Osteoid Osteoma

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BIDMC Radiology Clerkship
February 22, 2010
Overview

- Index Patient
- Periosteal Reactions
- Differential Diagnosis
- Principles of Osteoid Osteomas
- Bone Anatomy
- Menu of Tests
- Radiologic Images
- Treatments

http://peakrunningperformance.com/webpages/images/stories/skeleton.gif
Learning Objectives

- Recognize the clinical presentation of osteoid osteoma
- Understand the differential diagnosis for this clinical presentation
- Review the principles of osteoid osteoma and its classification within the context of bone anatomy
- Learn the menu of appropriate radiologic imaging studies and the indications
- Study the radiologic presentations and recognize classic findings
- Know how to medically and surgically manage osteoid osteomas
Index Patient: Presenting History

- **Chief Complaint**
  - Right wrist pain

- **History**
  - 18 yr old R hand dominant male with persistent R wrist pain for 4 months
  - Pain is worse at night, waking patient from his sleep
  - Pain relief with ibuprofen
  - No history of trauma or repetitive motions with hand

- **Review of Systems**
  - Denies numbness/tingling, fevers, chills, night sweats

- **Past, Family, Social Histories**
  - Non-significant
Index Patient: Physical Exam

- Palpable nodule (3.5 x 3 cm) over the radial aspect of the R distal radius with focal tenderness and swelling
- No erythema, discoloring, ecchymosis, or drainage
- Full range of motion of R shoulder, elbow, wrist, and fingers; no strength deficits
- Normal sensation in all distributions
- +2 pulses bilaterally
- No palpable axillary lymph nodes
Our Patient: Radiograph of cortical osteoid osteoma in R distal radius

Ovoid sclerotic lesion with central radiolucency
1.1 x 1.3 cm

Fusiform cortical thickening

Image from BIDMC PACS
Our Patient: R distal radius osteoid osteoma on CT Imaging

Axial C- CT

Focal areas of radiolucency surrounded by sclerotic regions that occupy the cortex and invade the medulla
Our Patient: Periosteal reaction on CT Imaging

Coronal C-CT of R distal radius

Periosteal reaction: elevated cortex from bony expansion

Image from BIDMC PACS
Periosteal Reaction: Non-aggressive Types

Periosteal Reaction: Aggressive Types

ONION SKIN

SUNBURST

HAIR ON END

CODMAN'S TRIANGLE

Partial Differential Diagnosis for Wrist Pain/Bone Mass

- **Masses**
  - Benign Neoplasms
    - Osteoid Osteoma
    - Osteoblastoma
    - Osteoma
    - Enostosis (bone island)
  - Ganglion cyst

- **Infection**
  - Brodie abscess (subacute osteomyelitis)
  - Osteomyelitis

- **Inflammation**
  - Tenosynovitis
  - Rheumatoid arthritis

- **Degenerative Conditions**
  - Osteoarthritis
  - Stress fracture

- **Neurological**
  - Carpal tunnel syndrome
Our Patient’s Differential Diagnosis

- **Masses**
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Unlikely given patient’s history and presentation
Distinguishing Characteristics on Radiologic Imaging

- **Masses**
  - **Benign Neoplasms**
    - Osteoid Osteoma - < 2 cm; radiolucent nidus with surrounding sclerosis; may spontaneously regress
    - Osteoblastoma – large (> 2 cm); no regression in size over time
    - Osteoma – cold bone scan; absent periosteal reaction & radiolucent nidus
    - Enostosis – cold bone scan; thorny radiations; low signal on T2w MRI
  - **Infection**
    - Brodie abscess – cortical destruction with a linear, serpentine tract extending away from abscess
  - **Degenerative Conditions**
    - Stress fracture – linear radiolucency perpendicular, rather than parallel, to cortex
Background: Osteoid Osteoma

- **Demographics**
  - Majority of patients are young (< 35 yr old)
  - Males > females (2-3:1)

- **Benign skeletal neoplasm**
  - Consists of a spherical nidus of osteoid tissue & bony trabeculae superimposed on highly vascularized connective tissue
  - May initially appear on radiograph as a small sclerotic bone island within a circular lucency
  - NO malignant potential

- **Size**
  - Ranges from 0.5-2 cm (avg 1.5 cm)
  - No growth progression
  - May regress spontaneously over years
Background: Osteoid Osteoma (continued)

