Infectious Diseases in Pediatrics

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Pneumococcal Vaccine 2010

- **Pneumococcal Conjugate Vaccine (PCV13)**
  - All children 2-59 months
  - A single revaccination after 5 years of age for children with asplenia or other chronic diseases or immunocompromising conditions (e.g., chronic lung disease, cochlear implants, HIV)
  - These children should also receive PPSV
Influenza Vaccine 2010

- Administer annually to children/adolescents 6 months through 18 years of age. (trivalent inactivated vaccine)
  - Live attenuated vaccine for children over 2 years of age (but not for 2-4 year olds who have been wheezing in the past year)

Influenza

- 6 yo with cough and high fever

Meningococcal Vaccine 2010

- Administer at 11-12 years of age (catch up unvaccinated 13-18 year olds).
- Administer to previously unvaccinated college freshmen if living in a dormitory
- Administer to children 2-10 years of age with special conditions; (eg, persistent complement deficiencies, asplenia)

U.S. rates of meningococcal disease by age

Source: Pediatr Infect Dis © 2007 Lippincott Williams & Wilkins
General vaccine recommendations

- All vaccines can be administered at the same visit as all other vaccines.
- If not given at the same visit, live parenteral vaccines or live intranasal influenza vaccine should be separated by at least 4 weeks.

General vaccine recommendations

- Increasing the interval between doses of a multidose vaccine does not diminish the effectiveness of the vaccine.
- Decreasing the interval may interfere with antibody response.

General vaccine recommendations

- Live vaccine should not be administered to severely immunosuppressed patients.
- Inactivated vaccines are safe for immunosuppressed patients.

Common Vaccine Questions

- Can you give live virus vaccine to children taking corticosteroids?
  - No: if taking >2 mg/kg/day or >20 mg/day of prednisone for greater than 14 days.
  - Yes: if taking lower daily doses, on alternate day dosage, on systemic steroids for less than 14 days, on inhaled or topical steroids.
Live attenuated vaccines for patients with HIV

- **Vaccine**
  - Varicella: Asympt. yes, Sympt. no
  - MMR: Asympt. yes, Sympt. no
  - LAIV: Asympt. no, Sympt. no
  - Rotavirus: Asympt. no, Sympt. no

Children with anaphylactic egg allergy

- MMR is okay
- Influenza vaccines are not okay

Common Vaccine Questions

- How long should children wait to get vaccinated after receiving immunoglobulins?
  - Depends on the immunoglobulin

Common Vaccine Questions

- What are contraindications to further immunization with pertussis vaccine?
  - Anaphylactic reaction to the vaccine
  - Encephalopathy developing within 7 days of the vaccine
Common Vaccine Questions

- What are precautions to further vaccinations with pertussis vaccine?
  - Fever >40.5 within hours of a previous dose
  - Persistent inconsolable crying for >3 hours
  - Collapse or shock-like state
  - Seizure within 3 days of previous vaccine

Invalid contraindications to vaccination

- Mild illness
- Antimicrobial therapy
- Pregnant or immunosuppressed person in the home
- Breastfeeding
- Premature birth
- Tuberculin skin test

Tuberculosis in Children

- Epidemiology
  - Case rates highest in urban, poor children
  - Infants are at increased risk of progression of disease
  - Tuberculosis in a child is a sentinel event
  - Children usually not contagious
  - Incubation period 2-12 weeks

Clinical Manifestations

- Usually asymptomatic with normal chest xray
- Early manifestations include fever, cough, chills, night sweats
- Radiographic findings: hilar or mediastinal adenopathy, atelectasis, pleural effusion
Tuberculosis in Children

Diagnosis
- Isolation of organism best achieved with gastric aspirates

Tuberculosis in Children

Tuberculin testing
- Use Mantoux Method (5 tuberculin units administered intradermally)
- Test those children at increased risk for disease

Tuberculin Testing

Immediate TSTs
- Contacts of confirmed or suspicious cases
- Children with clinical findings of disease
- Children immigrating from or with recent travel to endemic countries and/or significant contact with indigenous persons from such countries.

