Diabetic Foot Osteomyelitis

Diagnosis and Treatment

Associate Professor M. Bulent Ertugrul

University of Adnan Menderes, School of Medicine

Department of Infectious Diseases and Clinical Microbiology

Nude – Pierre Auguste Renoir (Philadelphia Art Museum)

Osteomyelitis in the diabetic foot

- ~20% of all patients presenting with an infected foot ulcer have an underlying bone infection
- ~2/3 of patients hospitalized for severe foot infection have osteomyelitis

Lipsky BA. *Clin Infect Dis* 1997;25:1318-26
Lipsky BA. *Clin Infect Dis 2012*;54:132-73
Lipsky BA, *et al. Plast Reconstr Surg.* 2006;117(7 Suppl):212S-238S

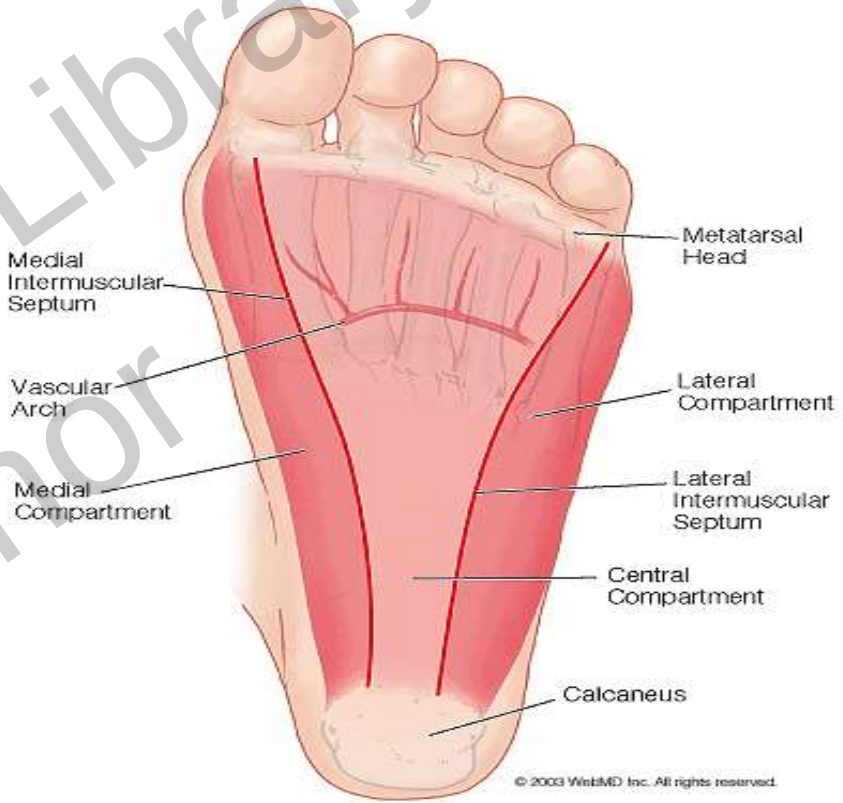
CASE

- 53 year-old, ♂
- Diabetes duration: 11 years
- Ulcer on plantar surface left 2nd toe: 3 months ago
- Initial therapy given by another clinic: ampicillin/ sulbactam (30 days)
- Healing following the treatment
- Reinfection 2 weeks ago, worsening of lesion despite second course of oral ampicillin/ sulbactam
- Hospitalization in our clinic following outpatient visit

