Pediatric Update;
Managing Pediatric Nasal Disease
Acute Otitis Media with Tubes

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  • Assistant Clinical Professor Dept. Surgery McMaster University.
Objectives

• To differentiate between viral and Acute Bacterial Rhinosinusitis (ABRS)
• To discuss the physiology of ABRS
• To briefly review allergic rhinitis
• To discuss the microbiology of sinusitis
• To review the current guidelines for antibiotic treatment of pediatric sinusitis
• To discuss adjunctive therapy
Sinusitis

- One of the most commonly treated conditions in the outpatient setting
- Fifth most common diagnosis for which antibiotics are prescribed (NAMCS data)
- Children will have 3 to 8 acute episodes of Viral URI per year
- Only 0.5-2% will develop Acute Bacterial Rhinosinusitis (ABRS)
Sinus Development

- Ethmoid and Maxillary sinuses are the only two sinuses large enough at birth to be clinically relevant.
- Frontal sinuses begin to invade vertical portion of frontal bone at age 4. Visible on Xray at 6 years. Quite well developed by age 12.
- Sphenoid sinus starts to develop at age 3 and increased expansion of sphenoid bone at age 5 with good pneumatization to Sella Turcia at age 7. Expand until age 20.
Sinonasal Anatomy

- OMC
- Functional concept rather than defined anatomical structure
- It is bounded by the medial orbital wall and the MT including
  - Maxillary sinus ostium
  - Hiatus semilunaris
  - Space between ethmoid bullae and MT
  - Space between uncinate and MT
Physiology

- Obstruction of OMU by inflammation results in a favorable environment for growth of bacteria, and prevents clearance of secretions.
Precipitating Factors

- Inflammatory disease
- Mechanical obstruction
- Systemic diseases
Etiology of rhinosinusitis

- Non Infectious Rhinitis
  - Allergic Rhinitis
  - Nasal polyps
  - Tobacco smoke
  - Outdoor air pollution
  - Rhinitis medicamentosa.
Allergic Rhinitis

40% of patients with chronic sinusitis suffer from allergic rhinitis.

Conjunctivitis

Asthma
Classification (ARIA Guidelines)

- Intermittent vs Persistent
- Mild vs Moderate-severe

- Intermittent AR is more common in children and adolescents than in adults.
ARIA Workshop Report —

New classification of allergic rhinitis

• Classification of allergic rhinitis according to
  - Duration of symptoms
  - Severity of symptoms and impact on quality of life

Intermittent symptoms
< 4 days/week or
< 4 weeks

Persistent symptoms
> 4 days/week and
> 4 weeks

Mild
- normal sleep
- normal daily activities, sport and leisure
- normal work and school
- absence of troublesome symptoms

Moderate-to-severe
Presence of one or more of the following items:
- abnormal sleep
- impairment of daily activities, sport and leisure
- problems caused at work or school
- troublesome symptoms

Typical physical findings in allergic rhinitis

– Often physical findings are not impressive unless during a severe exacerbation
– open mouth (associated with perennial nasal obstruction)
  • pale to bluish nasal mucosa
  • enlarged (boggy) inferior turbinates
  • clear nasal secretions (in severe cases, sometimes whitish)
  • conjunctival erythema
  • black or blue discoloration beneath lower eyelids

Etiology of rhinosinusitis

- Mechanical obstruction
  - Adenoid hypertrophy
  - Septal deviation
  - Foreign bodies
  - Anatomic variation in OMU
  - Choanal atresia
  - Nasal polyps
Etiology of rhinosinusitis

- Mechanical obstruction
  - Adenoid hypertrophy
  - Septal deviation
  - Foreign bodies
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  - Choanal atresia
  - Nasal polyps
Etiology or rhinosinusitis

- Systemic diseases
  - Cystic fibrosis
  - Immotile cilia syndrome
  - Immune deficiencies
    - Selective IgA deficiency
    - IgG deficiencies
    - Acquired (HIV, transplant, chemotherapy)
    - Autoimmune diseases
Definitions

Acute
If symptoms last less than 4 weeks.

