Antibiotics & Infections

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History of Antibiotics

Antibiotic deployment

Antibiotic resistance observed

Tulane Department of Family Medicine
Penicillins

- Mostly Gram+
- Anaerobes
- Syphilis
Penicillins

• Natural
  – Pen G, Pen V

• Anti-staphylococcal Penicillins
  – Methicillin, Oxacillin, Dicloxacillin

• Amino-penicillins (picks up some Gram-)
  – Ampicillin, Amoxicillin
  – Amoxicillin + clavulonic acid (Augmentin)

• Anti-pseudomonal Penicillins
  – Ticarcillin (usu with clavulonic acid)
  – Piperacillin (usu with tazobactam)
Cephalosporins

Some Gram+ with increasing Gram- coverage:

• 1\textsuperscript{st} Gen: Proteous, E. coli, Klebsiella (PEcK)
• 2\textsuperscript{nd} Gen: H. flu, Enterobacter, Neisseria (HEN)
• 3\textsuperscript{rd} Gen: Penetrates CNS, treats gonorrhea
• 4\textsuperscript{th} Gen: Very broad, covers pseudomonas
Cephalosporins

• 1st Gen: cephalexin (po), cefazolin (iv)
• 2nd Gen: cefuroxime (po), cefoxitin (iv)
• 3rd Gen: cefdinir (po), ceftriaxone (iv)
• 4th Gen: cefepime (iv)
Macrolides

Cover Gram+, some Gram-, atypicals, and Leigonella.

• Erythomycin
• Azithromycin
• Clarithromycin
Tetracyclines

- MRSA
- Propionibacterium acne
- Chlamydia and Mycoplasma
- Rickettsia
- Brucellosis
- Spirochetal infections
- Antrax, plague, tularemia, Legionella
Tetracyclines

- Tetracycline
- Minocycline
- Doxycycline
Aminoglycosides

Covers Gram-

- Gentamycin
- Tobramycin
- Amikacin
Quinolones

• 1\textsuperscript{st} Gen: Gram-, UTI only
  – Nalidixic Acid

• 2\textsuperscript{nd} Gen: Gram-, Pseudomonas, Staph, atypical
  – Ciprofloxacin

• 3\textsuperscript{rd} Gen: Expanded Gram+ and atypicals. Known as “respiratory quinolones”
  – Levofloxacin, Moxifloxacin

• 4\textsuperscript{th} Gen: Similar to 3\textsuperscript{rd} but less resistance.
  – Gemifloxacin
Others

- Vancomycin: MRSA
- Sulfamethoxazole/Trimethoprim
  - Gram- infections, MRSA, PCP
- Clindamycin: MRSA, anaerobic infections
- Metronidazole: anaerobic infections
- Linezolid: VRE, MRSA
- Aztreonam: Gram-
- Carbapenem: Big-gun, broad spectrum
Gram Positive

- Penicillins
- Macrolide
- 1st/2nd generation cephalosporin
- Respiratory quinolone
MRSA

- Clindamycin
- Doxycycline/Minocycline
- Linezolid
- SMX/TMP
- Vancomycin
Gram Negative

- Extended spectrum penicillins
- Cephalosporins
- Aminoglycosides
- Macrolides
- Quinolones
- Monobactams
- Carbapenems
Pseudomonas

- Aminoglycosides
- Ciprofloxacin
- Anti-pseudomonal penicillins
- Carbapenems
- 4th generation cephalosporins
Atypicals

• Macrolides
• Quinolones
• Tetracyclines
Anaerobic

• Penicillin
• Metronidazole
• Clindamycin
Considerations

• Get culture
• Use narrowest antibiotic that covers infection
• Use broad spectrum antibiotic for serious life-threatening infections, very ill patients with co-morbidity, etc...
• Remember to ask about allergies
• Remember to adjust dosing for renal function
# Sepsis