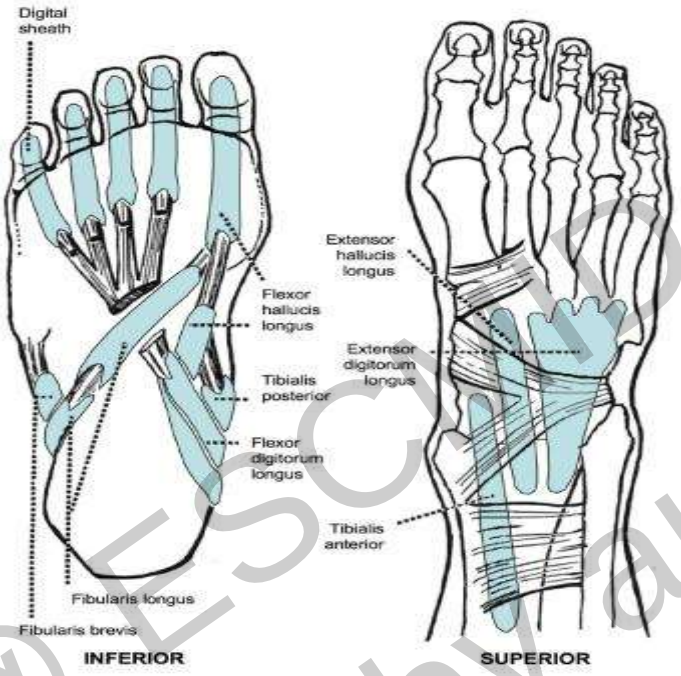
Physical examination

- Fever: 38.8° C
- Respiratory rate: 28/min.
- Pulse rate: 96/min.
- Necrotic and malodorous wound on the left foot

Compartments of foot



Tendon sheaths



Laboratory findings

- Leucocyte count: 18,230/ mm (PMN 87%)
- Hemoglobin: 9.8 g/dL (range: 13.6-17.2 g/dL)
- CRP: 236 mg/dL (range: < 6 mg/dL)
- ESR: 98 mm/h
- Procalcitonin: 2.19 ng/dL (range: < 0.5 ng/dL)
- Fasting glucose: 253 mg/dL (range: 70-105 mg/dL)
- Creatinine: 1.25 mg/dL (range: 0.7-1.3 mg/dL)

Question 1

- Which grade does the case belong according to the PEDIS/IDSA classification?

a. Grade 1 (uninfected)

b. Grade 2 (mild infection)

c. Grade 3 (moderate)

d. Grade 4 (severe)

Findings to be considered in the classification

- Presence of infection?
- Presence of deep abscess or compartment syndrome?
- Presence of osteomyelitis?
- Presence of SIRS?

Pierre Julien Paulien (1731-1804)
Dying Gladiator (1779) – Louvre Museum

Physical examination

- Fever: 38.8° C
- Respiratory rate: 28/min.
- Pulse rate: 96/min.
- Necrotic and malodorous wound on the left foot

Laboratory findings

- Leucocyte count: 18 230/ mm (PMNL 86.6%)
- Hemoglobin: 9.8 g/dL (range: 13.6-17.2 g/dL)
- CRP: 236 mg/dL (range: < 6 mg/dL)
- ESR: 98 mm/h
- Procalcitonin: 2.19 ng/dL (range: < 0.5 ng/dL)
- Fasting glucose: 253 mg/dL (range: 70-105 mg/dL)
- Creatinine: 1.25 mg/dL (range: 0.7-1.3 mg/dL)

Question 1

- Which grade does the case belong to according to the PEDIS/IDSA classification?

a. Grade 1 (uninfected)

b. Grade 2 (mild infection)

c. Grade 3 (moderate)

d. Grade 4 (severe)

Question 2

Does this patient have osteomyelitis? If so, how can it be diagnosed?

a. Physical examination
b. Probing to bone
c. Plain radiography of the foot
d. Magnetic resonance imaging
e. Culture/histopathological examination of bone

Diagnosis of osteomyelitis

- Physical examination
- Probing to bone
- Laboratory examinations
  - ✓ Biochemical
  - ✓ Microbiological
  - ✓ Pathological examinations of bone tissue
- Plain radiography of the foot
- High resolution ultrasonography
- 3/4phase leucocyte labelled scintigraphy
- Magnetic resonance imaging

Ertuğrul MB. J *Klimik* 2009;22(Supp 1)
Ertuğrul MB. *Türkiye Klin. G Cer* 2010;3(1):46-56

History and Physical examination

Variables		Osteomyelitis		P
		Yes	No	
	N=78	n=48	n=30	
Previous hospitalization	Yes (51)	26	25	0,017
	No (27)	22	5	
	N=76	n=46	n=30	
Wound depth	Grade 1	6	15	<0,001
	Grade 2	33	15	
	Grade 3	7	0	
	N=75	n=48	n=27	
Duration DFI (median, d [25% – 75%])		30 (20 – 63,8)	17,5 (10 – 32,59)	0,007
Wound size (cm^2) median [25% – 75%])		7,5 (3,75 – 15)	3 (2 – 6,25)	0,003

Wound size ≥4.5cm^2 significantly associated with presence of osteomyelitis (p=0.041, OR=2.8)

Ertugrul BM. et al. *Eur J Clin Microbiol Infect Dis.* 2012;31(9):2345-52.