Tuberculin Testing

Annual TST’s
- Children infected with HIV or living in household with HIV infected persons
- Incarcerated adolescents
Tuberculin Testing

- TST testing every 2-3 years
  - Children exposed to following persons:
    - HIV infected
    - Homeless
    - Residents of nursing homes
    - Institutionalized or incarcerated adolescents or adults
    - Users of illicit drugs
    - Migrant farm workers

Tuberculin Testing

- TST at 4-6 years and 11-16 years
  - Children whose parents immigrated from endemic countries
  - Children without specific risk factors who reside in high prevalence areas

Tuberculin Testing

- Definition of positive TST
  - >5mm
    - Children in close contact with active disease
  - >10mm
    - Children at increased risk of dissemination
  - >15mm
    - Children older than 4 years with no risk factors

Tuberculous in Children

- Treatment for positive TST, normal CXR
  - INH 10 mg/kg/d for 9 months
  - Don’t routinely monitor LFTs
Tuberculosis in Children

- Treatment for children who are contacts of contagious disease
  - 1. Do TST
  - 2. Treat for 3 months with INH if TST negative
  - 3. Repeat TST; if negative, stop treatment

Pulmonary tuberculosis

- 16 year old female with history of worsening cough and weight loss for one month
Mycobacterial Infections

- Axillary adenitis after BCG vaccination

TST and BCG

- AAP recommends using same criteria for interpreting TST results in children who have been previously immunized with BCG.

Pharyngitis in Children

Etiology

- Most cases are viral infections:
  - Adenovirus
  - Rhinovirus
  - Parainfluenza
  - Influenza
  - EBV

- Grp A Streptococcus accounts for 15% of all cases

- Uncommon causes – Grp C and G beta hemolytic streptococcus, N gonorrhea, tularemia

- Mycoplasma infections of the upper respiratory tract are also associated with pharyngitis
Pharyngitis in Children

- **Bacterial vs. Viral**
  - Scarlet fever rash
  - Fever, headache, abdominal pain
  - Sore throat in absence of viral symptoms
  - Tonsillar erythema, exudate
  - Palatal petechiae
  - Cervical lymphadenitis
  - Children >2 years old

- **Throat Cultures**
  - Laboratory confirmation of infection recommended as clinical identification not reliable
  - Throat culture remains the gold standard
  - Rapid antigen tests are highly specific, but have variable sensitivity (negative antigen tests should be followed up with culture)

Who NOT to do throat cultures on:

- Children <3 years old
- Children with coryza, conjunctivitis, cough, hoarseness, anterior stomatitis, discreet ulcerations
- Post-treatment

GAS Pharyngitis – Why Treat?

- **Suppurative sequelae**
  - Peritonsillar abscess, cervical adenitis, otitis media
- **Nonsuppurative sequelae**
  - Acute rheumatic fever, post-streptococcal glomerulonephritis
**GAS Pharyngitis - Treatment**

- **Penicillin V**
  - 250 mg BID for children for 10 days
  - 500 mg BID for teens for 10 days
- **Benzathine penicillin G**
  - 600,000 units IM for kids <60 lbs
  - 1.2 million units for everyone >60 lbs

**Streptococcal Pharyngitis**

- Palatal petechiae

**Streptococcal scarlet fever**

- Typical facial rash with erythema of cheeks and perioral pallor
Streptococcal Scarlet Fever

- Sandpaper exanthem of scarlet fever

Streptococcal Scarlet Fever

- Peeling of palms and soles 1-2 weeks after the illness

Streptococcal Infections

- Perianal streptococcal cellulitis
  - Diagnosis confirmed by culture of rectal swab
  - Treat like strep pharyngitis

Otitis Media

- Leading cause of physician visits among children
- Peak incidence rates occur at 6-18 months and 5-6 years of age
- 2/3 of all children have at least one episode of otitis media and 1/3 have 3 or more episodes per year
Acute Otitis Media

**Bacteriology**
- S. pneumo
- H. flu (non-typable)
- M. catarrhalis
- Grp A Strep
- S. aureus

**Definition:** fluid in the middle ear in association with signs or symptoms of local or systemic illness

- Without treatment: 80% resolve
- With treatment: 95% resolve

**Elements of the definition of AOM are all of the following:**
- Recent, usually abrupt, onset of signs and symptoms
- Presence of MEE that is indicated by any of the following:
  - Bulging of the TM, decreased TM mobility, air fluid level behind the TM, otorrhea
  - Signs or symptoms of middle-ear inflammation
    - Distinct otalgia; distinct erythema of the TM

**Severe illness**
- Moderate to severe otalgia or temperature greater than 39 C

**Nonsevere illness**
- Mild otalgia and temperature less than 39 C
Acute Otitis Media

- Treatment Recommendations
  - Infants younger than 6 months should receive antibiotics
  - Children 6 months – 2 years old: should receive antibiotics if diagnosis is certain. If diagnosis uncertain and illness nonsevere, observation for 48-72 hours can be considered