- **Mechanism**
  - Unknown etiology
  - Nidus consists of highly vascular osteoblastic proliferation, surrounded by a secondary zone of sclerosis
  - Elevated prostaglandin E2 levels in nidus responsible for bone pain & vasodilation
  - Tumor infarction may be involved during cases of spontaneous regression

- **Locations**
  - Typically affects the appendicular skeleton
    - Metaphysis/diaphysis of long bones: 70%
    - Femur/tibia: 55%
    - Phalanges of hands/feet: 20%
    - Spine: 10% - Causes **painful** scoliosis with concavity towards the lesion
    - Posterior elements: 90%
  - Extremely rare in skull & facial bones
# Osteoid osteoma vs Osteoblastoma

<table>
<thead>
<tr>
<th>Osteoid osteoma</th>
<th>Osteoblastoma</th>
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</thead>
<tbody>
<tr>
<td>Usually &lt; 2 cm diameter</td>
<td>Usually &gt; 2 cm diameter</td>
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<tr>
<td>Presents with <strong>intense pain</strong>, often sharply localized and worse at night</td>
<td>Lack of intense pain</td>
</tr>
<tr>
<td>Pain characteristically relieved by aspirin/NSAIDs</td>
<td>Aggressive behavior</td>
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<tr>
<td>Non-aggressive behavior</td>
<td>Typically in the vertebrae or major bones of the lower extremity</td>
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<td>Variable locations: femur, tibia, fibula, humerus, hands/feet, vertebrae</td>
<td>Often affects the spongiosa of the bone</td>
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<td><strong>Neural staining</strong> reveals axons throughout the tumor (may explain bone pain)</td>
<td>Absence of neural axons upon staining</td>
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Classification of Osteoid Osteomas

- **Cortical**
  - Most common location (80%)
  - Radiolucent nidus seen within the bone cortex and surrounded by fusiform cortical thickening/laminated periosteal formation
- **Cancellous**
  - Intramedullary lesion; mild reactive sclerosis & difficult to identify, significantly delaying the diagnosis
  - Common sites: femoral neck, posterior spine, hands & feet
- **Intraarticular**
  - Joint effusion or synovitis
- **Subperiosteal**
  - Round mass adjacent to cortex
  - Absent periosteal reaction
  - Very rare
Staging Classification for Benign Bone Tumors

Stage 1
LATENT
• Remains static or heals spontaneously

Stage 2
ACTIVE
• Progressive growth but limited by natural barriers

Stage 3
AGGRESSIVE
• Progressive growth, not limited by natural barriers

Classic Clinical Presentation

- Focal bone pain that worsens at night & increases with activity
- Pain is relieved by aspirin within 30 minutes (75% of cases)
- Local swelling and point tenderness
- Exacerbation of pain with alcohol
Menu of Radiologic Tests

- Plain Radiographs*
- Computed Tomography*
- MRI
- Ultrasonography
- Nuclear Imaging*
- Angiography

* Usually used for evaluating osteoid osteomas
Plain Radiographs

- Main imaging technique
- Diagnostic in 75% of cases
- **Classic Appearance**
  - Well-defined radiolucent nidus with surrounding zone of sclerosis
  - Central nidus is typically < 1.5 cm in diameter
Companion Patient #1: Radiograph of L tibial osteoid osteoma

21 yr old male with 4 months of atraumatic left calf pain, worse at night; osteoid osteoma eventually removed by percutaneous RF ablation

Periosteal reaction with cortical thickening in posterior tibia
CT Imaging

- Best imaging tool for osteoid osteoma
- Study of choice for localizing the nidus
- Good at evaluating complex anatomy (e.g. – spinal pedicles, laminae, femoral neck, hands, feet)
Companion Patient #1: L tibial osteoid osteoma on CT Imaging

Axial C- CT

Sagittal C- CT

Mature periosteal reaction and thickening with central radiolucency

Image from BIDMC PACS

Image from BIDMC PACS
Back To Our Index Patient: R distal radius osteoid osteoma on CT

Central radiolucent nidus within a sclerotic zone

Osteoid osteoma eventually removed by open surgical curettage
MRI

- **Advantages**
  - Easily detects edema in the soft tissues & bone marrow
  - Better at diagnosing cancellous/intramedullary osteoid osteomas
  - Good for evaluating joint effusion/synovitis for intraarticular lesions

