

## Indications for use of antibiotics in equine wounds

What, when, which, how?

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### **What** are we treating – pathogens

TABLE 7-3. Common Bacterial Isolates in Horses

Disease Process	Bacterial Isolates
Orthopedic surgery	Enterobacteriaceae, <i>Staphylococcus</i> , <i>Streptococcus</i> , <i>Pseudomonas</i>
Cellulitis	<i>Staphylococcus</i> , <i>Streptococcus</i>
Chronic wounds	<i>Pseudomonas</i> , <i>Staphylococcus</i> , <i>Serratia</i> , <i>Enterococcus</i> , <i>Providencia</i>
Enterocolitis	<i>Salmonella</i> , <i>Clostridium</i>
Iatrogenic septic arthritis	<i>Staphylococcus aureus</i>
Wounds	<i>Streptococcus</i> , <i>Staphylococcus</i> , Enterobacteriaceae, <i>Pseudomonas</i> , and anaerobes
Peritonitis after abdominal surgery	<i>Streptococcus</i> , Enterobacteriaceae, <i>Actinobacillus</i> , anaerobes
Penetrating wounds to synovial structures	Enterobacteriaceae, anaerobes
Septic physitis/arthritis (foals)	<i>Escherichia coli</i> , <i>Rhodococcus equi</i>
Paranasal sinus and guttural pouch	<i>Streptococcus equi</i> subsp. <i>equi</i> , <i>Streptococcus zooepidemicus</i> , <i>Aspergillus</i> , <i>Cryptococcus</i>

Auer & Stick (eds), Equine Surgery, 3rd ed., 2015

## When is antimicrobial therapy necessary?

- Perioperative antimicrobial therapy when:
  - Risk of SSI > 5 %
  - SSI will have catastrophic consequences

## When is antimicrobial therapy necessary?

TABLE 7-2. Classification of Surgical Wounds

Classification	Criteria
Clean	Plective, primarily closed, and undrained Nontraumatic, uninfected No break in technique No inflammation encountered Respiratory, alimentary, genitourinary tracts not entered
Clean-contaminated	Gastrointestinal or respiratory tracts entered without significant spillage Oropharynx entered Vagina entered Genitourinary tract entered in absence of infected urine
Contaminated	Minor break in technique Major break in technique Gross spillage from gastrointestinal tract Entrance of genitourinary tract or biliary tract in presence of infected urine or bile
Dirty	Transsection of "clean" tissues for the purpose of surgical access to a collection of pus Entrance of genitourinary tract or biliary tract in presence of infected urine or bile Entrance of genitourinary tract or biliary tract in presence of infected urine or bile

SSI rate, 'classical'	SSI rate, Ortega et al., J. Surg. Res. 2012
< 2 %	2.58 %
4-10 %	6.67 %
> 20 %	8.61 %
> 40 %	11.80 %

Auer & Stick (eds), Equine Surgery, 3rd ed., 2015

## **When** is antimicrobial therapy necessary?

- Perioperative antimicrobial therapy when:
  - Risk of SSI > 5 %
    - Clean-contaminated procedures (prophylactic use)
    - Contaminated procedures (prophylactic use)
    - Dirty procedures (curative use)
    - Clean procedures with implant
  - SSI will have catastrophic consequences
    - Clean procedures with implant

NB: correct debridement and lavage will **'upgrade'** the wound's classification

## **Which** antimicrobial drugs?

- Most often penicillin alone, ampicillin, cephalosporins (ceftiofur or cefquinome) or penicillin + aminoglycoside (gentamycin, amikacin)
- Based on results of bacteriological culture results (?)

## How are antimicrobials used correctly for perioperative wound treatment?

### • Correct preoperative use

- Correct dosage
- IV route preferable
- Within 30-60 minutes of incision
- Redose at 2 x T<sub>1/2</sub>
- Pre- and intraoperative use
  - Prophylactic antimicrobial compared to no use of prophylaxis (JAMA, Infect. Dis., 2007)

Antimicrobial Drug	Dose Range	Half-Life (t <sub>1/2</sub> )
Potassium Penicillin G	22,000–44,000 IU/kg	40 minutes <sup>34</sup>
Gentamicin	6.6–8.8 mg/kg	—
Ceftiofur <sup>a</sup>	2.2–5.0 mg/kg	189 minutes <sup>36</sup>
Procaine Penicillin G	25,000 IU/kg	19.7 hours <sup>35</sup>
Cefazolin	11.0–22.0 mg/kg	46 minutes <sup>40</sup>
Ampicillin	15.0–20.0 mg/kg	120 minutes <sup>41</sup>
Enrofloxacin	5.0–10.0 mg/kg	—
Metronidazole	15.0–25.0 mg/kg	—
Ticarcillin-clavulanate <sup>b</sup>	50.0 mg/kg	60 minutes <sup>42</sup>
Amikacin	15.0–25.0 mg/kg	—
Oxytetracycline <sup>c</sup>	6.6 mg/kg	12.95 hours <sup>43</sup>

on rate  
ellinger, Clin.

### • Correct postoperative use

- Absolutely no evidence for continuation for 24-48 hours
- Curative use may continue for 3-10 or more days postoperatively

Dallap-Schaer *et al.*, JVIM, 2012

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## How may antimicrobials be administered?