Subacute
If symptoms last between 4 to 12 weeks

Recurrent Acute
Symptoms 2-4 times per year with complete resolution between attacks
Disease free interval of 8 weeks between attacks

Chronic
Disease lasting greater than 12 weeks
Microbiology of Rhinosinusitis

- Viral
- Bacterial
  - S. Pneumonia: 35-52%
  - H. Influenza: 15-20%
  - M. Catarrhalis: 15-20%
  - S. Pyogenes and anaerobes: 3-7%
- Fungal (usually chronic)
Viral Sinusitis

- Over 50% caused by human rhinovirus
- Others include: coronavirus, influenza A and B viruses, parainfluenza virus, RSV, adenovirus and enterovirus.
- More common in Fall and early Spring.
- Influenza and adenovirus cause significant damage to epithelium resulting in reduced host defenses.
Viral Sinusitis

- Patients will have upregulation of production of histamine, bradykinin and various histamines.
- Suppression or neutrophil, macrophage and lymphocyte function
- Reduced adherent, chemotactic, phagocytic and oxidative function.
- Leads to secondary overgrowth and bacterial infection from S pneumoniae, H influenzae residing in the nasopharynx
Symptom Duration

• Mean Duration of Viral URI
  – 6.6 days for 1-2 year old children at home
  – 8.9 days for children <1 year old in day care
URI Symptom duration

- Last over 15 days in 7% of 1-3 year olds in home care
- 13% of 2-3 year olds in day care.
Acute Invasive Fungal Sinusitis

- Occurs in the immunosuppressed patient on steroids.
- Usually insulin diabetic patients
- Can occur in patients immunosuppressed for other reasons.
Invasive Fungal Sinusitis

- Requires immediate referral
- Treated surgically combined with IV Amphotericin

- Erosion of Hard Palate
Acute Bacterial Rhinosinusitis

- Evaluation
  - History
  - Physical Examination
    - Nasal endoscopy
  - Laboratory
  - Imaging
Diagnosing Sinusitis: The Problem

- Diagnostic accuracy presence of rhinosinusitis must be inferred largely from multiple nonspecific symptoms
- Inability to distinguish viral from bacterial sinusitis
Clinical Features

• In Pediatric patients the most consistent symptoms are:
  • nasal airway obstruction
  • purulent nasal discharge
  • headaches
  • irritability
  • day and night cough.
Diagnostic Factors Predictive of Sinusitis

- Major Factors
  - Facial pain or pressure
  - Facial congestion or fullness
  - Nasal obstruction
  - Nasal purulence or discoloured post nasal discharge
  - Hyposmia or anosmia
  - Fever

- Minor Factors
  - Headache
  - Halitosis
  - Fatigue
  - Dental pain
  - Cough
  - Ear pain or pressure

Lanza and Kennedy
Diagnostic factors...

- At least two major diagnostic factors or one major and two minor factors used to diagnose sinusitis.

- The more factors present the higher the chance of a correct diagnosis.

Task Force on Rhinosinusitis of the American Academy of Otolaryngology-Head & Neck Surgery
Imaging

- Imaging is not cost effective in the initial assessment of patients in the primary care setting.

- No role for CT in the setting of acute sinusitis unless complications suspected. Useful for chronic disease.
Imaging

Gwaltney et al found 87% of adults with acute onset URI symptoms demonstrated inflammation within the nose and viscous secretions with air bubbles in the sinuses on CT. This was resolved in 79% on repeat CT scan.
To culture or not to culture

- Nasal swabs are not helpful.
- Pathogens implicated in acute sinusitis are usually present regardless of presence of disease.
# How to distinguish between a cold, allergic rhinitis and acute sinusitis

<table>
<thead>
<tr>
<th></th>
<th>Colds</th>
<th>Allergic rhinitis</th>
<th>Acute sinusitis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration</strong></td>
<td>about a week</td>
<td>weeks or months</td>
<td>&gt; one week</td>
</tr>
<tr>
<td><strong>Nasal discharge</strong></td>
<td>clear and thin in the beginning, may turn green or yellow</td>
<td>clear and thin</td>
<td>purulent, green or yellow</td>
</tr>
<tr>
<td><strong>Cough</strong></td>
<td>frequent</td>
<td>not usually, may occur in concomitant asthma sufferers</td>
<td>frequent, especially in children</td>
</tr>
<tr>
<td><strong>Sneezing</strong></td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td><strong>Fever</strong></td>
<td>sometimes</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td><strong>Itchy nose, eyes and throat</strong></td>
<td>no</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td><strong>Facial pain/pressure</strong></td>
<td>rarely</td>
<td>rarely</td>
<td>yes, frequent and localised</td>
</tr>
<tr>
<td><strong>Headache</strong></td>
<td>rarely</td>
<td>rarely</td>
<td>frequent, especially in adults</td>
</tr>
<tr>
<td><strong>Causes</strong></td>
<td>over 100 types of viruses</td>
<td>inhaled allergens</td>
<td>virus, bacteria, fungus</td>
</tr>
</tbody>
</table>

**References:**
Management: Key Points

- Antibiotics
- Anti-inflammatory agents
- Decongestants
- Antihistamines
- Nasal Irrigation
Management: Decongestants

Forms
  Oral
  Topical

No randomized, placebo control trial has shown a significant benefit of oral agents.

