Ear Infections in Children

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Expert Opinion in Otorhinolaryngology Head & Neck Surgery
Inst Physics January 2009 LONDON
Everything you ever wanted to know about paediatric ear infections! But…..

- Biofilms
- Discharging Ears
  - Recurrent Otitis Media
  - Discharging grommets
  - CSOM
  - Otitis Externa
  - Important rarites
- Surgery for ear infections
- Immunity & Antibiotic resistance in recurrent ear infections
- Acute Mastoiditis – Contentious Issues
Sources

• Extensive Literature searches
  – Some level I b, also II, III

• Level IV – My ideas !
Biofilms

• Community of bacteria embedded in slime of extracellular polymeric substances (polysaccharides, nucleic acids & proteins)
• Complex multicellular microenvironment of mushroom shaped structures.
• Very low metabolic/reproductive rate
• 1000 more resistant to antibiotic agents.
• Develop on mucosal or on inert surfaces
Biofilms in ENT

- Cholesteatoma
- CSOM
- OME (ref 17)
- Implants – grommets, cochlear implants.
- Chronic tonsillitis
- Adenoids (ref 15)
- chronic sinusitis
Scanning electron micrograph – discharging grommet (ref 5)
• Demonstration of biofilms
  • OME
  • Recurrent AOM

• Pseudomonas aeruginosa - biofilm isolated from cholesteatoma
Drugs against Biofilms

• Nontypeable Haemophilus influenzae (NTHi) biofilm study (ref 13)
  – Fluoroquinolones: levofloxacin and gatifloxacin significantly inhibited biofilm formation
  – Fluoroquinolones potentially have a role in therapy against diseases caused by biofilms.

• Subinhibitory concentrations of Azithromycin inhibited biofilms. (ref 14)
Systemic Fluroquinolone Concerns

- Licensed by the US FDA in <18 years for pyelonephritis & inhalation anthrax only

- Used off licence in CF patients in U.K.

- Fluoroquinolones - *arthrotoxicity* in juvenile animals

- CNS disorders, photosensitivity, disorders of glucose homeostasis, prolongation of QT interval

- Fluoroquinolone use should be restricted to situations in which there is no safe and effective alternative (ref 40)
# Ear Discharge - Organisms

<table>
<thead>
<tr>
<th>Rec AOM</th>
<th>CSOM</th>
<th>Grommet-Otorrhoea</th>
<th>Otitis Externa</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Viruses</strong> 30 %</td>
<td>Pseudomonas aeruginosa</td>
<td>Strep. Pneumoniae</td>
<td>Pseudomonas aeruginosa</td>
</tr>
<tr>
<td>Respiratory syncytial virus (RSV)</td>
<td>Bacterial Staph. aureus</td>
<td>Pseudomonas Sp.</td>
<td>Staph. Aureus</td>
</tr>
<tr>
<td>Human coronavirus (HCV)</td>
<td>Moxarella catarrhalis</td>
<td>Other Staph. sp.</td>
<td>Enterococcus faecalis</td>
</tr>
<tr>
<td>Influenza (IV) type A (9.3%)</td>
<td>E. Coli</td>
<td>Haemophilus Infl.</td>
<td>Enterobacter cloacae</td>
</tr>
<tr>
<td>Adenovirus</td>
<td>Klebsiella sp.</td>
<td>Moxarella Cat.</td>
<td>Fungal Infections 10</td>
</tr>
</tbody>
</table>
OME & Microrganisms

- Streptococcus pneumonia (ref 9)
- Staphylococcus aureus
- H. Influenzae
- Pseudomonas aeruginosa
- Fungal organisms (ref 43)
Grommet Concerns
Discharging Grommets - associations

• Frequency of infections not related to swimming!

• Titanium Grommets – higher incidence of infection & granulation tissue (ref 2)

• Antibiotic Coated Tubes – no difference in complications using phosphorylcholine (PC) antibacterial coating fluoroplastic Armstrong tubes (ref 4)

• Ionized processed silicone tubes superior to other silicon ventilation tubes in regard biofilm growth & "otorrhea" rate (ref 18)
Discharging Grommets - Managements

• Quinolone Ear Drops = Otosporin drops

• Consensus View – ENT UK: Ototoxic Drops with steroid for up to 2 weeks max.