Physical examination

Ertugrul MB. et al.. J *Klimik* 2004;17(1):3-12

Diabetic foot osteomyelitis vs. Charcot osteoarthropathy

Charcot osteoarthropathy

- Tarsometatarsal joint involvement
- Intact skin
- Minimal changes in deep tissues

Osteomyelitis

- Distal metatarsal joint involvement
- Ulcer/wound of skin
- Abcess formation in deep tissues

Ertuğrul MB, Baktıroğlu S. J *Klimik* 2005;18(1):8-13

Diabetic foot osteomyelitis vs. Charcot osteoarthropathy

Ertuğrul BM, Lipsky BA, Savk O. *Diabetic Foot & Ankle* 2013;4:21855

Probing to bone

Probing to bone for diagnosing Diabetic Foot Osteomyelitis

Reference	No. Patients (Ulcer type)	Sensi-tivity (%)	Speci-ficity (%)	PPV (%)	NPV (%)	Preva-lence (%)
Grayson et al	76 (I)	66	85	89	56	66
Shone et al	81 (A)	38	91	53	85	24
Lavery et al	247 (A)	87	91	57	98	12
Morales Lozano et al	132 (I)	94	98	95	91	80
Aragon-Sanchez et al	327 (I)	95	93	97	83	74
Mutluoglu et al	65 (I)	66	84	87	62	60

A=All diabetic foot ulcers; **I=Infected** ulcers only; PPV= positive predictive value; NPV= negative predictive value; prevalence= the percent of patients studied who had osteomyelitis

Ertugrul BM, Lipsky BA, Savk O. *Diabetic Foot & Ankle* 2013;4: 2185

Inflammatory Markers of DFO

- Highly elevated ESR level (>70 mm/h) increases the likelihood of DFO

Kaleta JL *et al. J Am Podiatr Med Assoc* 2001;91:445-50
Malabu UH *et al. West Afr J Med* 2007, 26:113-116

ESR & Wound Size for Diagnosing DFO

ESR (mm/h)	Sensitivity	Specificity	PPV	NPV
ESR ≥65 + Wound size ≥2 cm	83	77	80	81
ESR ≥70 + Wound size ≥2 cm	79	82	83	78

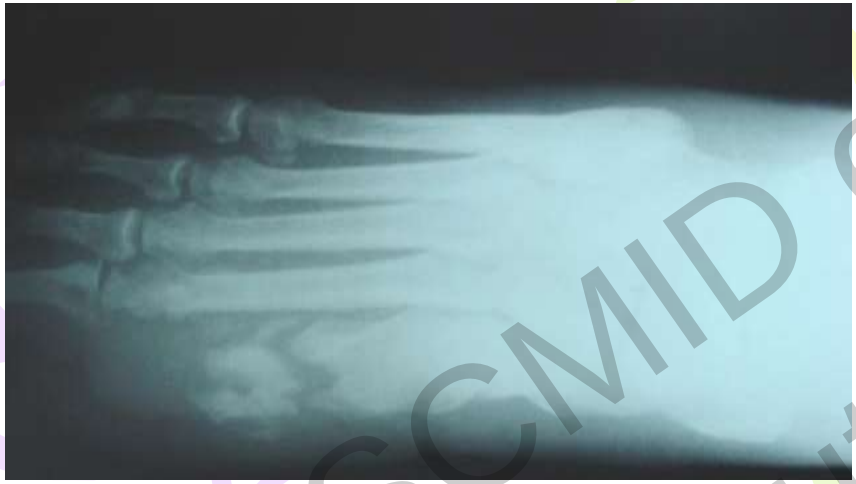
Ertuğrul MB *et al. Med Sci Monit* 2009;15(6):CR307-12