Topical agents are thought to be beneficial.
Management: Anti-Inflammatory agents

• Topical steroids have shown symptom relief in studies comparing antibiotic vs antibiotic plus topical steroid groups
  – Meltzer et al: amoxy-clav vs amoxy-clav/mometasone furoate 400 ug bid
  – Barlan et al: amoxi-clav vs amoxi-clav/budesonide 50ug bid kids

• They may contribute to a reduction in edema and/or cellular infiltration
Pharmacotherapy

- Intranasal corticosteroids
  - Potential risk for decreased growth velocity in children with beclomethasone dipropionate. In contrast, mometasone furoate monohydrate was shown to be safe in 1 year study.
  - Consider increased total steroid exposure if taken concomitantly with an inhaled corticosteroid, thereby increasing risk of systemic side effects.

Systemic bioavailability of nasally-administered steroids

Comparative clinical significance has not been proven.

* Registered trademark of Schering Canada Inc.

- Adapted from Nasonex® Product Monograph,1 Rhinocort® Turbuhaler® Product Monograph2, Rhinocort® Aqua Product Monograph3, Lumry4, and Corren5

## Paediatric indication for Nasal Steroids

<table>
<thead>
<tr>
<th></th>
<th>Nasonex*</th>
<th>Flonase®†</th>
<th>Nasacort®‡AQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Youngest paediatric of age approval</td>
<td>3 to 11 years of age</td>
<td>4 to 11 years of age</td>
<td>4 to 12 years</td>
</tr>
</tbody>
</table>

* Registered trademark of Schering Canada Inc.
† Registered trademark of GlaxoSmithKline.
‡ Registered trademark of Aventis Pharma Inc.

**Approved indication for adjunctive use in acute rhinosinusitis**

<table>
<thead>
<tr>
<th></th>
<th>Nasonex*</th>
<th>Flonase®†</th>
<th>Nasacort®‡ AQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

* Registered trademark of Schering Canada Inc.
† Registered trademark of GlaxoSmithKline.
‡ Registered trademark of Aventis Pharma Inc.

Management: Antihistamines

- Have not proven to be effective in the management of acute sinusitis
- First generation antihistamines can cause dryness of mucosal membranes and hence may interfere with mucosal clearance
- Aerius is the only antihistamine that yields significant improvement in nasal congestion.
Management: Nasal Irrigation

- Numerous commercial products
  - Hydrasense
  - Salinex
- Benefit is from rinsing away mucosal irritants.
Treating with antibiotics
Diagnosing ABRS

• A diagnosis of ABRS can be made in general with children
  – after 10 days of symptoms
  – If the symptoms worsen after 5-7 days and is accompanied by some or all of the symptoms or signs as noted.

  Otolaryngology Head and Neck Surgery Jan 2004 Executive Summary; Antimicrobial treatment guidelines for bacterial rhinosinusitis
Acute Sinusitis Treatment

• Williams et al 2001, reviewed 49 trials involving 13660 participants evaluating antibiotics for acute maxillary sinusitis.
  – Patients diagnosed by sinus aspiration or radiograph
  – For acute maxillary sinusitis, current evidence supports the use of Penicillin or Amoxicillin for 7-14 days.
  – No difference in relapse or recurrence rates at one year follow up between antibiotic and placebo group
## Table 5. Recommended antibiotic therapy for children with ABRS

