

ROLE OF INTERVENTION RADIOLOGY IN BENIGN BONE TUMOURS

Essay

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By

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ABSTRACT

Interventional radiology has an important role on benign bone tumours involved in the treatment of the patient(therapeutic role) as well as the diagnosis of disease (diagnostic role). It offers an alternative to the surgical treatment of many conditions and can eliminate the need for hospitalization, in some cases

Image-Guided Percutaneous Biopsy becoming an increasingly accepted modality for initial biopsy in most musculoskeletal tumors. All biopsies planned in consultation with the referring orthopedic surgeon. Needle pathway decided on the basis of the expected definitive treatment to avoid inter-compartmental contamination, to minimize the amount of biopsy tract that removed at the time of definitive surgery and to avoid neurovascular structures. (James S. Jelinek et.al.,2002)

There are many therapeutic roles of intervention radiology on benign bone tumors like Percutaneous thermal ablation includes (Radio-frequency, Microwave or Laser photocoagulation ablations)-cryoablation – cementoplasty(verebroplasty) - selective transcatheter arterial embolization - direct Percutaneous intra-tumoural injections and adjuvants like ethanol.(Erkan Y.et al., 2002)

Key ward :-

- Benign bone tumours
- Clinical and radiologic features
- Diagnostic & therapeutic role of intervention radiology

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TABLE OF CONTENT

<i>TOPIC</i>	<i>PAGE</i>
LIST OF FIGURES.....	1
LIST OF ABBREVIATIONS.....	2
INTRODUCTION AND DEFINITIONS.....	3
BENIGN BONE TUMOURS	
Classification of Benign Bone Tumours.....	5
Clinical presentation of Benign Bone Tumours.....	16
INTERVENTION RADIOLOGY OF BENIGN BONE TUMOURS	
(I) Diagnostic Role (Imaged guided percutaneous biopsy).....	64
(II) Therapeutic Role	
- Percutaneous thermal ablation.....	73
(Radiofrequency ablation).....	74
(Microwave ablation).....	86
(Laser ablation).....	91
- Cementoplasty / Vertebroplasty.....	101
- Selective and Super-selective transcatheter embolization.....	114
- Other procedures.....	121
DISCUSSION.....	125
SUMMARY AND CONCLUSION.....	133
REFERENCES.....	136

LIST OF FIGURES

Fig. No.	Title	Page No.
1.	Locations of benign bone tumours.	10&11
2.	Plain film of femoral shaft osteoid osteoma	19
3.	CT cuts showing osteoid osteoma nidus	20
4. (a,b,c)	Plain film showing osteoblastoma	23
5.	CT showing osteoblastoma	24
6.	Plain film for different sites of chondromas	25
7.	Plain film show lower femoral enchondroma	28
8. (a,b)	Plain film showing osteochondromas	32
9.	Plain film of chondromyxoid fibroma	34
10.	Plain radiograph of chondroblastoma	37
11.	Plain film shows ABCs	41
12.	MRI of right pubic bone ABC	42
13.	left Proximal humerus solitary bone cyst	45
14.	plain radiographs of fibroxanthoma	47
15.	Haemangioma of the dorsal vertebrae	50
16. (a,b)	Giant cell tumour in different locations	54
17.	Plain radiograph shows (EG) of ribs and skull	58
18. (a,b)	Plain film of fibrous dysplasia	61
19.	8-gauge trephine needle for bone biopsy	66
20.	Different types of bone biopsy needles	67
21.	Pathway of percutaneous bone biopsy	70
22.	Various radiofrequency (RF) electrodes	79
23.	Procedure & Technique of RF ablation	82
24.	Procedure & Technique of RF ablation	83
25.	Microwave device	88
26.	LASER system and application set	94
27.	Application of Laser photocoagulation	97
28.	Optical fiber placement of laser	98
29.	Procedure of ILP	99
30.	Materials for percutaneous cementoplasty	104
31. (a,b,c,d)	Technique of cementoplasty in angioma	109
32. (a,b,c)	Opacification of bone in cementoplasty	110
33.	Cement leakage	112
34. (a,b)	Selective embolization of pelvic ABCs	119

