### INTERVENTIONAL RADIOLOGY AND ITS ROLE IN MSK



HOSSEIN GHANAATI M.D; PROFESSOR OF RADIOLOGY

**TEHRAN UNIVERSITY OF MEDICAL SCIENCES** 

The lumbosacral spine is the source of pain, suffering, and disability more frequently than any other part of the body. The long-term outcome, the complications and suboptimal results that may accompany open disk surgery have led to the early development of other treatment techniques that avoid a surgical approach through the spinal canal and extensive disk ablation.

# Imaging modalities & pain control :

- Fluoroscopy
- CT scan
- CT fluoroscopy
- Sonography
- MRI

### **INTERVENTIONAL PROCEDURES**

- 1- P.R.T
- 2- P.L.D.D
- 3- Facet block (diagnostic and treatment)
- 4- Percutaneous Vertebroplasty
- 5-ozone therapy
- 6-discogel





GE HIGHLIT





### PRT

Peri Root Therapy is an interventional radiologic procedure has been done with CT

guide .during this procedure corticostreoid is injected adjacent to involved nerve root and

thereby significant higher concentration of drug in the target will be available with lower

systemic side effects.



















## Response to P.R.T (No.170)



## PLDD

The advantage of this percutaneous technique is to reduce volume and pressure of the pathologic disk without damage to other spinal structures. All minimally invasive techniques such as PLDD are based on the reduction of volume of the pathologic disk. In this procedure, laser energy is transmitted through a thin optical fiber into the intervertebral disk. The aim of PLDD is to vaporize a small portion of the nucleus. The ablation of this relatively small volume results in an important reduction of intradiskal pressure, thus reducing disk herniation

- No significant soft-tissue injury; no risk of fibrosis
- No extensive hospitalization; performed on outpatient basis
- No general anesthesia; can easily be performed under local anesthesia
- Minimal recovery time
- No scars
- Lower costs (25%-30% of surgical treatment costs)

Research Journal of Biological Sciences Year: 2009 | Volume: 4 | Issue: 3 | Page No.: 265-267

#### **Results of Lumbar Disc Percutaneous Laser Disc Decompression** (PLDD) with One Year Follow up in Iran

Hossein Ghanaati , Hassan Hashemi , Mojtaba Miri , Majid Ghaffar Poor and Kavous Firouznia

**Abstract:** > Disc protrusion is a very common disorder and usually

# TECHNIQUE

After CT guided proper positioning of needle, nucleous pulposous was evapourated with Nd – YAG laser.

#### total energy was 1200 – 1600j and Power between 10-20 watts.



### IMPROVEMENT ACCORDING TO SLR



### **TUMOR ABLATION**

#### Management of Painful Bone Metastases

- Conventional Therapy:
  - » Radiation Therapy
  - » Chemotherapy
  - » Hormonal Therapy
  - » Systemic Radioisotope Therapy
  - » Bisphosphonates
- Image-guided Intervention:
  - » Embolization
  - » Radiofrequency Ablation (RFA)
  - » Embolization and RFA
  - » RFA and "Cementoplasty"

RF ablation of the bony lesions The principle of RF ablation is a transformation of electromagnetic energy into thermal energy

1. Ions follow the changes in the direction of the alternating electric current (460–480 kHz)

2. The ion agitation



### RF ablation of the bony lesions

#### Painful masses inside bone or soft tissue,

- 1. Benign lesions : osteoid osteoma , ABC before filling
- 2. Malignant painful lytic lesions spread into bone and muscle
- 3. Lesions in a weight bearing structurel(>ke% of healthy bone), must be ac
- <sup>4. cl</sup> Palliative, reduce mass effect and control of local spread with large tumors

Posteraro AF, Dupuy DE, Mayo-Smith WW.Radio-fre quency ablation of bony metastatic disease. Clin Radiol 2004; 59:803–. 811

























#### **RFA** Applications in Bone

#### Osteoid Osteoma



#### *Rosenthal et al. Radiology 2003; 229(1):171-5*

- Osteoid osteoma: percutaneous treatment with radiofrequency energy
  - » 263 patients underwent 271 ablations over 11 years
  - » All technically successful, < 1% complication rate
  - » Follow up
    - Complete relief of symptoms in 89%
    - Recurrent lesions in 8% of patients, 60% successfully retreated

### Percutaneous ablatin of osteoid osteoma



### Percutaneous ablatin of osteoid osteoma



# Iranian Journal of Radiation Research

[Home ] Volume 2, Number 1 (6-2004)Back to browse issues page2004, 2(1): 9-14Percutaneous Laser photocoagulation of osteoid osteoma: Assessment of treatment in nine casesAuthor(s): K.

