Use of Antibiotic Prophylaxis for Trauma Procedures

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Objectives:
- Identify guidelines and review recommendations for antibiotic use in traumatic injuries
- Discuss different antibiotic options given a specific type of injury
- Name alternative antibiotics to use in patients with allergies
Antibiotic Prophylaxis for Trauma Procedures

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Critical Care Clinical Pharmacist
Shock Trauma ICU
Intermountain Medical Center
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- Discuss different antibiotic options given a specific type of injury
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Trauma Injuries and Infection Considerations

Open Fractures
Tube Thoracostomy
Penetrating Abdominal Trauma
Facial Fractures
Soft Tissue Injury
Open Fractures
Open Fractures

- Defined as a fracture where fragments communicate with the environment through a break in the skin
- Guidelines recommend narrow-spectrum antimicrobial prophylaxis
- Morbidity related to broad-spectrum antibiotics
  - Potential acute kidney injury with the use of aminoglycosides
  - Development of antibiotic resistance
  - Superinfections with multi-drug resistant (MDR) organisms

Hoff WS. *J Trauma.* 2011;70(3):751-754
## Gustilo Classification

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type I</strong></td>
<td>Open fracture with skin wound &lt; 1 cm in length and clean</td>
</tr>
<tr>
<td><strong>Type II</strong></td>
<td>Open fracture with laceration &gt; 1 cm in length without extensive soft tissue damage, flaps or avulsions</td>
</tr>
<tr>
<td><strong>Type III</strong></td>
<td>Open segmental fracture with &gt; 10 cm wound, extensive soft tissue damage or traumatic amputation (special categories include: gunshot fractures and farm injuries)</td>
</tr>
<tr>
<td><strong>III&lt;sub&gt;A&lt;/sub&gt;</strong></td>
<td>Adequate soft tissue coverage</td>
</tr>
<tr>
<td><strong>III&lt;sub&gt;B&lt;/sub&gt;</strong></td>
<td>Significant soft tissue loss with exposed bone that requires soft tissue transfer to achieve coverage</td>
</tr>
<tr>
<td><strong>III&lt;sub&gt;C&lt;/sub&gt;</strong></td>
<td>Associated vascular injury that requires repair for limb preservation</td>
</tr>
</tbody>
</table>

Gustilo RB. J Trauma. 1984;24(8):742-746
Updated in 2011

Systemic antibiotics should be initiated as soon as possible after injury

- Directed at gram positive organisms
- Given within 3 hours of injury
- Infection rates reduced from 7.4% to 4.7%
- Gram-negative coverage should be added for type III fractures
- Clindamycin should be added when fecal or clostridial contamination is suspected

Hoff WS. J Trauma. 2011;70(3):751-754
Patzakis MJ. J Orthop Trauma. 2000;14:529-533
Patzakis MJ. Clin Orthop Relat Res. 1989;246:36-40
Recommended antibiotics

- Type I and type II
  - Cefazolin
- Type III
  - Cefazolin + gentamicin or ceftriaxone alone

Duration

- Type I and type II
  - < 24 hours
- Type III
  - 72 hours after injury or not > 24 hours after soft tissue coverage achieved
Considerations

- Fluoroquinolones
  - No advantage compared to cephalosporin/aminoglycoside regimens
  - May impair fracture healing
  - May result in higher infection rates in type II open fractures
- Duration of prophylaxis > 72 hours
  - More likely to be harmful than beneficial

Hoff WS. J Trauma. 2011;70(3):751-754
Patzakis MJ. J Orthop Trauma. 2000;14:529-533
Patzakis MJ. Clin Orthop Relat Res. 1989;246:36-40
**Evidence based protocol for prophylactic antibiotics in open fractures: improved antibiotic stewardship with no increase in infection rates**