LIST OF ABBREVIATIONS

- **CT : Computed Tomography**
- **MRI : Magnetic Resonance Imaging**
- **US : Ultrasonography**
- **PET : Positron Emission Tomography**
- **SBCs : Simple Bone Cysts**
- **ABCs : Aneurysmal Bone Cysts**
- **FCD : Fibrous Cortical Defect**
- **NOF : Non Ossifying Fibroma**
- **GCT : Giant Cell Tumours**
- **EG : Eosinophilic Granuloma**
- **OCE : Osteo-Cartilagenous Exostosis**
- **MHOCE : Multiple Hereditary Osteo-cartilagenous Exostosis**
- **CM ,MM :Centimeter and millimeter**
- **RFA : Radio-Frequency Ablation**
- **C1,C2 : 1st cervical vertebra, 2nd cervical vertebra**
- **MWA : Micro-Wave Ablation**
- **ILTT : Interstitial Laser Induced Thermotherapy**
- **ILP : Interstitial Laser Photocoagulation**
- **PMMA: Polymethylmethacrylate**
- **TAC : Trans-Catheter Arterial Embolization**
- **AVF : Arterio-Venous Fistula**
- **PVA : Poly-vinyle Alcohol**
- **PEI : Percutaneous ethanol injection**

Introduction and definitions

A Tumor: is a lump or mass of tissue that forms when cells divide uncontrollably. For most bone tumors, the cause is unknown. A growing tumor may replace healthy tissue with abnormal tissue. It may weaken the bone, causing it to break (fracture). Aggressive tumors can lead to disability or death, particularly if signs and symptoms are ignored. (American Academy of orthopedic surgeons, 2004).

A Bone Tumor: is an overgrowth of cells within the bone. These cells could arise from cells normally present in the bone or other times can arise from the proliferation of cells from other sites of the body. For reasons that aren't well understood, these cells grow abnormally and form a "tumor". One very important question to ask regarding a bone tumor is whether it is benign or malignant (Timothy B. Rapp et al., 2007).

A Benign Bone Tumor: by definition is not life threatening. Nonetheless, many benign bone tumors can be aggressive and cause problems to the affected bone and surrounding joint. These effects may cause significant long-term effects on the function of the affected limb, Benign bone tumors may also cause the bone to constantly ache and may weaken it to the point that it breaks. Other benign bone tumors are "incidental findings", or are discovered on an x-ray taken for an unrelated problem. Many of these benign bone tumors do not cause symptoms, (Timothy B. Rapp. Et al., 2007)

Fortunately, the majority of tumors that originate in the bones are benign, meaning very unlikely to spread from its original site to a new location. On contrary to what most people expect, benign bone tumors occur most often in people less than 30 years old. Most are discovered in children, while their skeletons are still growing. These tumors are often strongly influenced by the hormones that stimulate normal growth. As a result, many benign tumors actually stop growing once a child reaches skeletal maturity (i.e. when bones stop growing in length). This usually occurs between the ages 14-16 in girls and the ages of 16-19 in boys. (Cleveland Clinic, 2008)

The management of patients with bone tumours requires consideration of many factors: (Afshin Gangi, X Buy et al., 2007)

- Histology of the tumours with differentiation of benign and malignant tumours
- Careful evaluation of the patient's general condition.
- An understanding of the disease process.
- An appreciation of the degree of bone destruction.
- A working knowledge of available treatment options that required.(Afshin Gangi, X Buy et al., 2007)

Benign Bone Tumors

Benign bone tumors almost never metastasize and are best classified by the matrix which the tumor cells produce such as bone, cartilage, fibrous tissue, fat or blood vessels. Some of these tumors can be described as 'aggressive' because they may recur locally after removal (resection). It is very important to determine whether a tumor is benign or malignant to avoid over or under treatment of the patient. (American Academy of orthopaedic surgeons, 2004)

Classification of benign bone tumours according to (David W. Stoller, 2004)

- **Osteoblastic tumours:**

(osteoid osteoma, osteoblastoma)

- **Cartilaginous tumours:**

(enchondroma, osteochondroma, chondroblastoma, chondromyxoid fibroma)

- **Fibrous tumours:**

(fibrous dysplasia, fibrous histiocytosis of bone)

- **Miscellaneous tumours & tumour like lesions:**

(giant cell tumours, aneurysmal bone cyst, inter-osseous haemangioma, unicameral bone cyst, interosseous lipoma).