- Children 2 years and older:
  - Should receive antibiotics if diagnosis certain and disease severe
  - Observation is an option when diagnosis uncertain or if diagnosis is certain and disease nonsevere

Acute Otitis Media

- Antibiotic Treatment
  - Amoxicillin 80-90 mg/kg/d
  - Treat all children < 6 years of age or those with severe disease for 10 days
  - Children 6 years and older with nonsevere disease can be treated for 5-7 days

- Antibiotic Treatment
  - For patients with severe disease, first line treatment should be augmentin (90 mg/kg/d amoxicillin, 6.4 mg/kg/d clavulanate)
Acute Otitis Media

- Alternative first line therapy for penicillin allergic patients
- For severe disease
  - Ceftriaxone, 1-3 days
- For nonsevere disease
  - Non-type 1 allergy: cefdinir, cefpodoxime, cefuroxime
  - Type 1 allergy: azithromycin, clarithromycin

Acute Otitis Media

- Antibiotic options for treatment failure after 48-72 hours initial therapy
  - Nonsevere disease – augmentin
  - If has non-type penicillin allergy, ceftriaxone for 3 days
  - For type 1 penicillin allergy, clindamycin for 10 days

Acute Otitis Media

- Antibiotic treatment for clinical failure after 48-72 hours initial therapy
  - Severe disease: Ceftriaxone for 3 days
    - If penicillin allergic, clindamycin (consider tympanocentesis)

Otitis Media

- Opacification of the tympanic membrane with loss of normal landmarks
Sinusitis in Children

- Development of Sinuses in Children
  - Ethmoid and maxillary sinuses present at birth
  - Frontal sinuses begin to develop at 2 years old but not fully developed until 6 years of age
  - Sphenoid sinus developed by 6 years of age

Sinusitis

- Diseases predisposing patients to sinusitis
  - Viral rhinitis
  - Allergic rhinitis
  - Ciliary dysmotility
    - Kartagener's Syndrome
  - Cystic Fibrosis
  - Asthma

Sinusitis

- Clinical diagnosis
  - Nonspecific signs and symptoms (rhinorrhea, sore throat, cough) for >10 days
  - More severe signs and symptoms (fever, facial pain, facial swelling)

Sinusitis

- Diagnosis
  - Clinical diagnosis
  - Transillumination
  - Xray, CT scan, MRI
Sinusitis in Children

- Radiologic diagnosis
  - Consider sinus x-rays, CT scan, MRI for recurrent sinusitis, suspected complications of sinusitis (especially orbital involvement), or unclear diagnosis

- Bacterial etiology of acute sinusitis
  - Strep pneumoniae, H.influenza, M.catarrhalis, S.aureus

Sinusitis in Children

- Treatment (10-14 days)
  - Amoxicillin
  - Augmentin
  - Second generation cephalosporin
  - Azithromycin

Sinusitis

- Orbital cellulitis secondary to extension of ethmoid sinusitis
**Sinusitis**
- Pott's Puffy Tumor- osteomyelitis secondary to frontal sinusitis

**Pneumonia Syndromes**
- Infants – febrile, ill appearing, lobar consolidation
  - Etiology – s.pneumonia, h.influenza, s.aureus
  - Mgt - CBC, blood culture, consider LP
  - Treatment – ceftriaxone, cefuroxime, vancomycin plus ceftriaxone if considering s.aureus

**Pneumonia Syndromes**
- Infants – afebrile, well appearing, interstitial infiltrates
  - Etiology – chlamydia trachomatis, RSV, influenza, adenovirus, parainfluenza, pertussis
  - Mgt – CBC, chest xray, hospitalize for respiratory distress, apnea
  - Treatment - erythromycin

**Chlamydia Trachomatis**
- Pneumonia in infants
  - Afebrile illness 2-19 weeks after birth
  - Staccato cough, tachypnea, rales
  - Chest xray - bilateral diffuse infiltrates, hyperinflation
  - Occasionally severe
  - Untreated disease can linger or recur
  - Elevated C trachomatis-specific IgM
Chlamydia Pneumonia

- Chest xray of 3 month old infant with 2 week history of cough and rales
- History of neonatal conjunctivitis
- Elevated chlamydia IgM

Pneumonia Syndromes

- Toddlers/preschoolers/adolescents – febrile, ill, lobar consolidation
  - Etiology – strep pneumoniae, staph aureus
  - Treatment
    - Outpatient – IM ceftriaxone, augmentin, amoxicillin
    - Inpatient – Ceftriaxone, Vancomycin

