Microbiology Pearls
CAPA Conference

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Pearls?

• Jewelry: the incomparable pearl has been regarded throughout history as a treasure almost beyond value
• Figuratively: Something that is very choice or precious

Learning Objectives

Microbiology Pearls:
• Relate current issues in microbiology and infectious diseases
• Describe use of the laboratory to determine the etiology of the infectious process
• Recognize properties of medically important microbes

Current Issue: Antibiotic Resistance

• Treatment with antibiotics → dramatic shift in normal flora, resistant genes capable of spreading to a true pathogen
• Greatest R in normal flora is at one day after end of course of ABX
• Six months after treatment, still not at baseline
• Pearl: Ask when last antibiotics, if within 3 months, choose different antibiotic

Role of the Microbiology Lab

- Clarify the presence of infection
- Specify the etiology
- Motivate the appropriate selection of antimicrobial
- Assist in the identification, control, and prevention of nosocomial infections and infections in the community

Determine Etiology of Infection

- Microscopic examination
- Culture
- Immunochemical
- Molecular
**Microscopic & Culture**

- **Microscopic Examination**
  - Gram stain and wet mounts
  - Timely
  - Presumptive etiology
- **Culture – gold standard**
  - Not timely
  - Depends on quality of specimens and lab's ability to provide favorable conditions for growth

**Immunoochemical & Molecular**

- **Immunoochemical (serologies)**
  - Monoclonal antibody technology allows production of large amounts of pure antibody which reacts to a specific antigen
  - Enzyme linked immunosorbant assay (ELISA), direct fluorescent antibody, indirect fluorescent antibody
- **Molecular - rapid**
  - Probes
  - Amplification
  - Gene or signal
  - Pulse gel

**Microbiology Lab Results**

- **Pearl:** All results must be interpreted clinically
  - Dilemma of colonization vs infection
**Selected Medically Important Microbes**

**Respiratory Infections**

**Respiratory Viruses**
- Rhinitis (common cold), pharyngitis, laryngitis
  - Rhinovirus
  - Coronavirus
  - Respiratory syncytial virus (RSV)
  - Parainfluenzae
  - Adenovirus
  - Herpes simplex virus
  - Epstein Barr Virus
- Tracheitis, bronchitis, bronchiolitis, bronchopneumonia
  - Coronavirus
  - Parainfluenzae
  - RSV
  - Adenovirus
  - Influenza A and B

**Acute Bronchitis**
- Pearl: 90% of cases are caused by viruses
- Antibiotics not indicated unless suspect pertussis
  - Consider ABX if with comorbidity of significant heart or lung disease especially if >65 yrs of age
- Pearl: Colored sputum does not reliably differentiate between bacterial and viral acute bronchitis or other acute lower respiratory infections
COPD Exacerbation

- Causes: bacteria, viruses & air pollution
  - Viruses 30-66%
  - Bacteria 30-50%
- Most common bacterial etiologies
  - Nontypeable Haemophilus influenzae (NTHi)
  - Streptococcus pneumoniae
  - Moraxella catarrhalis
- Other pathogens = Gram negative bacilli
  - Pseudomonas and Enterobacteriaceae
- Gram stain and sputum culture usually not recommended

Antibiotics for COPD Exacerbation

- Most effective antibiotic not known
- Cover the 3 most common pathogens
  - Nontypeable Haemophilus influenzae (NTHi)
  - Streptococcus pneumoniae
  - Moraxella catarrhalis
- Consider risk for Pseudomonas infection

More About S. pneumoniae, NTHi, Moraxella catarrhalis

- Most common causes of acute otitis media
  - S. pneumoniae = most common cause but increasing incidence on NTHi
- Most common causes of acute bacterial sinusitis
  - S. pneumoniae + NTHi = 75%, Moraxella 25%
  - Most common cause of sinusitis = viral
- CAP – S. pneumoniae most common
More About *S. pneumoniae*, *NTHi*, *Moraxella catarrhalis*

- *S. pneumoniae* increasing intermediate resistance to penicillin
- *Haemophilus influenzae* - national incidence of β-lactamase production is 37%
- *Moraxella* 90% (55-100%) produce beta-lactamase
- Pearl: Implications for treatment of acute otitis media in children

Urinary Tract Infections (UTIs)

**Uncomplicated Cystitis in Women**

- Uncomplicated: premenopausal, non-pregnant, no co-morbidities
- Etiology
  - *Escherichia coli* = 75-95%
  - Other GNR: *Proteus mirabilis, Klebsiella pneumoniae*
  - *Staphylococcus saprophyticus*

**Treatment Guidelines for Uncomplicated Cystitis**

- Nitrofurantoin 100 mg bid for 5 days
  - Pearl: Do not use nitrofurantoin for pyelonephritis
- Fluoroquinolones efficacious in 3 day dosing but not recommended because should be used for more serious infections
- For cystitis: Threshold of 20% resistance prevalence at which drug no longer recommended for empirical treatment
  - Pyelonephritis = 10% threshold
- Must be familiar with local antibiograms
Local Antibiogram

- Compilation of antimicrobial susceptibilities of selected bacteria
  - Provides statistical information on local level