Other Classifications:

The American Academy of Orthopaedic Surgeons (AAOS) says common benign tumors include:

- Osteochondroma, Fibrous dysplasia, Giant cell tumor, unicameral bone cyst or (solitary bone cyst), Osteoid osteomas. Benign cartilaginous tumors are some of the most common lesions affecting the skeletons of children, These include (exostoses, enchondromas, periosteal chondromas, chondromyxoid fibroma and chondroblastoma).(American Academy of Orthopaedic Surgeons, 2004)

Classification According to tumor Aggressiveness: (Timothy B. Rapp. 2007).

Benign “Non-Aggressive” Bone Tumors	Benign “Aggressive” Bone Tumors
- Osteoid osteoma - Unicameral (simple) bone cyst - Hemangioma of bone - Intra-osseous ganglion cyst - Osteochondroma - Exostoses - Enchondroma - Non-ossifying fibroma - Chondromyxoid Fibroma - Periosteal-Cortical Desmoid	- Fibrous Dysplasia - Giant Cell Tumor - Osteoblastoma - Chondroblastoma - Anuerysmal Bone cyst

Classification of primary tumours of bone according to (David Sutton et al., 2003)

Tumors arise from skeletal tissue:

- bony origin (bone island, osteoid osteoma, osteoblastoma)
- cartilagenous origin (chondroma, chondroblastoma, chondromyxoid Fibroma)
- fibrous origin (fibrous cortical defect, non ossifying fibroma, fibromatosis, desmoplastic fibroma)
- giant cell containing (giant cell tumour, aneurysmal bone cyst, brown tumour)

Tumors arise from other tissues:

- Blood vessels (haemangioma, haemangiomatosis, vanishing bone disease, haemangiopericytoma)
- Nerves (neurofibroma, neuroliemmmoma)
- Fat (lipoma)

Tumors of no known origin:

- (Solitary bone cyst)

Non neoplastic tumors:

- (histiocytosis, hydatid, hematoma , infarction, brodie's abscess)

The following are important parameters to be consider in the evaluation of benign bone tumors:(Helliwell TR. et al., 1999)

1-Age: (probably the most important clinical clue):

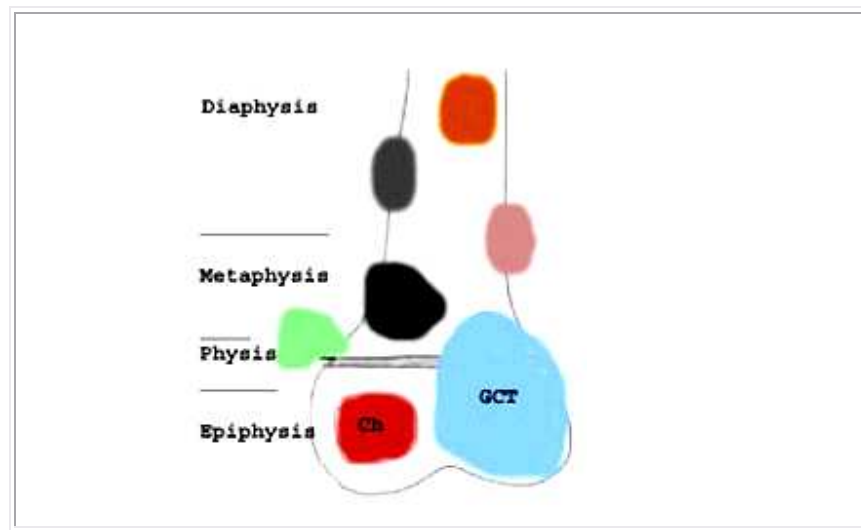
- 0 – 10 ys. : simple bone cyst, eosinophilic granuloma.
- 10 – 20 ys. : non-ossifying fibroma, fibrous dysplasia, simple bone cyst, aneurysmal bone cyst, osteochondroma (exostosis), osteoid osteoma, osteoblastoma, chondroblastoma, chondromyxoid fibroma.
- 20 – 40 ys. : enchondroma, giant cell tumor.
- 40 ys. & above : osteomas.