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Criteria</th>
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<tbody>
<tr>
<td>Systemic inflammatory response syndrome (SIRS)</td>
<td>At least two of the following:</td>
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<tr>
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<td>Body temperature &gt;38.5°C or &lt;35.0°C</td>
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<td>Heart rate &gt;90 beats/min</td>
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<td>Respiratory rate &gt;20 breaths/min or PaCO₂ &lt;32 mmHg or a need for mechanical ventilation</td>
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<td>White blood cell count &gt;12 000/mm³ or &lt;4000/mm³ or immature forms &gt;10%</td>
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<td>Sepsis</td>
<td>SIRS Plus: documented infection on the basis of either of the following:</td>
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<td>Culture or Gram stain of blood, sputum, urine or normally sterile body fluid positive for pathogenic microorganism</td>
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<td>Focus of infection identified by visual inspection (e.g. a ruptured bowel with free air or bowel contents found in the abdomen at surgery, or a wound with purulent discharge)</td>
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<td>Severe sepsis</td>
<td>Sepsis Plus at least one of the following signs of organ hypoperfusion or organ dysfunction</td>
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<td>Areas of mottled skin</td>
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<td>Capillary refill time ≥3 s</td>
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<td></td>
<td>Urinary output &lt;0.5 ml/kg for at least 1 h or renal replacement therapy</td>
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<td>Lactic acid levels &gt;2 mmol/l</td>
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<td>Abrupt change in the mental status or an abnormal electroencephalogram (EEG)</td>
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<td>Platelet counts &lt;100 000/ml or disseminated intravascular coagulation (DIC)</td>
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<td>Acute lung injury (ALI) or acute respiratory distress syndrome (ARDS)</td>
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<td></td>
<td>Cardiac dysfunction (echocardiography)</td>
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<tr>
<td>Septic shock</td>
<td>Severe sepsis Plus at least one of the following:</td>
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<tr>
<td></td>
<td>Systemic mean blood pressure &lt;60 mmHg (&lt;80 mmHg if previous hypertension) after 20–30 ml/kg starch or 40–60 ml/kg isotonic saline, or pulmonary capillary wedge pressure between 12 and 20 mmHg</td>
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<td></td>
<td>Need for dopamine &gt;5 mg/kg/min or norepinephrine or epinephrine &gt;0.25 mg/kg/min to maintain a mean blood pressure above 60 mmHg (80 mmHg if previous hypertension)</td>
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</table>
CNS

- Meningitis

**Age Group**

- Newborns
- Infants and Children
- Adolescents and Young Adults
- Older Adults

**Causes**

- Group B *Streptococcus*, *Escherichia coli*, *Listeria monocytogenes*
- *Streptococcus pneumoniae*, *Neisseria meningitidis*, *Haemophilus influenzae* type b
- *Neisseria meningitidis*, *Streptococcus pneumoniae*
- *Streptococcus pneumoniae*, *Neisseria meningitidis*, *Listeria monocytogenes*
Eye

- **Blepharitis**
  - Staph
- **Dacryocystitis**
  - Staph, Strep, Pseudomonas, E. coli
- **Conjunctivitis**
  - Staph, Strep, H. flu, Moraxella
  - Newborns consider GC/Chlamydia
Ear

• Otitis externa
  – Pseudomonas
  – Staph

• Otitis media
  – Strep pneumo
  – H. flu
  – Moraxella
  – Other Strep species
Nose & Sinus

- Nasal vestibulitis
  - MRSA
- Sinusitis
  - Strep pneumo
  - H. flu
  - Moraxella
Throat

• Pharyngotonsillitis
  – GAS, other strep, staph, H. flu
Lung

• Bronchitis
  – Usually viral
  – Strep pneumo, H. flu, Moraxella, Mycoplasma, Chlamydia