Imagine tecniques in DFO

Imaging technique	+ LR	– LR
Plain radiograph	2.3	0.63
MRI	3.8	0.14
18F-FDG PET	5.6	0.4
^{99m}Tc / ^{111}In labelled-leukocytes scans	4.73 / 2.31	0.12 / 0.38
^{99m}Tc or ^{67m}Ga SPECT/CT	3.0	0.18
^{99m}Tc-UBI 29-41 scan	Max*	Min*
^{99m}T bone scan	1.11	0.71

+ LR = positive likelihood radio; – LR = negative likelihood ratio
*specificity=100%, specificity=100%

Lipsky BA et al. Diagnosis and Management of Foot Infections in Persons with Diabetes: IWGDF Infection Guidance Revision 2015



*Ertuğrul MB, Baktıroğlu S. J *Klimik* 2005;18(1):8-13

*Permission of Dr. Selcuk Baktiroglu

Plain radiographs

Osteomyelitis

- Periosteal reaction or elevation
- Loss of cortex with bony erosion
- Focal loss of trabecular pattern or marrow radiolucency
- New bone formation
- Bone sclerosis with or without erosion
- Sequestrum: devitalized bone
- Involucrum: layer of new bone growth
- Cloacae: opening in involucrum or cortex

Ertuğrul BM, Lipsky BA, Savk O. *Diabetic Foot & Ankle* 2013;4:21855

	Sensitivity	Specificity
Microbiological examination	92	60
Tc^{99} radiolabelled leukocytes scintigraphy	91	67
Magnetic resonance imaging	78	60

Ertuğrul MB *et al. Diabet Med* 2006;23:649-53

Percutaneous bone biopsy

Divide specimen for:
- ✓*Microbiology*
- ✓*Histopathology*

Pathological examination

- Diagnostic criterion:
  Bone biopsy
  - ✓ PMNL ≥10 / microscopic area

Lonner HS *et al. J Bone Joint Surg* 1996;78:1553-8

Ayşe Akman, The foot, 2008

Diagnosis of osteomyelitis

- For infected open wound do probe-to-bone test; (Strong; High)
- Markedly ⇧ serum inflammatory markers, especially ESR, suggestive of osteomyelitis in suspected cases (Weak; Moderate)
- Histological & microbiological examinations of an aseptically obtained bone sample (Strong; Moderate)
- Avoid using results of soft tissue or sinus tract specimens for selecting antibiotic therapy for osteomyelitis (Strong; Moderate)
- Plain X-rays (Strong; Low)
- MR imaging (Strong; Moderate)
- SPECT/CT or 18 F- FDG PET scans (Weak; Moderate)

Lipsky BA et al. Diagnosis and Management of Foot Infections in Persons with Diabetes: IWGDF Infection Guidance Revision 2015

Question 2

Does our patient have osteomyelitis? If so, how can we diagnose?

a. Physical examination
b. Probing to bone
c. Direct radiography of the foot
d. Magnetic resonans imaging
e. Culture/histopathological examination of bone

Treatment of DFO

- Outpatient or Inpatient?
- Antibiotics
  - ✓ Local, oral, parenteral
  - ✓ Empirical or culture based
  - ✓ Duration of treatment
- Vascular intervention?
- Hyperbaric oxygen therapy?
- Surgery?
  - ✓ Necessary, or is antibiotic therapy sufficient
  - ✓ Amputation?
  - ✓ Which level?

