Advances In Musculoskeletal Intervention

Neil Johnson, MB.BS, M.Med FRANZCR
William Shiels, DO

Cincinnati Children’s Hospital
Nationwide Children’s Hospital
Disclosures

• Dr. Johnson
  CCHMC is a Research Site for Philips Medical
  – Research Agreement / I.R. Animal Lab
  – No Personal Financial Benefits

• Dr. Shiels
OUTLINE

• Basic MSK Intervention

• Beyond Basics
  – Core Biopsy
  – Treating Lesions
  – Screws, Bone Grafts and Hardware

• Two Important Lesions
  – Histiocytosis (LCH)
  – Aneurysmal Bone Cyst

• Advanced Guidance and Fusion Imaging

• A Little Politics
MSK Intervention: Basics

• Image Guidance
  – CT / CT Fluoroscopy
  – Ultrasound
  – Standard Fluoroscopy
  – Cone Beam CT +/- Guidance
  – Combined / Fusion Imaging

• “Needle” Biopsy
  – Cytology X
  – Small Diameter < 4mm
    • Automated Gun
    • True Cut (Slot) Type Devices: Fibrous Lesions
MSK Intervention: Basics

- **Abscess Drainage**
  - Similar To Other Sites

- **Joint Injections**
  - MRI Arthrography
  - Steroid Injections
    - Joint / Tendon Sheath
    - Bursa

- **Marking Deep Lesions for Surgery**

- **Foreign Body Removal**
MSK Intervention: Beyond Basics

- Deep Large Core Bone Biopsy
  - Equipment
  - Guidance

- Malignant Tumor Biopsy
  - Intelligent Approach Paths
  - Viable Tissue – “The Edge Is The Target”
  - Exceptions: When Even Good Biopsies Go Bad

- Screws, Routers and Bone Grafts
  - Orthopedics Through Small Holes
Beyond The Basics

NF1 Malignant Nerve Sheath Tumor: ? Mets to Sternum and T1
Ultrasound Guided Biopsy of Sternum for Diagnosis
2 Months: Metastasis Enlarged

* Mediastinum

MANUBRIUM

change the outcome®
Palliative R.F. Ablation of Sternal Met
Ultrasound guidance
Tendon Sheath Steroid Injections
Finger Tendon Sheath Steroid
On An Awake (Smiling!) Patient
I.R. In The Operating Room
Cone Beam CT + Guidance: The Complex Angled Approach

- Planning 3D Low Dose CT Equivalent
- Complex Angled Approach (On Screen Guidance)
- High Quality Fluoroscopy
Post Traumatic Physeal Bar

[Images of medical samples and X-rays]
Ultrasound: Avoiding Major Structures

Desmoplastic Fibroma

Radial Nerve?
Ultrasound: Avoiding Major Structures

Newborn
Newborn: Forearm Biopsy
“Fibromatosis Coli”
Mediastinal Germ Cell Tumor: SVC Syndrome
Anatomically Based Guidelines for Core Needle Biopsy of Bone Tumors: Implications for Limb-sparing Surgery

Patrick T. Liu, MD • Scott D. Valades, MD • F. Spencer Chivers, MD • Catherine C. Roberts, MD • Christopher P. Beauchamp, MD

Diagnostic image-guided needle biopsy plays a vital role in the work-up and treatment of patients with extremity bone tumors. The radiologist and the orthopedic oncologic surgeon should take a team approach to this procedure, especially when the bone lesion might be a primary sarcoma for which limb-sparing surgery (LSS) would be considered. A set of anatomically based guidelines were developed that can be used by the radiologist, in combination with case-by-case consultation with the surgeon, to plan image-guided core needle biopsies of extremity long bone lesions that may be treatable with LSS. By using these guidelines, along with the aforementioned consultation, the radiologist will be able to preserve the patient's chances of receiving optimal surgical treatment.