- Firouznia <sup>\*</sup>, H. Ghanaati, H. Hashemi, N. Ahmadinezhad, H. Soroush , M. Shakiba<sup>\*</sup> Dept. of Radiology, Medical Imaging Center, Imam Khomeini Hospital, Tehran University ,**Study Type**: Original Research | **Subject**: Radiation Biology**Article abstract:ABSTRACT**
- **Background:** Osteoid osteoma is a benign bony neoplasm and its classic treatment is surgery. In the r ecent decades percutaneous Laser therapy was suggested to be replaced by surgery. In this study we have reviewed the results of the first applications of interstitial Laser photocoagulation (ILP) for treatment of osteoid osteoma in Iranian patients.

### **RFA** Applications in Bone

- Painful Bone Metastases
  - » Metastatic renal cell carcinoma





#### **RFA of Painful Bone Metastases**

- Indications
  - » Osteolytic painful bone metastases
  - » Not suitable or have failed standard therapy
  - » Pain originating from a solitary site of metastases
  - » Pain severity 4 or higher (scale of 0 to 10)

#### • Exclusions

- » Tumors in contact with hollow viscera
- » Tumors in close proximity to major neurovascular bundles
- » Lesions in weight-bearing bones with impending fracture
- » Internal fixation with metallic devices at the site of tumor
- » Large hypervascular tumors (relative contraindication)

#### **RFA of Painful Bony Metastases**







#### **RFA of Painful Bony Metastases**




#### RFA & "Cementoplasty"

- 68-year-old female with NSCLC
- Painful metastates to left femur
- Received radiation therapy (10 fraction) with no benefit





#### RFA & "Cementoplasty"

- Treated with RFA and "Cementoplasty" in one visit
- Complete pain relief
- Discontinued all narcotics





#### Vertebroplasty



Percutaneous vertebroplasty is a therapeutic procedure that involves injection of bone cement into a cervical, thoracic, or lumbar vertebral body lesion for the relief of pain and the strengthening of bone

- The role of percutaneous cementoplasty is :
  - to treat pain and to consolidate the spine
  - Bone packing with acrylic glue (methyl methacrylate) is a procedure aimed at preventing pathological fractures and pain in patients with vertebral body lesions.



#### INDICATIONS

- SYMPTOMATIC VERTEBRAL HEMANGIOMAS
- PAINFUL VERTEBRAL BODY TUMORS (METASTASIS, MYELOMA)
  SEVERE PAINFUL OSTEOPOROSIS

## CONTRAINDICATIONS

#### • HEMORRHAGIC DIATHESIS

#### • INFECTION

#### • ± Epidural extension of the lesion



## TECHNIQUE ...

#### • Anterolateral route for cervical level



## TECHNIQUE ...

 Transpedicular and intercostovertebral routes for thoracic level patient in prone position





## TECHNIQUE ...

# Transpedicular and posterolateral routes for lumbar level









## SYMPTOMATIC VERTEBRAL HEMANGIOMAS



# PAINFUL VERTEBRAL BODY TUMORS (METASTASIS, MYELOMA)

- Painful vertebral metastasis
- Poor surgical candidate
- No neurological symptoms





# SEVERE PAINFUL OSTEOPOROSIS

- Failed several weeks of usual treatment
  - Analgesics, calcitonin, alandronate, rest, bracing
- Bedridden with pain requiring IV narcotics
- Fast collapse of the vertebral body

## Patient selection

- Physical Exam
  - Correlates with the level of pain
- Spine X-rays and CT
  - Recent and remote; At least 1/3 remaining vertebral body height

#### MRI

- Marrow edema, tumor, spinal canal stenosis, compression of cord
- Bone scan
  - Particularly with tumors











## Cementoplasty





















Patient have history of previous nephrectomy

And pathologic findings indicating to RCC









P

W/O

BABAK

HOSEINI, S,ALI 855-AT-5584 \*21-Aug-1945

21-Aug-2006 15-49-19-10 1 IMA 14 SPI 1 SP -63.0

BABAK IMAGING CENTER HOSEINI, S,ALI Emotion 855-AT-5584 VA47C \*21-Aug-1945 H-PR-CA<sub>21</sub>-Aug-2006 16:00:24.27 3 IMA 3 SEQ 7 SP -73.0

10cm

WC

kV 110 mAs 105 TI 1.0 GT 0.0 SL 5.0 788 500 0/0 135 B40s L15T0

W/O

P


# 61YM85/6/8

30-AUG-2006 16:49:30

88 L 0 CAU 0 LAO EMB. # 1/ 9 FRM 10/ 23

PRE

LT.





