Problem Based Learning Academic Sessions for Students, Residents and Fellows
University of New Mexico
Department of Orthopaedics and Rehabilitation
Center for Healing In the Lower Extremity (CHILE)

Introduction

On behalf of the fellows and faculty of Orthopaedics, I would like to extend you a warm welcome to the UNM-CHILE! As David Armstrong of the University of Arizona, Southern Arizona Limb Salvage Alliance (SALSA) once said, “Any treatment rendered to the deformed, insensate foot should be undertaken with the prime intentions of reducing the potential for future limb-threatening events and allowing the patient to continue as an ambulatory, productive member of society.” I consider it a tremendous privilege to take part in the care of this patient demographic. I hope that you gain a great appreciation and respect for the work of limb salvage, as I have. Please contact me if you have any questions or concerns.

Cheers!

Eric Lew, DPM
University of New Mexico
Department of Orthopaedics and Rehabilitation
Co-director, Center for Healing In the Lower Extremity
ejlew@salud.unm.edu
515-783-6791

Learning Objectives

- Learn the role of Podiatry or “Toe” as an inpatient and outpatient service in the limb salvage setting
- Be able to collaborate with Vascular Surgery or “flow” among other services and employ a team approach to limb salvage
- Understand and recognize the co-morbid factors that threaten a limb for complications
- Learn to diagnose, stage or classify a diabetic foot infection (including osteomyelitis and puncture wounds) and offer appropriate operative and non-operative treatment
- Learn to diagnose, stage or classify peripheral arterial disease.
- Understand the utility of the various non-invasive vascular studies including indications for ordering them and interpretation
- Be able to implement the principles of wound healing and offloading
- Infectious Disease/Microbiology: understand the characteristics of certain pathogens, virulence and how to obtain a reliable culture
- Understand antibiotic therapy, selection, mechanism of action, and side effects.
- Recognize and diagnose acute and chronic Charcot neuroarthropathy and offer appropriate non-operative and operative treatment

Suggested Reading Material

• Lavery LA et al; Prediction of Healing for Postoperative Diabetic foot Wounds Based on Early Wound Area Progression, 2008 Diabetes Care 31:26-29
• Lipsky BA Treating diabetic foot osteomyelitis primarily with surgery or antibiotics: have we answered the question? Diabetes Care. 2014 Mar;37(3):593-5. doi: 10.2337/dc13-2510.
• Timothy K. Fisher, DPM, Christy L. Scimeca, DPM, Manish Bharara, PhD, Joseph L. Mills Sr, MD, David G. Armstrong, DPM, MD, PhD, A step-wise approach for surgical management of diabetic foot infections, Journal of Vascular Surgery 2010, (52) 125
• Armstrong DG et al. Activity Patterns of Patients with Diabetic Foot Ulceration. Diabetes Care, 2003: 26 2595-2597
• Rogers LC et al, The Charcot Foot in Diabetes, Diabetes Care 2011(34): 2123-2129
• Barshes NR et al, The system of care for the diabetic foot: objectives, outcomes, and opportunities. Diabetic Foot and Ankle 2013: 4 21847
• M Pinzur et al, Amputations at the middle level of the foot. A prospective review. 1986 JBJS: 68 (1061-1064)
• Lawrence LA, Probe-to-Bone Test for Diagnosing Diabetic Foot Osteomyelitis, Reliable or Relic? Diabetes Care, 2007, 30 (2)
• Wukich DK, Charcot arthropathy of the foot and ankle; modern concepts and management review. Journal of Diabetes and Its Complications 2008

Other Helpful Sources
• http://iwgdf.org/guidelines/
• https://diabeticfootonline.com/

Week 1 Topics: Introductory Material and Article Discussions
• Review of WIfI article
• Review of Comprehensive Foot Exam and Risk Assessment
- Review 3- Minute diabetic foot exam
- Pediatric indications and reasons for hospital admission
- Non-invasive Vascular Studies
- Invasive Vascular Procedures
- Principles of Wound Healing and Offloading

**Week 2 Topics: Antibiotics, Diabetic Foot Infection, Osteomyelitis**
- Use case examples to discuss topics (from patients on service or may use case examples below):

