Bone Biopsy: Review of Indications, Procedure & Clinical Utility

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Trephination of Bone

- From Latin *trypan*, meaning to bore
- The act of obtaining a cylindrically shaped core of bone that can be used for tests and bone studies, cutting holes in bones or for cutting out a round piece of the cornea for eye surgery.

Bone Biopsy: Introduction

- Trephination of bone
- Diagnostic tool to assess static and dynamic parameters
- Assess effects of new medications
- “Gold Standard” in evaluation of Metabolic bone disorders
Bone Biopsy: Indications

- Osteoporosis
- Osteomalacia
- Hyperparathyroidism
- Renal Osteodystrophy-Chronic Kidney Disease
  - Predominant Hyperparathyroidism
  - Low turnover disease
    - Osteomalacia
    - Adynamic bone disease
  - Mixed Uremic Osteodystrophy
- Bone pain
- Fractures
Bone Biopsy

- Skilled Physician
- Adequate sample
- Proper instruments
- Labeling with bone markers
Bone biopsy: Labeling

- Bone turnover
  - Rate of bone formation and mineralization
  - Double labeling
    - Tetracycline - Days 1 & 2
    - Declomycin - Days 12-14
    - Bone harvest - Day 20
Double Labeling

Tetracycline double-labeling at the bone-osteoid interface. Two regular distinct labels. The outer golden yellow label represents administration of declomycin; the inner greenish layer represents administration of tetracycline.
Bone Biopsy: Procedure

- OR / Office
- General or Local Anesthesia
- Donor Site – Iliac Crest
  - Anterior vs. Posterior
  - Vertical vs. Horizontal
Bone Biopsy: Procedure

- **Instrumentation**
  - Manual vs. Electric Drill

- **Specimens x 2**
  - 5-8 mm diameter
  - 1.5-2.5mm length

- **Storage in 100% Ethyl Alcohol**
Bone Biopsy: Constraints

- Painful, Invasive
- Costly
- Limited number of centers to analyze
- Delay in interpretation
- Limited understanding of results
Bone Biopsy: Complications

- Infection
- Hematoma
- Neuropathy
- Hip Fracture
- Osteomyelitis
Bone Biopsy: Pitfalls

- Poor Specimen
- Patient Body Habitus
- Inappropriate Specimen Handling
Bone Biopsy: Clinical Utility

Osteopenia.

- Trabeculae cut perpendicularly to their long axis.
- Reduced connectivity between trabeculae.
Osteopenia

Low Turnover Osteopenia
- Absence of osteoblasts, osteoblasts, osteoid and resorption zones

High Turnover Osteopenia
- High fraction of trabecular surface covered by osteoid and presence of numerous osteoblasts covering the osteoid seam.
Bone Biopsy: Clinical Utility

Osteomalacia

- Excessive accumulation of osteoid and increased width of osteoid seams.
Bone Biopsy: Clinical Utility

Hyperparathyroid bone disease
- Appearance of woven osteoid.

Hyperparathyroid bone disease
- Increase in number of osteoclasts and increased extent of trabecular surface exhibiting resorption lacunae. Increased density of osteocytes. Marrow fibrosis.
Bone Biopsy: Clinical Utility

Renal Osteodystrophy

- Predominant hyperparathyroid bone disease. High fraction of trabecular surface covered by osteoid seams.
- High osteoid-osteoblast interface. High bone-osteoclast interface with appearance of tunneling resorption.
- Marrow fibrosis.
Bone biopsy with morphometric analysis is the best method to assess metabolic bone disorders and to guide clinical management. The procedure is safe and tolerated well by patients. Research to develop non-invasive serum or bone markers have not proven to be specific or sensitive enough at this point in time.
Thank You!
Happy Thanksgiving!