Pneumonia in Children

- 8 year old boy with 1 week history of abdominal pain, fever, vomiting

Pneumonia in Children

- 8 year old boy; WBC 28,000, right upper lobe consolidation, worsening respiratory distress
Pneumonia in Children

- 8 year old boy after two week IV antibiotic treatment for pneumonia/empyema

- 13 month old boy with history of recurrent pneumonias and 2 weeks of cough
- At bronchoscopy found to have coin and peanut in proximal esophagus

Things children swallow

- 3 year old boy ingested fishing sinker

- Fishing sinker ingestion as a cause of lead toxicity
Pneumonia Syndromes

- Toddlers/preschoolers/adolescents – +/- fever, well appearing, diffuse crackles, wheezing
  - Etiology – RSV, influenza in the winter; parainfluenza in the Fall
  - Pertussis, mycoplasma pneumoniae
  - Treatment – supportive, erythromycin if suspect mycoplasma or pertussis

Mycoplasma pneumoniae

- 8 yo female with 10 day history of fever and cough

Croup

- Self-limited subglottic viral infection
  - Parainfluenza, RSV
- Barking cough, hoarseness, stridor
- Predominance in Fall and Winter
- Usually in children <2 years old
- Spasmodic croup

Croup

- Diagnosis
  - History and physical examination
  - AP and lateral neck films
Croup

- Lateral neck film
  - Normal epiglottis
  - Increased air in the hypopharynx

**Differential Diagnosis of Croup**

- Infectious
  - Epiglottitis
  - Bacterial tracheitis
  - Diphtheria
  - Peritonsillar abscess
  - Retropharyngeal abscess

**Differential Diagnosis of Stridor**

- Epiglottitis
  - Lateral neck film (positive thumb sign)

**Differential Diagnosis of Croup**

- Anatomic
  - Foreign body
  - Laryngeal papillomas
  - Tracheomalacia
  - Subglottic webs, vascular rings
  - Psychogenic stridor
Croup

- **Treatment**
  - Oxygen
  - Nebulized saline
  - Racemic epinephrine
    - 0.5ml of 2.25% solution in normal saline
  - Steroids
    - Decadron 0.6 mg IM or po
    - Prednisone 2mg/kg/d for 3 days
  - Hospital admission

UTIs in Infants and Children

- **Prevalence of UTIs in febrile children**
  - <2 year old without a “source” – 5%
  - Girls <1 year old – 6.3%
  - Girls 1-2 years old – 8.1%
  - Boys <1 year old – 3.3%
  - Boys 1-2 years old – 1.9%
  - Circumcised boys – 0.2-0.4%
  - Uncircumcised boys – 5-20 times higher

Urinary Tract Infections in Children

- **Neonatal UTIs**
  - Often associated with bacteremia (21-33%)
  - As compared to:
    - 1-3 month olds – 18%
    - 4-8 month olds – 6%

Urinary Tract Infections

- **Microbiology**:
  - E Coli (90%)
  - Proteus (males)
  - Staph saprophyticus (sexually active teens)
  - Enterococcus
  - Klebsiella
  - Enterobacter, pseudomonas
Urinary Tract Infections

- Distinguishing lower tract from upper tract disease:
  - Fever, CVA tenderness
  - CBC, sed rate, CRP
  - Radioisotope scan

UTIs in Children

- Making the diagnosis
  - Supra-pubic aspiration
  - Catheterization
  - Perineal collecting bags
  - Best possible clean catch

UTIs in Children

- Interpretation of urinalysis
  - Leucocyte esterase
  - Nitrite
  - Pyuria
  - Bacteruria on unspun gram stain

UTIs in Children

- Outpatient treatment
  - Empiric antibiotic therapy is directed against E Coli
  - Cephalexin first line therapy for 7-14 days
  - Alternative po antibiotics
    - TMP-SMX
    - Sulfisoxazole
    - Cefpodoxime (vantin)
    - Amoxicillin
UTIs in Children

- Inpatient therapy for children who are toxic, dehydrated, or unable to take po fluids
  - Ceftriaxone 75 mg/kg/d
  - Cefotaxime 150 mg/kg/d divided q6h
  - Cefazolin 50 mg/kg/d divided q8h
  - Gentamicin 7.5 mg/kg/d divided q8h