- **Appearance**
  - T1w: nidus is isointense to muscle
  - T2w: radiolucent areas of nidus with intermediate to high signal intensity
Companion Patient #2: Radiograph of L tibial osteoid osteoma

18 yr old male with nocturnal focal pain in L proximal tibia for 2 years; relief with NSAIDs; osteoid osteoma eventually removed by percutaneous RF ablation

Non-aggressive thick periosteal reaction of the L medial tibial metaphysis
Companion Patient #2: L tibial osteoid osteoma on Axial CT

Axial C- CT

5 mm radiolucent nidus

Thick periosteal reaction (10 mm)
Companion Patient #2: L tibial osteoid osteoma on Coronal CT

Oval-shaped radiolucent lesion within the medial tibial cortex
Dimensions: 4 x 4 x 18 mm
Companion Patient #2: L tibial osteoid osteoma on MRI STIR

Edema appears as high signal intensity within the bone marrow.
Companion Patient #2: L tibial osteoid osteoma on MRI T1w

Low signal intensity edema in soft tissue structures surrounding the cortical lesion

Coronal C- MRI T1w
Image from BIDMC PACS

Axial C- MRI T1w
Image from BIDMC PACS
Nuclear Imaging: Bone Scan

- Uses technetium-99m phosphonates
- Tumor site demonstrates focal area of intense uptake
- **Double density sign**: small focus of increased activity (nidus) surrounded by a larger area of less intense activity (reactive sclerosis)
- Tracer is excreted through kidneys and urinary bladder
Companion Patient #3: Sacroccocygeal osteoid osteoma on CT Imaging

19 yr old male with 1 yr hx of pain at coccyx, worse at night pain & relieved with ibuprofen; osteoid osteoma eventually removed by percutaneous RF ablation

Small curvilinear lucency (6 mm) with focal sclerosis in adjacent posterior cortex
Companion Patient #3: CT guided biopsy of a sacrococcygeal osteoid osteoma

CT guided needle core biopsy of the radiolucent nidus

Image from BIDMC PACS
Companion Patient #3: Coronal bone scan of a sacroccocygeal osteoid osteoma

Coronal Bone Scan

Small intense focus of tracer uptake in the coccyx with double density sign

Image from BIDMC PACS
Companion Patient #3: Sagittal bone scan of a sacrococcygeal osteoid osteoma

Abnormally increased focal area of intense tracer uptake

Image from BIDMC PACS
Ultrasonography

- May be used for guidance of percutaneous biopsies
- Doppler U/S detects the highly vascular nidus
- Useful for detecting intra-articular osteoid osteomas
Angiography

- Central nidus is highly vascular
- Intense circumscribed blush that develops during the early arterial phase and persists into venous phase is diagnostic
- Angiography is useful for distinguishing osteoid osteoma from a Brodie abscess
Treatments

- **Medical Management**
  - NSAIDS
- **Surgical Management**
  - Open surgical curettage
  - CT guided
    - Percutaneous radio-frequency (RF) ablation, laser, ethanol, or thermocoagulation therapy
- **Anesthesia**
  - General or spinal
Summary

- Osteoid osteoma (OO) is a latent benign bone tumor that classically presents as focal pain that is worse at night and relieved by NSAIDs.
- Cortical osteoid osteomas are often associated with non-aggressive periosteal reactions.
- OOs and osteoblastomas are histologically similar but differ in size, pain intensity, location, aggressiveness, and neural staining patterns.
- OOs are classified by their relative position to the bone: cortical, cancellous, intraarticular, and subperiosteal.
Summary Continued

- OOs have a classic appearance on plain radiographs and CT imaging: central radiolucent nidus with surrounding zone of sclerosis
- CT imaging is the best imaging tool for OOs and is the study of choice for localizing the nidus
- MRI is useful for detecting soft tissue/bone marrow edema and intramedullary OOs
- Nuclear bone scans may localize the tumor and demonstrate focal areas of intense tracer uptake; double density sign is occasionally seen
- Doppler U/S can detect the highly vascular nidus
- Angiography may distinguish OOs from a Brodie abscess: intense blush that persists into venous phase is diagnostic of OO
References


Acknowledgements

- Dr. Gillian Lieberman
- Dr. Jim Wu
- Dr. Erica Gupta
- Dr. Jay Catena

**Special Thanks To:**
- Dr. Corrie Yablon
- Dr. Aarti Sekhar
- Maria Levantakis
- Patients