<table>
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<tr>
<th>Objective</th>
<th>To examine infection rates before and after implementation of an evidence based protocol with decreased use of aminoglycosides (AMG) and glycopeptide (vancomycin) antibiotics for open extremity fractures</th>
</tr>
</thead>
</table>
| Intervention | » Grade I – II  
  » Cefazolin or for penicillin allergy, clindamycin x 48h  
  » Grade III  
  » Ceftriaxone x 48h or for penicillin allergy clindamycin and aztreonam |
| Results | » No significant differences in baseline  
  » AMG and glycopeptide antibiotics were significantly reduced 53.5% vs. 16.4%  
  » SSI rate per fracture of 20.8% for the pre-protocol and 24.7% for the post-protocol (p=0.58)  
  » No difference in SSI with one or more resistant pathogens in the pre-protocol (16/21, 76.2%) and post protocol (13/18, 72.2%) cohorts  
  **No increase in SSIs caused by gram-negative bacteria or resistant pathogens, including MDR pathogens and MRSA**  
  » No significant differences seen in SSI |

Rodriguez L. J Trauma Acute Care Surg. 2014;77:400-408
Tube Thoracostomy
Thoracic Trauma

- Pneumothoraces and hemothoaces
  - Majority of thoracic injury
  - 85% managed with tube thoracostomy
- Empyema and pneumonia are potential complications post trauma
  - Increased length of stay, cost, and morbidity
- Prophylactic antibiotics recommended to decrease surgical wound infections
  - Administered BEFORE incision
- Traumatic hemopneumothorax
  - Pleural cavity has already been violated prior to the delivery of antibiotics

Guideline from 1998

- Sufficient evidence to recommend use of antibiotics in tube thoracostomy
- 1st generation cephalosporin
  - Cefazolin
- Limited to 24 hours
  - If given prior to tube placement

Moore FO. *J Trauma Acute Care Surg.* 2012;73:S314-344
Current guideline

- Do presumptive antibiotics reduce the incidence of empyema?
- If presumptive antibiotics reduce the incidence of empyema or pneumonia, what is the optimal duration of antibiotic prophylaxis?
Antibiotic prophylaxis in tube thoracostomy after chest trauma remains controversial

- **Timing of administration**
  - Not truly prophylactic
- Typically limited to 24 hours
- Usually a first generation cephalosporin
  - Adequate coverage for *Staphylococcus aureus*

Moore FO. *J Trauma Acute Care Surg.* 2012;73:S314-344
Recommendations

- Unable to recommend for or against the routine use of presumptive antibiotics in tube thoracostomy to reduce the incidence of empyema and pneumonia
- Unable to recommend optimal duration
  - Insufficient published data
- Remains controversial
  - Large multicenter RCT needed

Penetrating Abdominal Trauma
Penetrating Abdominal Trauma

- Prior to routine use of antibiotics for surgical site infections
  - Mortality rate 65% to 70%
- EAST first published guidelines in 1998 for the use prophylactic antibiotics
  - Decreased infection rates
- Updated in 2012 with new prospective literature to support recommendations

Goldberg SR. *J Trauma Acute Care Surg.* 2012;73:S321-S325
Duration of antibiotics

- Kirton et al. confirmed the 24 hour course
  - Compared ampicillin/sulbactam for 24 hours versus 5 days
    - No difference in infection rate
- Delgado et al.
  - Compared the duration of antibiotics after penetrating abdominal wounds associated with bowel injury and rates of infection
    - No reduction of infection rates when antibiotics were administered beyond 24 hours

Goldberg SR. J Trauma Acute Care Surg. 2012;73:S321-S325
Kirton OC. J Trauma. 2000;49:822-832
Timing of administration

- Best prevention of infection
  - Therapeutics doses to penetrate tissue before or at time of bacterial contamination
    - NOT in the trauma patient
    - Prompt administration of antibiotics prior to laparotomy for trauma OR as soon as feasible following gross contamination

Additional antibiotics for prolonged surgery

- No studies

Goldberg SR. *J Trauma Acute Care Surg.* 2012;73:S321-S325
Damage control laparotomy

- NO current literature addresses the role of prophylactic antibiotics when the abdomen is left open
  
