IMAGING – GUIDED SPINE BIOPSY

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LECTURE OUTLINE

• Introduction
• General principles
• Indications
• Contraindications
• Technique
• Complications
• Summary
INTRODUCTION

Biopsy of bone lesions

• Closed biopsy under imaging guidance has many advantages over open surgical biopsy
• Imaging: usually done under local anaesthesia
INTRODUCTION

Imaging- guided biopsy

- Fluoroscopy for long bones
- US for surface bone lesions
- MRI for more occult lesions
- CT for complex- shaped bones e.g. spine, pelvis
- CT fluoroscopy is emphasized
GENERAL PRINCIPLES

• Primary tumours: specialist centres
• Multidisciplinary approach
• Review the clinical history
• Correlate with other forms of imaging e.g. radiographs, MRI, bone scintiscans
• Complete all imaging prior to biopsy
Solitary C6 renal cell carcinoma metastasis
GENERAL PRINCIPLES

• Plan biopsy route
  - does not compromise surgery
  - avoid neurovascular bundles
  - does not cross compartments
• Consultation - surgeon & pathologist
• Pre-biopsy blood tests
• Informed consent
INDICATIONS

• Focal bone lesion ? nature
• Investigate primary bone tumour
• Confirm metastasis in a patient with a known primary
• New vertebral compression fracture ? Malignant
• Confirm infection
Severe L4 compression fracture
CONTRAINDICATIONS

- Decreased platelets
- Bleeding tendency
- Suspected vascular lesion in the thoracic vertebra
- Infected soft tissue around bone (for non-infected lesions)
- Inaccessible sites
- Uncooperative patient
CT TECHNIQUE

- Positioning of patient
  - facilitate needle access
  - comfort
- Monitoring
  - nursing support
  - pulse oximetry
- Sedation (+/-)
CT TECHNIQUE

- Select appropriate slice
- Surface markers - line of pins
- Free-hand
CT TECHNIQUE

• Plan needle route
  - depth
  - angulation
• Lesion details
  - size, location,
  - soft tissue extent
• Avoid adjacent vital structures
CT FLUOROSCOPY TECHNIQUE

- Coordinates
  - transverse: axial CT image
  - cephalocaudad: gantry light beam
- Surface marked, cleaned and draped
CT FLUOROSCOPY TECHNIQUE

- Table movement: real-time scanning
TECHNIQUE

Biopsy needles

• Many different types
• Size range: 11G – 22G
• Depends on type of tissue
  - aspiration e.g. Chiba
  - cutting e.g. Quickcore
  - trephine e.g. Ostycut
TECHNIQUE

Chiba aspiration needle

• 22G, 15cm long
• Aspiration for cytology
• May be placed coaxially
• Smears and microbiology
TECHNIQUE
Chiba needle

• Coaxial placement
Examples of cutting needles with spring-loaded firing mechanisms

Quickcore 18G

Easycore 18G
TECHNIQUE

Quickcore cutting needle

• 18G, 9-15cm long
• Spring-loaded gun mechanism
• Plunger to cock spring
• Non-removable notched inner stylet for specimen collection
Cutting needle

1. Needle tip to lesion edge
2. Cock gun
3. Depress plunger to advance notched stylet into lesion
4. Fire gun
   - Outer cannula snaps forward over inner stylet
   - Tissue captured in notched part of stylet
5. Withdraw needle
TECHNIQUE

Quickcore (or Trucut) cutting needle

- Soft tissue & osteolytic lesions
- Maceration-free specimens
- Cortical defect for bone lesions
Cutting biopsy of soft tissues - specimen is collected within the notched inner stylet that is advanced into the lesion to capture the desired tissue core.
Examples of trephine bone biopsy needles

11G Cook bone biopsy needle

14.5G Ostycut needle
TECHNIQUE

Ostycut trephine needle

- 14.5-17G, 10-15cm long
- Serrated cutting needle
- Sharp cutting stylet
- Longer probe to dislodge specimen
1. Needle tip to lesion edge
   - Remove stylet
2. Advance needle
   - Apply suction
   - Jiggle needle to break off specimen
3. Withdraw needle
4. Trephine needle
Trephine biopsy of a bone lesion