• Systemic Antibiotics and ear drops
  – Use for fever or severe otalgia
  – Doesn’t clear otorrhoea quicker

• Systemic Ciprofloxacin – occasionally needed
Grommet Concerns – Frequency of Complications & Late Sequelae

• Otorrhoea 2 % up to 14 %
• Tube Blockage – 8.6%. Thick Glue, use of drops (ref7)
• Persistent perforation 4.6 %
• Retraction 5.2 %
• Atelectesis 6 %

• Increased prevalence of *long-term changes*
  - myringosclerosis and late atrophy. (ref 1)
Grommet problems ctd.

• purulent otorrhoea 10-26% p.a.
• Myringosclerosis 39-65%
• atrophic scars 28%
• tympanic membrane perforations 3%
• granulation tissue 5-40%

• complications associated with tympanostomy tube insertion - 80% of operated ears (ref16)
Montelukast ?

Pneumoccal Vaccination ?
Acute Otitis Media
Management of Recurrent Acute Otitis Media

• Low dose prolonged antibiotics?

• Insertion of Grommets: frequency of otitis media / discharge significantly decreased (t test, p<0.0001) (ref12)

• Data are not enough to support anti-reflux treatment in children with refractory middle ear infections (ref45)
O.M. PRONE CHILDREN

• Parental smoking
  – nasopharynx of healthy children of smokers
  – nasopharynx of parents
  – ↑number of pathogens c.f non-smokers (ref30)

• Streptococcus pneumoniae
• Haemophilus influenzae
• Moraxella catarrhalis  (ref 39)
What else in AOM?

- AOM - 70% of cases bacteria.
  - 30% viral
- Redness and bulging of the tympanic membrane are characteristic findings in bacterial AOM (ref 38)
- Streptococci pneumoniae with partial penicillin resistance associated with recurrent AOM.
- Treatment duration - 10 days
Pneumococcal vaccination?

- After vaccination, get increase incidence of colonisation and infections by other bacteria (Haemophilus) and see non-vaccine serotype shift
- Finnish study - Reduced incid AOM by 7%
- Vaccine efficacy in OME – 2-5 years
  39% reduction in grommet insertions

Overall frequency of AOM in the ambulatory setting declined by 20% (ref 33)
Pneumococcal vaccination

• Standard UK Immunisation Schedule:
  • At 2 and 4 months of age
  • Prevenar = 7 valent vaccine (7 capsular subtypes)

• At risk children
  • Incl. Cochlear implants
  • Pneumovax II – 23 valent
  • Not recommended under 2 years of age
CSOM – Medical treatments

- Otic drops of either ciprofloxacin 0.2% or polymyxin B, neomycin, and hydrocortisone - 6 to 12 days (ref 29)

- Bacteriologic eradication was seen in 89% on Cipro. and 85% of Otosporin cases

- Oral Antibiotics also reduce discharge in short term (ref 37)
CSOM

• Cholesteatoma Surgery - Open vs Closed

• Paediatric Tympanoplasty
  – Surgical Technique
  – Age
History of Tympanoplasty

- Howard House (1930s) - latex from condoms with a Toynbee silver wire (ref 53)
Graft Material?

- Temporals fascia
- Cartilage Palisades
- Periosteum
Technique

• On-lay / Over-lay

• Underlay

• Reverse Through-lay
What Age to perform myringoplasty?

- Smyth: any age, as soon as possible
- Plester: 5 years
- Dawes: 10 years
- Strong: over 7 years (tubal cartilage and tensor palati mass after 7)
- Mawson: over 12 years

Many authors success rate not influenced by age (eg House Ear Institute, Chandrasekhar et al. Arch Oto H&N Surg 1995; 121:873-878, and Denoyelle, Garabedien group, Paris Laryngoscope)
Myringoplasty Age

• Mean age of most paediatric published series = 10 – 11 years (range 4 – 17)

• Younger age acceptable if post-grommet cases
  – Other ear predicts outcome

• General Advice (G.Morrison)
  – 8 yrs or over if infections controllable and one good hearing ear
  – Much earlier if bilat. Subtotal perfs. with disabling hearing loss & infections
Mastoid Surgery for tubotympanic CSOM

• 34 ears - mastoid surgery for chronic otorrhea - 97% cure (ref 47)