2-Skeletal Location:(while many lesions favor certain bones, some tumors almost exclusively occur at specific sites)(**Table-2**)

Lesions	Most common skeletal sites
Non-ossifying fibroma	Metadiaphyseal regions of the tibia and distal femur (80%).
Simple bone cyst	The vast majority of SBCs is found in the proximal humerus (55%) and proximal femur (20%).
Chordoma	Base of the skull or sacrum (90%)

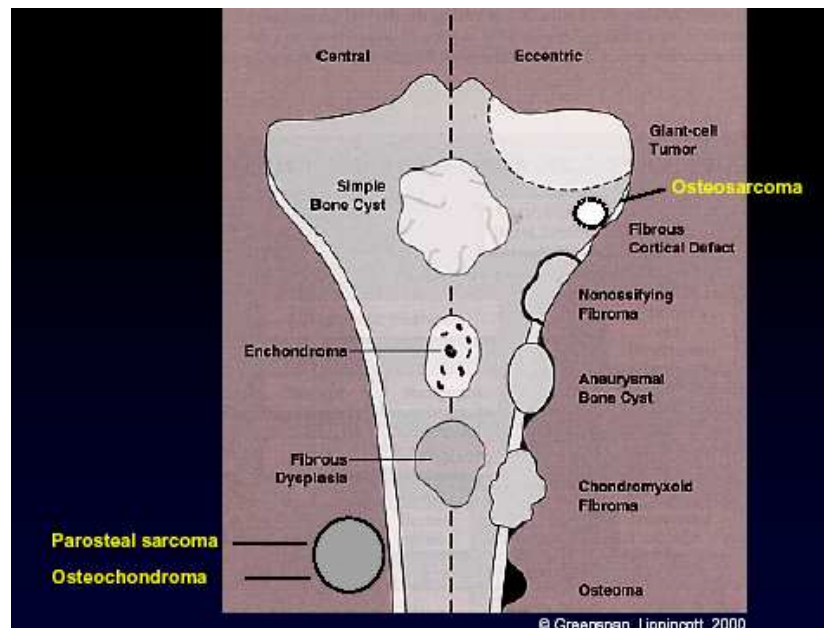
Chondroblastoma	Long bones(knee , proximal humerus)- (70%).
Giant cell tumor	Knee area, distal radius (65%).
Enchondroma	Small bones of the hands and feet (60%). This is in fact the commonest tumor at these sites.
Fibrous dysplasia	Femur, tibia, skull and ribs
Osteochondroma	Knee area, proximal humerus, pelvis
Osteoblastoma	Spine (30%), mandible, long bones
Aneurysmal bone cyst	Any bone; common in the spine
Chondromyxoid fibroma	Knee area (30%), pelvis, small bones of the feet
Hemangioma	Spine, craniofacial bones

3-Site of Long Bone Involvement: (most primary bone tumors have favored sites within long bones; this may provide a clue to diagnosis.



(Figure-1a)-sites of long bone involvement.(Helliwell TR. et al., 1999)

(Table - 3)Typical Anatomic Regional Location of Benign Bone Tumors: (Figure-1A&1B)			
Tumor	Epiphysis	Metaphysis	Diaphysis
Osteoblastoma	Rare	Most common	Uncommon
Osteoid osteoma	Uncommon	Common	Common
Giant-cell tumor	Most common	Rare	Extremely rare
Chondroblastoma	Most common	Rare	Extremely rare
Chondromyxoid fibroma	Rare	Most common	Common
Enchondroma	Rare	Common	Common
Chondrosarcoma	Uncommon	Common	Most common
Osteochondroma	Extremely rare	Most common	Common
Non-ossifying fibroma	Extremely rare	Most common	Common
Aneurysmal bone cyst	Common	Common	Rare



(Figure-1b)- Anatomical locations of benign bone tumours.(Helliwell TR. et al., 1999)

4-Patterns of Growth and Bone Destruction:



- Benign and non-growing (or extremely slowly growing) lesions are well circumscribed and show **geographic pattern** of bone destruction with a sclerotic rim. Geographic pattern refers to a well-defined area of lysis. The sclerotic rim is more commonly seen in the weight-bearing bones and represents bone reaction to the lesion. Its presence means that the bone has been given sufficient time to react. Some authors say that the sclerotic rim signifies benignancy to about 95%.