Artwork: Lorie Marchinkow
Application of vacuum through plunger withdrawal during jiggling motion
Use of air-powered drill attached to the biopsy needle (@Peter Munk)
Coaxial passage of a cutting needle through a trephine needle

Artwork: Lorie Marchinkow
TECHNIQUE

Cervical spine approach

- C3-7: anterolateral or posterolateral
- Depends on lesion location
- Anterolateral: supine
  - avoid trachea, oesophagus, major neck vessels, nerves
- Posterolateral: prone
  - similar to thorolumbar
TECHNIQUE
Thoracic spine approach
• Transpedicular, costovertebral or intercostal
• Usually prone
• Avoid pleura, spinal canal, big vessels
TECHNIQUE

Other approaches

• Modify according to location

L1 pars  C2 lat mass
TECHNIQUE

Expected results

• Accuracy rates up to 97%
• Higher in osteolytic lesions
• Higher with more samples in different areas
TECHNIQUE

Sample management

- Microbiology: core, clot, aspirate
- Histopathology: core
- Cytology: core, blood clot, aspirate
COMPLICATIONS

- Depends on needle type & location
- Serious complications < 1%
- Less than open biopsy under GA
- Haematoma
- Trauma to adjacent structure
  - pneumothorax, nerve damage, vessel damage, fracture
- Infection
SUMMARY

Imaging – guided bone biopsy

• Safe and effective
• Useful role in diagnosis and management of bone lesions
• Meticulous technique is needed
Image-Guided Musculoskeletal Biopsy

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KEYWORDS
- Bone biopsy • Musculoskeletal biopsy
- Musculoskeletal diseases • Musculoskeletal intervention
- Orthopedic Imaging

Sampling of bone and marrow for analysis has been recognized for millennia; however, image-guided bone biopsy has become a relatively recent development. Since the description of percutaneous biopsy for diagnosis of skeletal lesions by Coley in 1931,1,2,3 and fluoroscopic-guided procedures by Lall in 1970,4,5 image-guided bone biopsy has developed significantly, led by innovations in imaging and intervention. It has become an essential part of managing musculoskeletal lesions, including primary and secondary bone tumors5,6 and infections.7,8

Although early reports dismissed minimally invasive bone biopsy only as a “simple, primary diagnostic procedure” with significant inconclusive or misleading results,9,10 later reports increasingly recognized their low morbidity, lower cost (compared with open biopsy),11 high accuracy, and repeatability in the event of inconclusive results.12,13,14,15 This has led to greater importance of image-guided bone biopsy, which has replaced open surgical biopsy in many instances. The advantages of the procedure even have translated to veterinary applications16,17. The accurate characterization based on the small tissue samples obtained is often challenging, however.18,19

Image guidance allows safe passage of needles, often into small and otherwise inaccessible lesions, and into the portions of the lesion most likely to yield useful samples, while avoiding damage to important structures. This article hopes to provide a useful guide to image-guided musculoskeletal biopsy for radiologists in practice and in training.

PREPARATION
Why Must One Perform This Biopsy?

The presence of a bony or soft tissue lesion does not automatically imply the need for histology. Clinical information, laboratory findings, and imaging features may be sufficient to provide high diagnostic confidence for certain lesions, allowing for a conservative management or therapeutic trial. In addition, a clearly benign lesion for which therapy is not indicated does not require biopsy. A range of benign bone lesions has been described in the literature and familiarity with these may help avoid an unnecessary biopsy.20-41 The history, physical examination, and laboratory and imaging findings for each patient should be reviewed thoroughly and the case discussed with the referring clinicians. The indication and approach to image-guided biopsy must be tailored for each patient.

Indications and Contraindications

The recognized indications and contraindications for biopsies in general are outlined in Box 1.42-44