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<th>CTAZ</th>
<th>GEN</th>
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OP TMP/SMX susceptibility is 68%. OP Cipro susceptibility is 78%. Nitrofurantoin susceptibility is 97% and should only be used for uncomplicated UTIs with CrCl>60ml/min. OP cefazolin (Keflex) susceptibility is 92%
Skin and Soft Tissue Infections (SSTIs)

SSTIs

• Cellulitis
  – Acute infection and inflammatory response in the dermis and subcutaneous tissues
• Erysipelas
  – Upper dermis and superficial lymphatics
  – Causative agents = Streptococci (GABHS)
• Impetigo
• Abscesses
• Folliculitis
• Furunculosis (boils)
• Carbuncles (coalescent boils)

Erysipelas

Impetigo
Cellulitis

Bacteria

- **Common**
  - Group A streptococci (*Streptococcus pyogenes*)
  - Groups B, C, and G β-hemolytic streptococci
  - *Staphylococcus aureus* – MSSA and MRSA
- **Uncommon**
  - *Hemophilus influenzae*
  - *Pseudomonas aeruginosa*
  - *Pasteurella multocida*
  - Anaerobes
  - *Vibrio vulnificus*
  - *Aeromonas*
  - *Erysipelothrix*

Changing Trends

- Visits for cellulitis and soft-tissue infections have increased from 32 to 48 per 1000 population from 1997-2005
- Increase in methicillin resistant *S. aureus*
  - Most common cause of cellulitis when associated abscess

Clues to Causative Organism

- **Streptococci**
  - Absence of abscess, drainage or necrotic lesion
  - Lymphangitis
  - Raised indurated border
  - Peau d’orange appearance of skin
- **Staphylococcus aureus**
  - Associated abscess, draining, necrotic lesion or penetrating trauma
MRSA Abscesses with Cellulitis
Cellulitis: Diagnostic Studies

- Diagnosis is usually made clinically
- Drainage from abscess or weeping wound → culture
- Material from needle aspiration of inflamed skin or skin biopsy can be cultured when no purulence or drainage – rarely done
- Role of blood cultures
  - Less than 5% positive
- CBC
  - Gauge severity of infection
- Creatine kinase (CK)
- Glucose
- Plain x-rays or CT when osteomyelitis is suspected as in diabetic foot ulcer with cellulitis

Antibiotic Therapy

- Empirical therapy is started based on the clinical presentation and morphology of the cellulitis and associated lesions (if any)
- Empirical therapy can be adjusted based on culture results and/or clinical response to treatment

Oral Antibiotic Therapy: Uncomplicated Purulent Cellulitis

- Abscesses must be drained for ABX to be effective
- Staphylococci – MSSA and CA-MRSA
  - Trimethoprim-sulfamethoxazole (Bactrim, Septra)
  - Doxycycline / Minocycline
  - Linezolid (Zyvox)
    - One of few oral ABX adequately tested in comparative trials with parenteral vancomycin
    - Very expensive, not 1st line
  - Clindamycin
    - Inducible resistance
    - Resistance increasing among S. aureus

Susceptibility of Staph Isolates

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<tr>
<td>Vancomycin</td>
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Treatment of Staphylococci

• Pearl: All antibiotics that are effective against MRSA are effective against MSSA
• Nafcillin predicts cephalasporin sensitivity
• Pearl: MRSA resistant to all β-lactam AXB

Oral Antibiotic Therapy: Uncomplicated Non-Purulent Cellulitis

• Streptococci
  – Penicillin
  – Amoxicillin
  – Cephalexin (Keflex)
  – Clindamycin
    • Penicillin allergic patients
    • Approximately 5% of streptococci are resistant
  • Staphylococci – MSSA and CA-MRSA

Empiric Outpatient Treatment

• Therapy to cover Beta-hemolytic streptococci and MSSA and MRSA
  – Monotherapy
    • Clindamycin 300 mg every 6 hours
    • Linezolid 600 mg every 12 hours
  – Dual therapy
    • PCN or Cephalexin or Dicloxacillin: 500 mg every 6 hours
    PLUS
    • Trimethoprim-sulfamethoxazole (2 DS every 12 hours) or doxycycline (100mg every 12 hours)

Parenteral Therapy

• Streptococci and MSSA
  – Semi-synthetic penicillins: nafcillin, oxacillin
  – Cephalosporins: ceftriaxone, cefazolin, cefuroxime
  – Penicillin allergic: clindamycin
• MRSA
  – Vancomycin, daptomycin (Cubicin),
    tigecycline (Tygacil), linezolid (Zyvox)
Other Considerations: ABX Therapy

- Facial cellulitis
  - *Hemophilus influenzae* particularly in children
- Human and animal bites
  - Human: *Eikenella corrodens*, anaerobes, *viridans streptococci*
  - Animal: usually polymicrobial: *Pasturella multocida*, *Streptococci*, *S. aureus*, anaerobes
- Immunocompromised patients
  - Cultures important, empiric broad spectrum
  - Infectious disease consult

Take Home Points

- If suspect infectious disease as cause of patient’s symptoms, consider most likely etiologic agents
- If bacteria, choose abx based on local antibiograms, spectrum and potential toxicity to patient
- Ask yourself if microbiologic diagnostic testing is indicated