Medical

- Patient is too medically unstable for surgery
- Poor postoperative mechanics of foot is likely
- No other surgical procedures on foot are needed
- Infection is confined to small, forefoot lesion
- No adequately skilled surgeon is available
- Surgery costs are prohibitive for the patient
- Patient has a strong preference to avoid surgery

Surgical

- Foot infection is associated with substantial bone necrosis
- Foot appears to be functionally nonsalvageable
- Patient is already nonambulatory
- Patient is at particularly high risk for antibiotic-related problems
- Infecting pathogen is resistant to available antibiotics
- Limb has uncorrectable ischemia (precluding systemic antibiotics)
- Patient has a strong preference for surgical treatment

Lipsky BA et al. Diagnosis and Management of Foot Infections in Persons with Diabetes: IWGDF Infection Guidance Revision 2015

Selection of Antibiotherapy

- Patient status
- Causative bacteria
- Proper antibiotic

Site of Infection, by severity or extent	Route of administration	Duration of therapy
Bone or joint		
•No residual infected tissue (eg, postamputation)	Parenteral or oral	2-5 days
•Residual infected soft tissue (but not bone)	Parenteral or oral	1-3 wk
•Residual infected (but viable bone)	Initial parenteral, than consider oral switch	4-6 wk
•No surgery, or residuel dead bone postoperatively	Initial parenteral, than consider oral switch	≥ 3 mo

Lipsky BA et al, *Clin Infect Dis* 2012;54:132-73

❖Elongated antibiotic therapy is usually advisible in some selected patients who do not receive surgical treatment (Strong; Moderate).

❖For diabetic foot osteomyelitis we recommend 6 weeks of antibiotic therapy for patients who do not undergo resection of infected bone and no more than a week of antibiotic therapy if all infected bone is resected (Strong; Moderate)

Lipsky BA et al. Diagnosis and Management of Foot Infections in Persons with Diabetes: IWGDF Infection Guidance Revision 2015

After operation

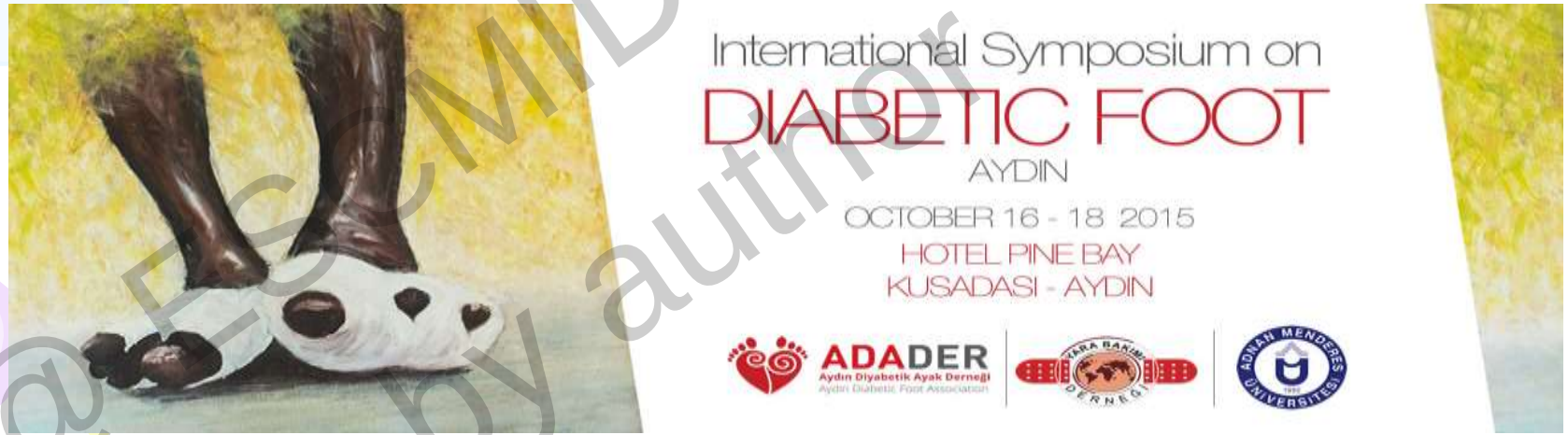
Folow-up in clinic

After 3 months

Thank you for your attention

INTERNATIONAL WORKING GROUP ON THE DIABETIC FOOT
http://www.iwgdf.org

KLİMİK DERNEĞİ DİYABETİK AYAK İNFEKSİYONLARI ÇALIŞMA GRUBU
http://www.klimik.org.tr



http://www.aisdf.org