• Pneumonia
  – Strep pneumo, H. flu, Moraxella, Mycoplasma, Chlamydia
Cardiac

• Need cultures...can be anything
GI

• PUD: H. pylori
• Gastroenteritis
  – Get culture...consider ETEC based on travel
• Cholecystitis/Ascending cholangitis
  – E. coli, Clostridium, Klebsiella, Strep
• Diverticulitis
  – E.coli, Strep, Clostridium, Bacteroides
• Colitis: C. difficile
GU

- Cystitis/Pyelonephritis
  - E. coli, Klebsiella, Proteus, Staph sapro
- Prostatitis
  - E. coli, other Gram -, Gonorrhea
- Pelvic inflammatory disease
  - Mixed, cover for GC/Chlamydia
<table>
<thead>
<tr>
<th>Age group</th>
<th>Most common organisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborns (younger than 4 mo)</td>
<td><em>S. aureus</em>, <em>Enterobacter</em> species, and <em>group A</em> and <em>B Streptococcus</em> species</td>
</tr>
<tr>
<td>Children (aged 4 mo to 4 y)</td>
<td><em>S. aureus</em>, group A <em>Streptococcus</em> species, <em>Haemophilus influenzae</em>, and <em>Enterobacter</em> species</td>
</tr>
<tr>
<td>Children, adolescents (aged 4 y to adult)</td>
<td><em>S. aureus</em> (80%), group A <em>Streptococcus</em> species, <em>H. influenzae</em>, and <em>Enterobacter</em> species</td>
</tr>
<tr>
<td>Adult</td>
<td><em>S. aureus</em> and occasionally <em>Enterobacter</em> or <em>Streptococcus</em> species</td>
</tr>
<tr>
<td>Sickle cell anemia patients</td>
<td><em>Salmonella</em> species are most common in patients with sickle cell disease.</td>
</tr>
</tbody>
</table>
Skin

- MRSA
- Strep
Case #1

Hx: 2 y/o male with 3 days of fever (Tmax 102), irritability, runny nose, dry cough, and tugging at ears.

PE: Crying child, conjunctiva clear, left TM red and bulging, right TM ok, nostrils congested, OP clear, lungs clear, heart tones regular, abdomen soft/non-tender, no rash
Otitis Media: diagnosis

• Acute onset
• Middle ear effusion
• Inflamed TM
• Pain, irritability, or fever
Otitis Media: etiology

- Strep pneumo
- H. flu
- Moraxella
Otitis Media: treatment

- Analgesics
- Antibiotics
  - High-dose amoxicilllin or amox/clav
  - Cefdinir, cefuroxime, or cefpodoxime
  - IM ceftriaxone
Case #2

Hx: 25 y/o female with 7-8 days of sinus congestion and runny nose which was initially improving now with 2 days of right-sided facial pain and yellow-green nasal discharge.

PE: T=100.6, appears uncomfortable, conj clear, TMs clear, right max sinus ttp, purulent nasal d/c on right, OP clear, lungs clear, RRR, no rash
Sinusitis: diagnosis

- 10 day URI or worsening after 5-7 days
- Facial pain, pressure, fullness
- Purulent rhinorrhea
- Maxillary toothache
- Nasal obstruction
Sinusitis: etiology

- Viral: rhino, adeno, influenza, para-influenza
- Strep pneumo
- H. flu
- Moraxella
- Staph
Sinusitis: treatment

• Relieve obstruction
  – Steam, saline, etc...
  – Topical/Oral decongestant
  – Topical/Oral steroid

• Analgesia
  – NSAIDs
  – Acetaminophen
  – Short course of narcotic
Sinusitis: treatment

• Antibiotics: although controversial they seem to help.
• Target antibiotic to organism if able
• Amoxicillin, amox/clav, 3rd gen cephalo
• Respiratory quinolone for complicated cases
• Macrolide for PCN allergic
Case #3

Hx: 8 y/o male with acute onset sore throat, fever, and abdominal pain

PE: T=102, appears ill/fatigued, conj clear, TM clear, nostrils patent, OP w/ tonsillar exudate, uvula midline, neck supple w/ tender submandibular nodes, lungs clear, RRR, abd soft but tender throughout. No rebound/guarding.
GAS Tonsillitis: diagnosis