• tympanoplasty without mastoidectomy (31 ears) 91% cure.
Otitis Externa

• Unusual in Children
  – Check attic
  – Consider Immunity

• Use of Cotton buds causes it (ref 20)
• Instrumenting the ear canal
• Swimming
Fungal Otitis Externa

• Candida albicans - 43% of cultures.
  – Candida parapsilosis 24%
  – Aspergillus fumigatus in 13%.  (ref 41)

• Median of 3.8 weeks for symptom resolution.
Keratosis Obturans / Chronic Otitis Externa

- Keratosis obturans - regular aural toilet, (ref 19)
  - bilateral obstructive cerumen plugs leading to circumferential canal distention, irritation, pain, and hypoacusis (ref 51)

- DIPROSALIC SCALP LOTION – Betamethasone, 2% salicylic acid, alcohol solvent
Ear Infections – Differential Diagnosis: LCH
Differential Diagnosis – Rhabdomyosarcoma
Ear Infections - Influence of Immunity

• Surface polysaccharides of encapsulated bacteria of these bacteria poorly immunogenic

• the polysaccharides are thymus-independent (TI)-2 antigens which induce an inadequate immune response in neonates and infants. (ref 31)
Immune Investigations

• IgG, IgA, IgM, IgE and IgG subclasses.

• HIV-serology

• Lymphocyte populations
  • In vitro lymphocyte responses to mitogens and alloantigens

• Immunodeficiency maybe limited to defective antibody responses to polysaccharide antigens.
Drug Resistance

- 1930s - Sulfonamides - resistance of Pneumococci gp A Streptococci
- 1950s - beta-lactamase-producing Staphylococci
- 1960s - highly resistant gram-negative enteric bacteria
- 1970s beta-lactamase-producing Haemophilus influenzae & Moraxella catarrhalis
- 1980s - multidrug-resistant Pneumococci.

Currently
- In USA 25% of pneumococci are resistant to penicillin
- 25% of H influenzae and 90% of M catarrhalis produce beta-lactamase (ref 22)
- Multiresistant Pseudomonas
- MRSA

MANAGEMENT STRATEGY:

- Topical rather than systemic antimicrobial drugs
- Avoid unnecessary use of antibiotics
Acute Mastoiditis
Acute Mastoiditis

- Post auricular Swelling
- Fever

- Masked Mastoiditis
  - Acute OM signs settled on antibiotics
  - Insidious course
  - Presents with a complication of mastoiditis.

- Organisms (refs 11 & 49):
  - Strep. Pneumoniae (58%)
  - Strep pyogenes
  - H. Influenzae
  - Staph. Aure
  - Klebsiella pneumonia
  - Pseudomonas aeruginosa
Changing Incidence of Acute Mastoiditis?

- 1990-2002 - A significant increase in the incidence of AM in infants recorded ($p=0.01$). Tel-aviv, (ref 11)

- 1996 -2005 Melbourne: The yearly number of cases of AM treated remained stable (ref 36)
  - % mastoiditis patients given prior antibiotics for AOM decreased over time to 2005
Acute Mastoiditis - Management

• 50 - 60 % Require surgery
  • Mastoidectomy in > 25%. (ref 8)
  • Grommet +/- post-aural abscess (ref 6)

• ↑complications in under 2 year olds (ref 8)

• 45% of patients had received oral antibiotics prior to presentation.
Whether to Scan?

- CT diagnosis
  - coalescent left mastoiditis
Complications – Spread of infection

• 30 % Subperiostial Abscess (ref 11)
• 12% Lateral Sinus Thrombosis

• Extradural Abscess
• Brain Abscess
• Meningitis
• Hydrocephalus
Lateral Sinus Thrombosis

• **Clinical**: headache, spiking fever, vomiting, torticollis, tender IJV, papilloedema

• **Diagnosis**:
  – Contrast CT / MRI
    • isointense on T1 and hypointense on T2-weighted images. Magnetic resonance venography
  – Neck U/S of upper IJV

• **Fusobacterium necrophorum**, inducer of hemagglutinin-mediated platelet aggregation (ref 54)

• Thrombophilic tendency in some patients (ref 56)

• Anticoagulation ? (ref 55)
  – Pros – recanalisation (ref 57)
  – Cons – bleeding, release of septic emboli - Lemierre syndrome.
Bibliography - 57 Refs.


Thank You