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**Case 1**
HPI: A 59 diabetic male patient presents to the ED with an ulcer that looks infected. He c/o callous on the dorsum and tip of toe, weakness and fatigue. This is painful and sore, and has increased redness, drainage and swelling x 3 days. He requires help to get to the treatment. He c/o fever, chills, fatigue, and weakness. He denies any chest pain, sob, cough, nausea or vomiting.
PMH: DMII x 16 yrs, peripheral neuropathy, high cholesterol, HTN, PAD
Meds: Insulin, simvastatin, Plavix, Lisinopril, Gabapentin
PSH: Appendectomy 1974, Hernia 1981, Right femoral bypass
Allergies: NKDA
Family: Stroke, DM, PAD
Social: Tobacco, Alcohol, SSDI, Married w/ children
Vitals: 100.2, 167/89, 58, 16
ROS: fever, chills, weakness and fatigue
PE: HEENT: EOMI, PERRLA
   - Neck: ROM WNL, No JVD
   - Lungs: CTAB
   - Cardo: RRR, no murmur
   - Abd: soft, non-tender, bowel sounds x4 quad.
   - Vascular: no pedal pulses, biphasic waveforms
   - Derm: 1st and 3rd digit ulcerations, no odor, purulent discharge. Bone of head of middle phalanx is exposed. X-ray-distal phalanx is eroded
Labs:  HgB: 10.2, Hct: 30.1, Platelets: 150,000, WBC: 11,000; no left shift, Glucose: 376, BUN: 20,
Creatinine: 1.5 (high)
Gram Stain: Many PMN’s, Many G + cocci clusters, Few G – Rods
Microbiology: Klebsiella pneumonia, staphylococcus Aureus (MSSA), Viridans Streptococci
Assessment: DMII ulceration, Osteomyelitis, Renal insufficiency

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**Questions/Topics to discuss**
1. What labs do you want to order? Be able to Interpret results. What is the meaning of “left shift”?
2. What does leukocytosis indicate? CBC with Diff, what is left shift? Why is it important? What is absolute neutrophil?
3. How do you identify kidney insufficiency or failure?
4. How do you recognize, diagnose peripheral arterial disease (PAD)? What is the significance of calcified vessels? What are the two types of vascular calcification and what is their etiology?
5. What imaging do you want to order? When do you order an MRI?
6. When and how do you obtain a culture?
7. What is a Gram Stain? Why are PMN’s important? How does it direct treatment?
8. What is empiric antibiotic therapy? What is the drug of choice? Discuss antibiotic treatment and duration.
9. Describe and discuss Antibiotics: PCNs, Cephalosporins Use and dosages
10. Look up articles and discuss Osteomyelitis. What labs are used to help diagnose osteomyelitis? What constitutes a “bone biopsy?”
11. Plan: How do you know when to admit a patient? Write Admission Orders:
12. Discuss surgical Plan, wound closure, and post-op course
   a. A step-wise approach for surgical management of diabetic foot infections (look up article by Fischer, 2010 )

**Week 3 Topics: Puncture Wounds, septic arthritis**

- Use a case example from service or below as follows to learn the topics

**Case 2**
Cc: “I have a nail in my foot”
HPI: 35 y/o male presents to Ed with complaint of nail in foot. Shot the nail into his foot. 1 hour s/p. c/o pain to 1st met head pain. No c/o of f/c/n/v/sob/chest pai/calf pain
Vitals: BP: 135/85, respirations: 25, Pulse: 100. Temperature: 99.8 F
PMH: DM II 5 yrs , cholesterol 7 yrs
PSH: n/a
Allergies: n/a
Family: DM, HTN, MI, Alcoholism
Social: roofer/construction, on feet all day, smoker, no sure about tetanus, alcohol, no illegal drugs
Meds: metformin, Zocor
ROS: non-contributory
General: Alert and oriented
Eyes, lungs, heart, normal Abdomen
Nail extrudes from the first met head, no cellulitis, normal healthy looking foot.
X-ray: dorsal medial to plantar lateral through the first metatarsal head. Goes through joint.

**Questions/Topics to Discuss**
1. Puncture wounds and normal lab values (look up Lavery article)
2. MRI imaging of puncture wounds
   a. What is best study to find each foreign body (wood, plastic, metal, etc)
3. What are common bacterial pathogens in puncture wounds?
4. Surgical risk of amputation following puncture wound (Armstrong and Lavery article)
5. Discuss Tetanus prophylaxis
6. Describe puncture wound classification systems
7. Antibiotics: Fluoroquinolones, Bactrim, Aminoglycosides, Macrolides, Nitromidazoles, cyclolipopeptides, (discuss MOA, dosage, side effects, etc)
8. Microbiology: Pseudomonas, Actinobacter baumannii, Aeromonas hydrophilia, Eikenella corrodens, Pasteurella multocida, Stenotrophomonas maltophilia, bacteroides, enterobacter, E. coli, Proteus, morganella morganii, (discuss characteristics, virulence, and DOC)
9. Discuss hematogenous osteomyelitis: etiology
10. Discuss septic arthritis: etiology, clinical presentation, labs, treatment other differentials
11. Discuss direct extension osteomyelitis: etiology, clinical presentation, classification
12. How to differentiate between osteomyelitis and charcot neuroarthropathy?
13. Discuss MRI diagnosis of osteomyelitis? Bone Scintigraphy?