#### Percutaneous treatment of the AVM



#### Angioplasty (steps)









#### Iliac artery angioplasty and stenting



## Limb Salvage with Infra-Popliteal Angioplasty

#### Peripheral Vascular Disease is an increasing common problem in developed countries

- Ageing population
- Lifestyle
- Increasing incidence of Diabetes and Hypertension

## Critical Limb Ischemia

- Occurs when a critical event puts a chronically ischemic limb at risk of amputation
  - Patients often severely symptomatic
  - Within 1 year
    - 25% of patients will die
    - 25% will require major amputation
- Successful treatment leads to
  - Instant relief of such severe disability
  - Returns the limb to a chronically ischemic but viable state



66 year-old female, diabetic

- Non healing shin ulcer
- Long occlusions of all run-off vessels
- Successful revascularisation of foot vessels by angioplasty



## 72 yr female, Diabetic Chronic Heel Ulcer



# 72 yr female, Diabetic Chronic Heel Ulcer ABI improved from 0.38 to 0.86

Repeat angioplasty required at 4 months





6 months

9 months

12 months



#### **VASCULITIS IMAGING**



HOSSEIN GHANAATI M.D; PROFESSOR OF RADIOLOGY

**TEHRAN UNIVERSITY OF MEDICAL SCIENCES** 

- **Vasculitis** is a group of disorders that destroy <u>blood</u> <u>vessels</u> by <u>inflammation</u>.
- Both <u>arteries</u> and <u>veins</u> areaffected.
- <u>Lymphangitis</u> (inflammation of <u>lymphatic vessels</u>) is sometimes considered a type of vasculitis.
- Vasculitis is primarily caused by <u>leukocyte</u> migration and resultant damage.

#### • Large vessel: <u>Takayasu's arteritis</u>, <u>Temporal arteritis</u>

- Medium vessel: <u>Buerger's disease</u>, <u>Kawasaki</u> <u>disease</u>, <u>Polyarteritis nodosa</u>
- Small vessel: <u>Behçet's syndrome</u>, <u>Eosinophilic</u> <u>granulomatosis with polyangiitis</u>, <u>Cutaneous</u> <u>vasculitis</u>, <u>granulomatosis with polyangiitis</u>, <u>Henoch–</u> <u>Schönlein purpura</u>, and <u>microscopic polyangiitis</u>.

# Takayasu arteritis (TA),

- idiopathic medial aortopathy or pulseless disease
- granulomatous large vessel <u>vasculitis</u> that predominantly affects the <u>aorta</u> and its major branches. It may also affect the <u>pulmonary arteries</u>.
- The exact cause is not well known but the pathology is thought to be similar to giant cell arteritis.

 Vasculitides are characterized by mostly autoimmunologically induced inflammatory processes of vascular structures. They have various clinical and radiologic appearances. Early diagnosis and reliable monitoring are indispensable for adequate therapy to prevent potentially serious complications.  Imaging, in addition to laboratory tests and physical examination, constitutes a key component in assessing disease extent and activity. This review presents current standards and some typical findings in the context of imaging in vasculitis with particular attention to large vessel vasculitides.

# CLASSIFICATION

- **type I:** classic type involving solely the aortic arch branches: brachiocephalic trunk, carotid and subclavian arteries
- type II:
  - **Ila:** involvement of the aorta solely at its ascending portion and/or at the aortic arch +/- branches of the aortic arch
  - **IIb:** involvement of the descending thoracic aorta +/- ascending or aortic arch + branches
- **type III:** involvement of the thoracic and abdominal aorta distal to the arch and its major branches, e.g. descending thoracic aorta + abdominal aorta +/- renal arteries
- **type IV:** sole involvement of the abdominal aorta and/or the renal arteries

type V: generalised involvement of all aortic segments



## ULTRASOUND

- long, smooth, homogeneous and moderately echogenic circumferential thickening of the arterial wall may be present; on transverse section, this finding is termed as the 'macaroni sign' and is highly specific for Takayasu arteritis (in contrast, atherosclerotic plaque is non-homogeneous, often calcified with irregular walls and generally affects a short segment)
- vascular occlusion may be seen due to intimal thickening and/or secondary thrombus formation
- flow velocities depend on the level of occlusion
- aneurysms may be noted

there may be a loss of pulsatility of the vessel



# ANGIOGRAPHY





## **CT/MRI**

- wall thickening: active acute phase
- wall enhancement: active acute phase
- aortic valve disease: stenosis, regurgitation
- occlusion of major aortic branches
- aneurysmal dilatation of the aorta or its branches
- pseudoaneurysm formation
- diffuse narrowing distally (i.e. descending and abdominal aorta): in the late phase
- The pulmonary arteries are also commonly involved, with the most common appearance being peripheral pruning.







# **Coronary findings**

- Described features on <u>CTCA</u> include <sup>7</sup>:
- stenosis of the coronary ostia: ~30%
- non-ostial coronary arterial stenoses: ~35%
- <u>coronary arterial aneurysms</u>: ~10%
- combination of stenosis and aneurysms ('string of pearls sign')




- 18F-fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT)has become a widely used imaging tool in patients with suspected Large Vessel Vasculitis, due to the enhanced glucose metabolism of inflamed vessel walls.
- The combined evaluation of the intensity and the extension of FDG vessel uptake at diagnosis can predict the clinical course of the disease, separating patients with favourable or complicated progress.