<table>
<thead>
<tr>
<th>Initial therapy</th>
<th>Calculated clinical efficacy (%)</th>
<th>Calculated bacteriologic efficacy (%)</th>
<th>Switch therapy options (no improvement or worsening after 72 hours)†</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mild disease‡ with no recent antimicrobial use (past 4 to 6 weeks)§</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoxicillin/clavulanate (90 mg/6.4 mg/kg per day)</td>
<td></td>
<td>91-92</td>
<td>97-99</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td></td>
<td>86-87</td>
<td>90-92</td>
</tr>
<tr>
<td>Cefpodoxime proxetil</td>
<td></td>
<td>87</td>
<td>92</td>
</tr>
<tr>
<td>Cefuroxime axetil</td>
<td></td>
<td>85</td>
<td>88</td>
</tr>
<tr>
<td>Cefdinir</td>
<td></td>
<td>84</td>
<td>86</td>
</tr>
<tr>
<td><strong>β-Lactam allergic# TMP/SMX</strong></td>
<td>83</td>
<td>84</td>
<td>Re-evaluate patient** Combination therapy¶</td>
</tr>
<tr>
<td>Azithromycin, clarithromycin, erythromycin</td>
<td>78</td>
<td>76</td>
<td></td>
</tr>
<tr>
<td><strong>Mild disease‡ with recent antimicrobial use (past 4 to 6 weeks) or moderate disease‡</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amoxicillin/clavulanate (90 mg/6.4 mg/kg per day)</td>
<td></td>
<td>92</td>
<td>99</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td></td>
<td>91</td>
<td>99</td>
</tr>
<tr>
<td><strong>β-Lactam allergic# TMP/SMX</strong></td>
<td>83</td>
<td>84</td>
<td>Re-evaluate patient** Combination therapy¶ (clindamycin or TMP/SMX plus rifampin)</td>
</tr>
<tr>
<td>Azithromycin, clarithromycin, erythromycin</td>
<td>78</td>
<td>76</td>
<td></td>
</tr>
</tbody>
</table>

*Clinical and bacterial efficacy (ie, clinical and microbiologic adequacy) is represented by the calculation from the Pophle therapeutic outcome model (see text) using the mean values of two surveillance data sets: the JCHH surveillance data set and the 1997-1999 Clinical Outcomes Research Initiative surveillance data set.*

†The switch therapy options (no improvement or worsening after 72 hours) are based on the clinical and bacterial efficacy data.

‡Mild disease is defined as a history of ABRS with no recent antimicrobial use (past 4 to 6 weeks) or moderate disease is defined as a history of ABRS with recent antimicrobial use (past 4 to 6 weeks) or moderate disease.

§Antimicrobials have been monitored in surveillance data sets for 1997-1999 and 2000-2002.

¶Combination therapy includes clindamycin or TMP/SMX plus rifampin.
Antibiotic Selection for Acute Sinusitis

- No difference in cure rates found between Cephalosporins, Macrolides and Amoxicillin Clavulinate.
- Higher drop-outs in Amox-Clav group due to adverse effects (4.4% vs 19%)
- No difference in clinical outcomes of Fluroquinolones vs cephalosporins, macrolides, penicillin classes.

Williams et al; 2001
Desrosiers et al 2002
Recommended Antimicrobials
Canadian Guidelines October 2002

• First line
  – Amoxicillin

• Second Line
  – Fluoroquinolones (not indicated in pediatric patients)
  – Macrolides
  – Oral B-Lactams
    • Amox-Clav 500/125mg tid or 875/125mg bid
  – Cefixime
  – Cefprozil
  – Cefuroxime Axetil
Indications For Second Line Therapy

- No response to first line after 72-96 hours
- Frontal or Sphenoid sinusitis
- Allergy to B Lactam antibiotics
- Patients receiving antibiotics in the previous 3 months
- Chronic underlying conditions or immunosuppression
- Patients in daycare
- Consider in patients under two years of age
• Initial therapy in adults is recommended for 10 days with Amoxicillin 500mg tid
• If the patient fails to improve in 72 hours they should be switched to second line antibiotics in a different class.
• Patients failing to improve on a second line antibiotic should be referred to a specialist.
Chronic Pediatric Nasal Discharge

• Antibiotics given after 10 days of persistent nasal discharge will reduce the chance of persistence in the short to medium term (2-6 weeks)
• No long term benefits have been reported
• Eight children must be treated to achieve one additional cure over placebo.

P. Morris et al 2001
Why is this important?

- Increasing rate of *S. pneumoniae* resistance. In Canada High level Penicillin resistant *S. pneumoniae* now 13.8%
- Multidrug resistant *S. Pneumonia* up from 2.7% to 8.8% over the last 5 years.
- Appropriate use of antibiotics reduces development of resistant strains of bacteria.

Zhanel et al Feb 2003
Complications…

- Chronic sinusitis
- Orbital infection
- Osteomyelitis
- Frontal sinus abcess
- Potts Puffy Tumor
- Intracranial infection
Complications...