**Case 3**
HPI: 40 y/o male admitted to ED. Pain to left ankle for one week with swelling and discoloration, no history of trauma, getting worse. Did have previous ankle fracture, but healed uneventfully
PMH: DMII x 10 yrs, old fx of the left ankle years ago, A-fib
Medications: Insulin NPH 70/30 30 U am and 40 U pm, Toprol XL 50 mg daily, Zocor 20 mg daily, Coumadin 5 mg
Social: nonsmoker, non drinker, unemployed single, lives with mother, tetanus up to date
PSH: unremarkable, wisdom teeth removed
ROS: no recent weight change, mildly weak and fatigued, diarrhea, for last 2 days no chest pain or SOB
Vitals: temp: 101.5, PB: 100/67 Pulse 81 bpm R: 18 (since pulse is 81, bp should be higher, he’s not on toprol)
Lungs: clear
Abdomen, soft non tender
Heart: irregular rate and rhythm
Ankle: redness with a patch, swollen, lymphangitis, increased warmt, no open lesions, warm, (we suspected a bite)
Labs: WBC: 18.8, Hgb: 12, Hct: 37, Platelet:110,000, Sodium 126, Potassium 3.9, Bun: 32, Creatinine: 1.9, Glucose: 633
X-ray: Fib has fracture: new, pathological
    Joint erosion (classic septic joint-end stage
    Joint effusion
    Gas along lateral malleolus
    Talar body is diminished
Assessment: end stage septic joint
Treatment: can control glucose, circulation is ok
Concerning: peiosteal reaction of tibia
Admit: I/D: prevent further sepsis and drain the abscess out.
Blood Culture, Gram Stain: G _ cocci clusters (Final: MRSA)
Abx: Vancomycin
Goal: manage sepsis
Surgical Management: 1) Resect bone, manage deadspace, , obtain wound closure  2) 2nd surgery (ex-fix) to maintain length 3) 3rd surgery – reconstruction
Post op management: Patient now ambulates in CROW boot.

Questions/Topics to discuss:
1. Fever Curves
   a. Types
   b. Fever of unknown origin
2. Blood Cultures
   a. Timing
   b. Sites
3. Coumadin
a. Surgical management of a patient on Coumadin: discontinue warfarin,
b. How many days to stop:
c. INR: What level is safe for surgery
d. When to use lovenox, protocol? IV heparin for patients?
e. Proper use of FFP or Vitamin K, when to order?

4. Antibiotics: **Linezolid**, Ertapenem (Invanz), Acinetobacter, Tigecycline (tygacil); cubacin, vancomycin, corynebacteria, Imipenem/Cilastatin (primaxin), Clindamycin; outpatient oral for

5. Microbes: Staph, epidermidis, Staph. Aureus, strep pyogenes/agala. enterococcus faecalis:peptostreptococcus, peptococcus, clostridium perfringensclindamycin, cephalosporin

6. Management of surgical dead space
   a. S/p incision and drainage
   b. Ways to manage a surgical dead space
   c. Elution kinectis application to antibiotic beads

7. Discuss Negative Pressure Wound Therapy:
   a. How does it work
   b. Instillation

**Week 4 Topics:** Diabetic Foot Surgery, Charcot Reconstruction, prosthetics/orthotics, partial calcaneotomy, amputations, tendon transfers, etc.

- **Case 4:** Keller Arthroplasty, vs HIPJ arthroplasty
- **Case 5:** **Total tibialis anterior tendon transfer, TAL**
- **Case 6:** STSG
- **Case 7:** **pan metatarsal head resections**
- **Case 8:** “sequential reduction and “floating” lesser metatarsal osteotomy
- **Case 9:** Skin Flap, Plastic

**Questions/Topics to Discuss:**
1. Classify Diabetic Foot Surgery (Discuss Armstrong and Fryberg article)
2. Discuss techniques of tendon transfers, tenotomies, osteotomies, PMHR, arthroplasties, TAL, etc.
3. Discuss conservative bracing options for various deformities (pes planus, charcot collapse,
4. Discuss indications for Charcot Reconstruction for both midfoot and rearfoot.
5. Discuss diabetic foot trauma
   a. Necrotizing Fasciitis
   b. Ankle Fractures
   c. Charcot
6. Discuss Surgical techniques for Midfoot Charcot and Hindfoot Charcot reconstruction