroxime axetil 30 mg/kg/day
	  • Cefpodoxime proxetil 8 - 16 mg/kg/d
	• Azithromycin 10 mg/kg/day or clarithromycin 15 mg/kg/day for 10 days
	  • Only beta-lactam-allergic patients
	• Clindamycin 17 - 25 mg/kg/day
	  • Beta-lactam-allergic patients
	  • Confirmed pneumococcal infection unresponsive to beta-lactams
	  • May be used in combination with antibiotics with a good Gram-negative cover

Third-line therapy • Fluoroquinolones • Ceftriaxone 1 - 2 g/day IVI for 3 - 5 days	**Third-line therapy** • Ceftriaxone 50 mg/kg/d for 3 - 5 days

The average child will suffer 3 - 8 and the average adult 2 - 3 episodes of VRS per year. Bacterial infections complicate only about 0.5 - 2% of these viral infections.

Very often antibiotics are used against bacterial infections without taking their efficacy against the specific pathogens into consideration.

Sinusitis is initiated by impairment of normal drainage and aeration of the sinuses, i.e. obstruction of the sinus ostia.

Patients with VRS usually present with a combination of the following symptoms: sneezing, rhinorrhoea, nasal congestion, hyposmia/anosmia, facial pressure, postnasal drip, sore throat, cough, ear fullness, fever and myalgia.

daytime cough, nasal obstruction, rhinorrhoea and fever are usually present.[3,6] The antibiotic guidelines are outlined in Table VI. Most children will respond to amoxicillin. Attendance in a day-care centre, severe disease and failure to improve after 3 days of therapy argue for the use of high-dose amoxicillin-clavulanate. If this fails, intravenous ceftriaxone might be indicated. In children with penicillin allergy a macrolide or clindamycin should be given. These drugs are however not effective against *H. influenzae* or penicillin-resistant pneumococci. Surgery is indicated for failed medical therapy or suppurative complications. Surgery for chronic sinusitis remains controversial. Patients should first be investigated and treated for systemic problems such as allergy, asthma, cystic fibrosis and immune deficiencies such as IgA or IgG deficiency. When surgery is indicated, it should be limited. The following are indications for surgery:

- spread of disease to adjacent structures
- sinus disease aggravating underlying condition such as asthma or cystic fibrosis
- definite areas of anatomic obstruction that can be linked to sinus disease.

FUNGAL SINUSITIS

The management of patients with fungal sinusitis falls outside the scope of this article, but surgery plays a major role in the management of most patients.

Fungal sinusitis can be categorised as follows:

- invasive — fulminant or chronic indolent
- non-invasive — mycetoma (fungus ball) or saprophytic
- allergic fungal sinusitis.

Patients with allergic fungal sinusitis usually present with nasal polyposis. There is a feeling among some researchers that fungi may play a role in all patients with nasal polyps. Currently it would be unwise to assume this, but future research will hopefully shed some light on this matter.

References available on request.

IN A NUTSHELL

Most URTIs are viral infections.

Only 0.5 - 2% of viral URTIs are complicated by bacterial superinfection.

Streptococcus pneumoniae, Haemophilus influenzae and *Moraxella catarrhalis* are the most common bacterial isolates.

The diagnosis of ABRS is usually made on clinical judgment.

The organisms most commonly encountered, as well as the patterns of resistance in a geographical area, should be taken into consideration when selecting an antibiotic.

Antibiotic therapy should be given for at least 10 days.

High-dose amoxicillin will cure most sinus infections.

The addition of clavulanate will extend cover to include most beta-lactam-producing Gram-negative as well as anaerobic bacteria.