- Intracranial infection
Complications

• Orbital abscess
Chronic Sinusitis

- Consider adenoidectomy
- Immune work up
- Allergy referral
- Local Irritants
- Sinus surgery rarely indicated in pediatric patients
Summary

• Acute sinusitis is diagnosed by clinical criteria.
• Management is with decongestants and nasal irrigation, steroid sprays for 7-10 days.
• Amoxil is indicated as the first line antibiotic after 10 days of persistent symptoms or exacerbation 5-7 days into an infection.
• Refer if patient fails second line therapy, suspected complication or chronic symptoms.
Summary

• If symptoms are consistent with chronic sinusitis, referral is indicated.
Case

• 5 year old female presents with ototorhea from left ear to my office.
• Patient otherwise well, no systemic complaints.
• Tubes placed 3 months ago for chronic otitis media.
• Seen recently at a walk in clinic and prescribed Amoxicil.
• No improvement noted.
Ideal treatment?

- This patient should have been started on topical antibiotic drops.
- Ciprodex or Cipro HC with no oral antibiotics in this case.

- The Journal of Otolaryngology, Volume 34, Supplement 2, August 2005
Use of Ototopical vs Systemic Antibiotics

- Ototopical antibiotics
  - All cases of uncomplicated AOMT
- Systemic antibiotics
  - Systemic illness
  - Complicated otitis media (ie mastoiditis)
  - Associated strep pharyngitis
  - Diabetic and immunocompromised patients
  - Failure of topical therapy
Ototoxicity

- No reported ototoxicity in animal or human studies with fluoroquinilones

- All other ototopical agents may be ototoxic in humans.

- Peter s. Roland Et al Consensus Panel on Role of potentially ototoxic antibiotics for topical middle ear use. Otolaryngology-Head and Neck Surgery. 2004; 130:S51-S55
Predisposing factors

Inflammatory problems
  URTI
  Allergies
Mucosal Irritants
  Air pollution
Mechanical obstruction
  Nasal polyps
Anatomic variants
  Foreign bodies
Polyps
Diagnostic Factors Predictive of Sinusitis

• Major Factors
  • Facial pain or pressure
  • Facial congestion or fullness
  • Nasal obstruction
  • Nasal purulence or discoloured post nasal discharge
  • Hyposmia or anosmia
  • Fever

• Minor Factors
  • Minor Factors
  • Headache
  • Halitosis
  • Fatigue
  • Dental pain
  • Cough
  • Ear pain or pressure

Lanza and Kennedy
A 5 day course of Gatifloxacin has been shown to be as effective as a 10 day course of Amoxil-Clav for Acute sinusitis.

» Sher et al.
Antimicrobial Therapy

• “New Generation” Fluoroquinolones
  – Moxifloxacin
  – Gatifloxacin
  – Levofloxacin

• Considered to be an excellent alternative for the treatment of acute and chronic bacterial sinusitis.

• Essentially no S. pneumoniae resistance to these antibiotics.

Zhanel et al Feb 2003
When to refer?

- Patients not improving on second line agents.
- Patients with greater than 12 weeks of symptoms (chronic)
- Patients with suspected complications of sinusitis.
- Patients where it is difficult to confirm diagnosis.
- Severe frontal headache
Rhinosinusitis

- Laboratory tests
- CBC
- CRP
- Total eosinophil count
- IGE/RAST
- Skin test
- Immune profile

- Sweat chloride
- PFT’s
- Thyroid function
- Nasal cytology/biopsy
- Endoscopic cultures
- Sinus puncture
- Chest xray
- 24 hour pH probe
Risk Factors

- Asthma
- Allergen exposure
- Active smoking
- Family history
- In utero smoke exposure
- Maternal smoking during the first year of life
- Longer duration of breast feeding
- Lower number of siblings
- Parents in higher socioeconomic status
- Urban residence
Signs and Symptoms

- Sneezing
- Rhinorhea
- Itchy nose and palate, watery eyes
- Cough secondary to post nasal drip
- Nasal congestion usually occurs later.
History

Discuss triggers, medications that have been tried, family history, social background, co morbidities such as asthma, conjunctivitis, rhino sinusitis.

Significant overlap between allergic and infectious rhinitis.
Symptoms less than 7 days

• No antibiotics recommended
Predisposing factors

Inflammatory problems
  URTI
  Allergies
Mucosal Irritants
  Air pollution
Mechanical obstruction
  Nasal polyps
  Anatomic variants
  Foreign bodies
Managing Sinusitis: Which antibiotic is best?

- Most antimicrobial studies are equivalency trials and most studies recruit patients based on clinical findings or radiology and not sinus aspiration.
- Increasing bacterial resistance to antibiotics