• Centor criteria (1 pt each)
  – Absence of cough
  – Swollen lymph nodes
  – Temp > 100.4
  – Tonsillar exudate
  – Age < 15
# GAS Tonsillitis: diagnosis

<table>
<thead>
<tr>
<th>Points</th>
<th>Probability of Strep</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or fewer</td>
<td>&lt;10%</td>
<td>No antibiotic or culture needed</td>
</tr>
<tr>
<td>2</td>
<td>11–17%</td>
<td>Antibiotic based on culture or RADT</td>
</tr>
<tr>
<td>3</td>
<td>28–35%</td>
<td></td>
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<tr>
<td>4 or 5</td>
<td>52%</td>
<td><strong>Empiric antibiotics</strong></td>
</tr>
</tbody>
</table>
GAS Tonsillitis: treatment

- Pen V or IM Bicillin
- Amoxicillin
- 1\textsuperscript{st} gen cephalosporin (best)
- Clindamycin if PCN allergic
Case #4

Hx: 57 y/o female with slightly productive cough, right-sided chest pain, and fever for 1 week. Getting worse. Some difficulty taking a deep breath. No hemoptysis. Non-smoker.

PE: T=99, Pox 97% RA, VSS, NAD but coughing, conj clear, TM’s clear, nostrils congested, sinuses non-ttp, neck supple, right basilar crackles/wheezees, RRR
CA-Pneumonia: diagnosis

• Lower respiratory tract infection in a nonhospitalized person that is associated with symptoms of acute infection with or without new infiltrate on chest radiographs
CAP: diagnosis

- Temperature greater than 38°C (100.4°F)
- Cough with or without sputum, hemoptysis
- Pleuritic chest pain
- Myalgia
- Gastrointestinal symptoms
- Dyspnea

- Malaise, fatigue
- Rales, rhonchi, wheezing
- Egophony, bronchial breath sounds
- Dullness to percussion
- Atypical symptoms in older patients
CAP: etiology

- Strep pneumo
- H. flu
- Moraxella
- Atypicals: about 15%
CAP: treatment

• Choose inpatient v. outpatient
• Use Pneumonia Severity Index
• Category I and II can be treated as outpatient
• Category III will need inpatient observation
• Category IV and V need admission
CAP: treatment

CAP diagnosis

- Comorbidities present
  - No: Treat as outpatient
  - Yes: Assign a risk class (see Table 3)
    - Low risk class II and III
      - Preferred antibiotics
        - Macrolides (level A)
        - Fluoroquinolones (level A)
        - Doxycycline (Vibramycin)
      - Preferred antibiotics
        - Amoxicillin/clavulanate (Augmentin) (level A)
        - Beta-lactam (cefpodoxime [Vantin], cefprozil [Cefzil], cefuroxime [Ceftin]) (level A)
    - Moderate risk class IV and high-risk class V
      - Treat as inpatient
      - Preferred antibiotics
        - Intravenous beta-lactam (cefotaxime [Claforan] or ceftriaxone [Rocephin]) plus a macrolide (level A) or a fluoroquinolone alone (level A)
Case #5

Hx: Healthy 35 y/o male with painful, red lesion on left thigh. Started oozing yesterday. He tried to poke it with a pin. No fever but thigh is starting to hurt.

PE: T=98.6, left thigh w/ 3 cm tender, fluctuant abscess w/ surrounding erythema and early lymphangitis
MRSA Abscess: diagnosis

• Most skin abscesses are MRSA now
• Send off culture, especially if recurrent
MRSA Abscess: treatment

- I&D
- Antibiotics for purulent cellulitis, systemic symptoms, or large abscess
MRSA Abscess: treatment

- Clindamycin
- SMX/TMP
- Doxycycline
- Minocycline
- Linezolid
Questions???

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