  ➢ Further research needed

Mechanism of penetrating injury

- High energy (gunshot) or low energy (stab) forces antibiotics should NOT be continued for more than 24 hours when there is an intestinal injury

Goldberg SR. J Trauma Acute Care Surg. 2012;73:S321-S325
Dosing in hemorrhagic shock

- Dosage may need to be increased 2 to 3 fold AND repeated after every 10 units of blood transfused

Aminoglycoside use in trauma patients

- Pharmacokinetics of drug distribution is altered in the injured patient
  - Higher volume of distribution secondary to aggressive fluid resuscitation
  - Antibiotic dosing may need to be higher and given more frequently
Recommendations

- Single preoperative dose of prophylactic broad-spectrum antibiotics with aerobic and anaerobic activity should be administered to all patients with penetrating abdominal trauma.
- Up to 24 hours of prophylactic antibiotics in the presence and absence of a hollow viscus injury.
- Antibiotics may need to be repeated during massive transfusion.
- If possible, aminoglycosides should be avoided because of suboptimal activity in patients with significant injuries.

Goldberg SR. J Trauma Acute Care Surg. 2012;73:S321-S325
Facial Fractures
Maxillofacial Trauma

- Often communicate with the skin surface, oral cavities, or sinus cavities
  - Contaminated with endogenous flora
- Without the use of prophylactic antibiotics for surgical fixation
  - Incidence of infection is 10% to 15%
### The efficacy of postoperative antibiotic regimens in the open treatment of mandibular fractures: a prospective randomized trial

<table>
<thead>
<tr>
<th>Objective</th>
<th>To determine the necessity and/or effectiveness of postoperative antibiotics in the treatment of mandible</th>
<th>Prospective and randomized at a single institution</th>
<th>Underwent open reduction and internal fixation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention</td>
<td>Both groups received pre-op and intra-op antibiotics on the day of surgery</td>
<td>Post-op</td>
<td>No antibiotics</td>
</tr>
<tr>
<td>Results</td>
<td>81 patients received ABX vs. 100 with no ABX post-op</td>
<td>22 overall infections</td>
<td>8 infection in the treatment group</td>
</tr>
</tbody>
</table>

Miles BA. *J Oral Maxillofac Surg* 2006;64:576-582
Literature Review

- **2013 Zix et al. RCT**
  - 60 orbital blow out fractures requiring repair
  - 2/29 (7%) in 5 day and 1/31 in the 1 day group

- **2013 Schaller et al. RCT**
  - 62 mandibular fractures that extended into the alveolar regions
  - 6/30 (20%) 5 day vs 6/32 (19%) the 1 day group

- **2014 Soong et al. RCT**
  - 35 Le Forte and 50 zygomatic
  - 2 (4%) patients in each group

**Antibiotic prophylaxis for > 24 hours post-op does NOT contribute to the prevention of infection**

### Objective

Evaluate the influence of the duration of postoperative antibiotics (1 day vs. ≥ 5 days) on wound infections following surgical treatment of facial fractures.

### Fracture type

- Mandibular, zygomatic complex, Le fort I or II type, and orbital floor
- Zygomatic fracture 42%, orbital floor 33%, mandibular 23%, and Le Fort-type 1%

### Intervention

- 1 day (group A) amoxicillin/clavulanic acid 1.2 g IV q8 hr vs. ≥ 5 days (group B) postop prophylaxis antibiotic regimen
- PCN allergic patients received clindamycin 600 mg IV q8 hr

### Results

- 125 patients 1 day vs. 214 ≥5 days
- 12 patients got post-op infections, 5 in group A and 7 in group B
- 11 in mandibular fxs and 1 in zygomatic complex fxs

Prolonged postoperative prophylactic antibiotic use in facial fractures does not have a significant benefit in reducing the incidence of infections ($p = 0.77$)

Mottini M. *J Trauma Acute Care Surg.* 2014;76:720-724
Skin and Soft Tissue Injury
Road Rash/Soft Tissue Injury