- Systemically
  - PO, IM, IV (jugular vein)
  - Intravenous regional limb perfusion
- Intraosseous perfusion
- Intrasyovially
- Other local administration
  - Antibiotic-impregnated beads (PMMA, plaster of Paris)
  - Antibiotic-impregnated sponges
  - Topical products (creams etc.)

## Intravenous regional limb perfusion

- Occlude venous return from injured/infected area
- Infuse antibiotics in superficial vein
- Place tight wrap over injection site and leave on for 10-30 minutes
- Repeat every 1-3 days



Photo courtesy of P. Pollock

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Photo courtesy of P. Pollock

## Intravenous regional limb perfusion

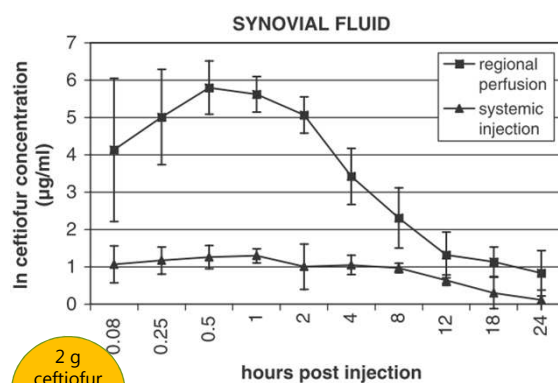
- Occlude venous return from injured/infected area
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Photo courtesy of P. Pollock

## Intravenous regional limb perfusion

- VERY high tissue concentrations of antibiotic achieved
- Concentrations may remain above MIC for ~ 24 h
- Tolerated reasonably well → repeated treatments possible
- Simple technique that may be used in the field



2 g  
ceftiofur  
@ 50  
mg/mL

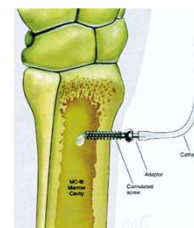
Pille *et al.*, Vet. Surg. 2005

## Intravenous regional limb perfusion

- Gentamycin
  - 1 g.
  - 30-60 mL sterile saline
  - No local analgetics (gentamycin pH dependent)?
- Ceftiofur
  - 1 g.
  - 20-50 mL sterile saline
  - 200 mg mepivacaine
  - NB: risk of precipitation
- Repeat as needed
  - Median is 5-7 times (range 1-21 times), Kelmer *et al.*, Vet. Surg. 2012; Rubio-Martinez *et al.*, JAVMA 2012
- Frequency and duration dictated by severity and 'accessibility' of infection
  - Horse behaviour, tolerance and occurrence of complications

## Other methods for local and regional antimicrobial therapy

- Intrasynovial administration
  - Gentamycin (150-500 mg/joint)
  - Amikacin (250-500 mg/joint)
  - Ceftiofur (150-500 mg/joint)
  - Penicillin (2-5 mill. IE/joint)
- Intraosseous infusion
- Antibiotic-impregnated beads
- Antibiotic-impregnated sponges



Take-home message: antimicrobials can never stand alone in wound treatment



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STINE JACOBSEN LECTURE NOTES



Take-home message: antimicrobials can never stand alone in wound treatment



Treatment incl. antimicrobials for this wound?

- Wound diagnosis
  - Acute, minimal contamination, sharp edges, no contusion, no critical structures involved
- Treatments
  - Debridement & lavage
  - Primary closure
  - 1 dose of IV penicillin before surgery
  - NSAID before and 3 days after surgery
  - Large, compressive bandage for 21 days



## Treatment incl. antimicrobials for this wound?

- Wound diagnosis
  - Chronic, healing by second intention, large amounts of tenacious exudate on the surface of the granulation tissue
- Treatment
  - Remove exudate
  - (Debride surface of granulation tissue)
  - Skin graft or dressings
  - Topical treatments (antimicrobial, antiinflammatory)
  - Systemic antibiotics not useful



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### The Efficacy of Systemic Antibiotics in the Treatment of Granulating Wounds

MARTIN C. ROBBAN, M.D., LEE E. EDSTROM, M.D.,  
THOMAS A. KRIZEK, M.D., AND MARLENE G. GOSKIN, B.A.



## Treatment incl. antimicrobials for this wound?

- Wound diagnosis
  - Chronic wound, dehiscence after suturing, dirty
- Treatment
  - Clip hair and remove exudate
  - Topical treatments or packing (antimicrobial?)
  - Systemic antibiotics not useful



## Treatment incl. antimicrobials for this wound?

- Wound diagnosis
  - Acute, sharp laceration, severe edema, severed extensor tendons, exposed bone
- Treatment
  - Debridement and lavage (soft tissues and bone cortex)
  - Primary closure
  - 1 dose of IV penicillin before surgery, 48 h of penicillin after surgery
  - NSAID before and 3 days after surgery
  - Splint bandage approx. 4 weeks



## Treatment incl. antimicrobials for this wound?

- Wound diagnosis
  - Wound with (or suspected of) joint penetration
- Treatment (preparation for referral)
  - Clip and clean wound surroundings
  - Broad spectrum, systemic antibiotics
  - Intrasynovial antibiotics
  - Sterile bandage



## Conclusions

- Guidelines mostly derived from human medicine, no hard and fast evidence from equine medicine
- Differentiate prophylactic from curative use of antimicrobials
- Limited evidence for efficacy of prophylactic antimicrobials
- In orthopedic infections, local/regional antimicrobial techniques are useful
- Systemically administered antimicrobials do not penetrate granulation tissue

THANK YOU FOR YOUR ATTENTION