Introduction

Over the past 30 years, the prognosis for patients with primary bone malignancies of the extremities has greatly improved due to innovations in imaging, chemotherapy, and surgical techniques. Orthopedic oncologic surgeons can now remove bone sarcomas without amputation in the vast majority of patients, with only a limited loss of function.
limb function, using a class of procedures known as limb-sparing surgery (LSS) (1–4). Radiologists often play an important role in the work-up of these patients by performing image-guided needle biopsy, which has been shown to be nearly as accurate as open biopsy for the diagnosis and staging of musculoskeletal sarcomas, but with fewer complications and lower costs (5–8).

Bone sarcomas have been shown to recur locally from tumor seeding along biopsy tracks after core needle biopsy (9,10), procedures that are generally performed with needles 16 gauge or larger (11). Survival rates for patients who experience local recurrence of these sarcomas are very low, even after repeat surgery (often amputation) and chemotherapy.
Caution......
Posterior Component...
Not Sampled (Sciatic Nerve + Surgery)
Original Diagnosis:

Benign Desmoplastic Fibroma Variant
So...Open Curettage and Bone Graft......

BUT......

I do not have good news for you, but at least you can move forward. I spoke to this morning. He agrees with the diagnosis of fibroblastic osteosarcoma, grade 2, and plans to issue his report soon. We had a brief discussion that helped me to better understand some of the key diagnostic issues. Kevin and I went back and reviewed two of the sections that Dr. had flagged as especially useful. I think we are both comfortable with the diagnosis. Thus, I think it is OK to schedule the port placement now and I’m fairly sure we can get you final reports prior to the actual surgery and initiation of chemotherapy.

I realize that treatment already will have begun, but it might be nice to review the case again on July 11. That will give me time to scan the biopsy slides and scan the curettage slides at better resolution. This seems to be a case where a good quality biopsy missed key areas of a highly variegated tumor due to random sampling variation.

Best regards,
Richard
Two Special Lesions

- Langerhans Cell Histiocytosis
  - Solitary Bone Lesion

- Aneurysmal Bone Cyst (ABC)
Langerhans Cell Histiocytosis

- **Histiocytoses:**
  - Group of proliferative disorders arising from histiocytes, a common progenitor cell in bone marrow.

- **3 types of Histiocytes (dendritic cells):**
  - Langerhans cell: Epidermis
  - Mononuclear Cell/Macrophage: Dermis
  - Dermal dendritic cell: Dermis

- **LCH and non – LCH Histiocytoses**

Courtesy Dr. Joseph Palumbo, MD
CCHMC
Types of Histiocytes: “It’s Too Complicated for Radiologists”

- CD34+
- CD14+
- MΦ
- CD14−
- LC

Fitpatrick’s Dermatology in General Medicine, pp 106
LCH Pathogenesis – Theories

- Infectious? Disseminated, spontaneous remission of milder forms
  - CMV, EBV, HHV-6, HHV-8 implicated; none proven
- Neoplastic ?
- Reactive Clonal Disorder ?
Histiocytosis Clinical Types
Old Classification

- Congenital Self-Healing Reticulo-histiocytosis
  – AKA Hashimoto-Pritzker disease
- Eosinophilic Granuloma
- Hand-Schuller-Christian disease
- Letterer-Siwe disease
Histiocytosis Clinical types
Current Classification

- Single system
  - **Isolated Bone Lesions** (Best Prognosis***)
- Multisystem
- Disseminated
  - Widespread, multi-organ disease (Poorest Prognosis)
LCH Isolated Bone Lesion
Skull

Langerhans Cell Histiocytosis (LCH)
LCH: Ultrasound Guidance
Biopsy and Steroid Infiltration

Brain

LT FRONTAL BONE

Depo Medrol 40 mg
(Methylprednisolone Acetate)
LCH Primary I.R. Treatment
Biopsy and Steroids
But....
2 Months Post Steroids

At Diagnosis
LCH Rib: Ultrasound and Cone Beam CT
Post Procedure

Patient remained stable throughout and was discharged from the PACU for follow-up Monday by Dr. [Name docked] of the hematology/oncology service.