- Prophylactic antibiotics will not reduce the overall rate of infection
  - Risk for resistant pathogens
- No randomized trials have demonstrated a benefit of antibiotics for simple wounds
- Wounds that are grossly contaminated and cannot be adequately cleaned
  - Antibiotic prophylaxis IS recommended
- Treatment of choice
  - 1st generation cephalosporin
  - 3-5 days of therapy
  - Debridement

Moran GJ. Infect Dis Clin Am 22;2008:117-143
High Risk Trauma Wounds

- Immunocompromised
- Joint wounds
- Grossly contaminated wounds that cannot be adequately cleaned
- Wounds with significant delay (>18 hours) before presentation
- Retained foreign body
- Puncture wounds
- Crush injuries
- Bite wounds
- Oral wounds

Moran GJ. *Infect Dis Clin Am* 22;2008:117-143
# 2014 IMC Guideline

<table>
<thead>
<tr>
<th>Abdominal Trauma</th>
<th>Antibiotic/Dose/Schedule</th>
<th>Duration</th>
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</table>
| Preoperative     | Ertapenem 1 g IV Q 24 hrs  
OR  
Pipericillin-tazobactam 3.375 g IV loading dose over 30 min followed by 3.375 g IV infused over 4 hrs Q 8 hrs  
*(Begin 4 hrs after loading dose)* | No presence of hollow viscus injury or contamination, no further doses  
Presence of hollow viscus injury or contamination, continue for 24 hrs  
Give dose within 60 min of incision |

<table>
<thead>
<tr>
<th>Extra-abdominal Trauma</th>
<th>Antibiotic/Dose/Schedule</th>
<th>Duration</th>
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<tbody>
<tr>
<td>Gustilo Grade I or II open extremity fractures (preoperative, as soon as possible after injury)*</td>
<td>Cefazolin 2 g IV Q 8 hrs†</td>
<td>Until 24 hrs after wound closure or 72 hrs total, whichever occurs first</td>
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</table>
| Gustilo Grade III open extremity fractures (preoperative, as soon as possible after injury)* | Cefazolin 2 g IV Q 8 hrs†  
Gentamicin 6 mg/kg IV Q 24 hrs‡ | Until 24 hrs after wound closure or 72 hrs total, whichever occurs first |
| Open extremity fractures with suspected fecal/clostridial contamination (farm-related injury) | Cefazolin 2 g IV Q 8 hrs† plus  
Gentamicin 6 mg/kg IV Q 24 hrs‡ plus  
Clindamycin 900 mg IV Q 8 hrs | Until 24 hrs after wound closure or 72 hrs total, whichever occurs first |
| Open facial fractures | Cefazolin 2 g IV Q 8 hrs† | 72 hrs |
| Chest tube (insertion) | Cefazolin 2 g IV push over 5 min | Once, prior to insertion (if possible) |
| Large soft tissue injury | Cefazolin 2 g IV Q 8 hrs† | 48 hrs |
| Alternatives if patient has allergies to above antibiotics | Clindamycin 900 mg IV q8hrs, instead of cefazolin  
Ertapenem 1 g IV Q 24 hrs, instead of gentamicin |  |

† In obese patients weighing > 120 kg, consider using 3 g cefazolin

‡ In obese patients weighing >120% ideal body weight (IBW), consider using gentamicin based on adjusted body weight (ABW)  
ABW = IBW + 0.4(TBW-IBW)
Take Home

- Use a first generation cephalosporin (cefazolin) for prophylaxis
- Give antibiotic as soon as possible
- Only use aminoglycosides if necessary
- All prophylactic antibiotics should be discontinued within 72 hours
Questions
Pharmacists: Receiving CE Credit

- CE provided by the California Society of Health-System Pharmacists
- Log-in to http://ihc.cshp.wcea.education (First time only: create account)
- Do not use Internet Explorer as your browser
- Click ‘Add Live Event’ on left menu
- Enter Secret Code (case-sensitive): Y e n J
- Then ‘Validate Code’
- Answer “No” to exam and upload certificate questions
- Choose ‘Fill Out’ for Evaluation Statement
- Complete evaluation and click ‘Save Changes’
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