Further evaluation of children with UTI

- Further evaluation of children with UTI
  - Follow-up cultures not necessary unless child not clinically responding
  - Duration of antibiotic therapy should be 7-14 days
  - Children who will need radiologic imaging of the urinary tract should be on prophylactic antibiotics until imaging completed

Urinary Tract Imaging

- Indications for Imaging
  - Acute Pyelonephritis
  - First UTI in a boy
  - First UTI in girl < 3 yo
  - UTI in a child with
    - Urinary tract abnormalities
    - Voiding abnormalities
    - Hypertension
    - Poor growth

Urinary Tract Imaging

- Ultrasound
  - Hydronephrosis, dilatation of distal ureters, hypertrophy of bladder, ureterocele
- Voiding Cystourethrogram
  - Vesicoureteral reflux, posterior urethral valves
- Radionuclide Renal Scans
  - Reflux, renal scarring
Bacterial Meningitis

- **The Bugs**
  - 0-3 months: Grp B Strep, Listeria, E Coli
  - 1-3 months: the above and S pneumoniae, N meningitidis, H influenzae
  - 3-36 months: Strep pneumoniae, N meningitidis, H influenzae, M tuberculosis

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Meningitis in Children

- **Viral meningitis**
  - Enterovirus (coxsackie, echo)
  - Mumps
  - HSV
  - VZV
  - EBV
  - Adenovirus

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Meningitis in Children

- **Treatment**
  - < 30 days: ampicillin and gentamicin or cefotaxime
  - > 30 days: vancomycin and ceftriaxone or cefotaxime
  - Dexamethasone
    - Should be considered as adjunctive treatment for H flu and S pneumo meningitis
  - Prophylaxis of contacts

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Pneumococcal Meningitis

- 6 month old infant with pneumococcal meningitis
- MRI showing multiple brain emboli.
Kawasaki’s Disease

- An acute multisystem vasculitis of unknown etiology
- A leading cause of acquired heart disease in children

Coronary artery dilatation or aneurysms will develop in 15-25% of untreated patients

Risk factors for coronary artery aneurysms
- Male
- < 1 year old
- Long duration of fever (> 10 days)
- Elevated sedimentation rate
- Elevated band count
- Hgb < 10, thrombocytopenia, hypoalbuminemia

Kawasaki’s Disease

Diagnostic Criteria:
- Fever for 5 or more days
- Bilateral nonexudative bulbar conjunctivitis
- Polymorphous exanthem with perineal accentuation
- Red cracked lips, strawberry tongue, pharyngeal erythema
- Erythema and induration of hands and feet
- Cervical adenopathy present in 50% of cases

Differential Diagnosis
- Measles
- Scarlet fever
- Steven’s-Johnson syndrome
- Staphylococcal scalded skin
- Toxic shock syndrome
- JRA
Kawasaki’s Disease

- Peak age of occurrence between 18 months and 2 years
- 80% of patients less than 5 years old
- Incidence is highest in Asians

Kawasaki’s Disease

- Associated findings
  - Urethritis with sterile pyuria
  - Hepatic dysfunction
  - Arthritis, arthralgia
  - Aseptic meningitis
  - Pericardial effusion
  - Myocarditis with CHF
  - Gallbladder hydrops

Kawasaki’s Disease

- Treatment/Management
  - IVIG
  - Aspirin
  - Echocardiography
  - Immunizations

Kawasaki’s Disease

- Dry, cracked lips
**Kawasaki’s Disease**

- Bulbar, nonexudative conjunctivitis

**Common Pediatric Viral Infections**

- Erythema infectiosum
  - Parvovirus B19
  - Low grade fever
  - Parvovirus affects red blood cell precursors
  - Decrease in reticulocyte count

**Kawasaki’s Disease**

- Erythema and tender induration of hand

**Common Viral Infections**

- Coxsackie virus infection
  - Hand-foot-mouth syndrome
  - Summer and Fall
  - Lesions on hands and feet are usually vesicular
  - May be associated with aseptic meningitis
Common Viral Infections

- Coxsackie virus
  - herpangina

Common Viral Infections

- Roseola
  - Human Herpesvirus 6
  - High fever for 1-5 days
  - Rash follows fever
  - Post-Occipital adenopathy
  - Common cause of febrile seizures

Scabies in Babies

- Predilection for axilla

Scabies in Babies

- Commonly associated with nodular lesions
- May involve the face
- Caused by the mite, Sarcoptes scabiei
- Elimite
Scabies

- 3 month old infant with typical lesions of scabies including papules and burrows