IMPRESSION:
Percutaneous CT and ultrasound guided biopsy of the right posterior seventh rib and deposition of steroid within the lesion. It should be noted that radiographic changes of healing may be delayed for at least 3 months after steroid application. Providing the lesion does not enlarge or extend, the lesion can be followed by radiographs and/or CT.

Dictated By: Neil D Johnson M.D.
Histology: No Active Lesion
LCH Pubis:
Curettage, Steroids and Percutaneous Bone Graft
LCH Pubis:
Curettage, Steroids and Percutaneous Bone Graft
20 Months Post Treatment
Incision for Pubic Ramus Surgical Approach: (Giant Cell Tumor)
LCH: Acetabulum Roof
LCH: Steroids and Bone Graft
LCH: Steroids and Bone Graft Primary and Only Treatment

5 Months
Aneurysmal Bone Cyst

- Expansile Lytic Vascular Lesion of Bone
- 1.4 / Million Individuals
- Usually < 20 Years Old
- Male = Female
- Occurs In All Bones
  - Most Common:
    - Pelvis
    - Spine (Posterior Elements)
    - Long Bones

Cottalorda, Arch Orthop Trauma Surgery (2007) 127: 105-114
Aneurysmal Bone Cyst

- 70% Primary

- 30% Secondary
  - Chondroblastoma
  - Osteoblastoma
  - Giant Cell Tumor
  - Fibrous Dysplasia
  - Malignant Bone Tumors
    - *** Telangiectatic Osteosarcoma ***
Aneurysmal Bone Cyst

- Differentiation from Unicameral Bone Cyst (UBC)
  - Single Cyst Vs Multiple Cysts
  - Fluid Level Less Likely in UBC
  - UBC Less Expansile

- BUT
  - Complicated UBC (Fracture) May Be Difficult
  - Biopsy Required
    - UBC: Simple Cyst Lining Vs ABC
    - UBC Different Histology
Aneurysmal Bone Cyst
2nd Procedure: Curettage, Bone Graft and Steroids
Percutaneous Bone Grafting: ABC
Aneurysmal Bone Cyst

- **Causation: Primary ABC**
  - Venous Obstructive Lesion
    - Post Traumatic
    - Post Infection
  - Vascular Malformation
  - Benign Neoplasm
    - 16:17 q22:p13 Translocation [1]
    - TRE17 / USP6 Oncogene Translocation [2]


Aneurysmal Bone Cyst

- **Treatment Options**
  - Traditional Open Surgery
    - 12-71% “Recurrence” [1]
    - Significant Complications
      - Blood Loss, Loss of Function (Plates / Screws), Infection
  - Radiotherapy
    - Secondary Malignancy
  - Percutaneous Sclerotherapy
    - STS
    - Ethibloc
    - Doxycycline
Aneurysmal Bone Cyst

- **Treatment Options**
  - **Hybrid**
    - Minimally Invasive CT Guided (<1cm Incision)
    - Curettage / Routing / Aspiration
    - Steroid Soaked Percutaneous Bone Graft
  - **Image Guided Doxycycline (Dr. Shiels)**
    - Ultrasound or CT Guided
    - Minimally Invasive
    - Cysts Individually Targeted
    - Doxycycline Suppresses Multiple Cellular Abnormalities
      - Metalo Matrix Proteins (MMP)
      - VEGF
Tumors:

- Biopsy Guidance Ultrasound Vs CT
- Avoidance of Major Structures
- Color Doppler: Identifying Viable Tumor

Ewing’s Sarcoma
17 Year old Male
5 months Left Hip Pain
Primary Ultrasound Guidance
Ultrasound Guidance
Same Patient......
Diagnosis Please
2.5 Year Interval: Diagnosis ....
2.5 Year Interval: Diagnosis Please....

December 2009

June 2012
Hybrid Ultrasound Guidance

? Best of Both ?

Magnetic Field Plate Under Patient
IR / OR of the future

Image Guided Orthopedics: We Need To Be There

- Surgery
  - General, Ortho, Neuro
- Pulmonology / GI
- Oncology
- Led by IR .... Or Not