Final Lecture 1

Monday, July 14, 2008
10:13 AM

Infection=Only thing w/ no gender bias or age bias
- Acts much quicker than anything else (including tumors)

Look at Marchiori (Dr. Kuhn wrote that chapter, and he writes the test not Yochum)

Subdivisions of infection (Osteomyelitis)
- **Separative**-most frequent (Staph Aureus accounts for 90% of all bone and joint infections)
  - Humerus infections are typically Streptococcus-Proximity to entry points
  - P**S**eudomonas-affects S-joints (Spine, SC, Symphysis Pubis, SI)
  - Transplant, HIV, immune suppressive meds
    - The rest of the infections (opportunistic
- **Non-separative**-most famous=TB
- **Fungal**
  - Regional distributions in the US
- **Syphilitic**
  - Young victims

How do we get these infections?
- Hematogenous spread
- Initial infection via breech of vessel wall 1st
  - URT (respiratory)
  - UTI (genital urinary)
  - Skin infection
- May also include direct infection-puncture of skin into bone carrying pathogen
- Contiguous spread
  - Skin infection to blood to spine to lung
- **Metaphysis**=most metabolically active part of bone

Lecture 2

Monday, July 21, 2008
10:20 AM

Osteomyelitis

Osteomyelitis=bacterial infection of bone
Entry sites/infection (Leading to hematogenous spread)-how infection spreads in body
- URT (respiratory)
- UTI (genital urinary)
- Dermatitis may present problem for diabetics

Direct infection
- Does occur but not as often
- Acts as event driven

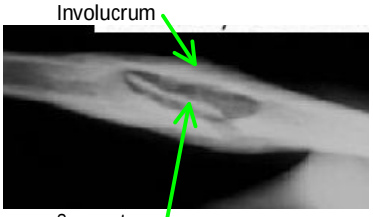
Contiguous spread=direct outspreading
Post surgical complication-inadvertent introduction of organism
- **Osteomyelitis**=big problem w/ orthopedic surgery

Higher concentration b/t 2-12
No definitive predisposition
Prone to show up in metaphysis
Sequestrum=remaining dead bone in middle of infection
Involucrum=bodies attempt to fully contain infection site (a prominent periosteal response)
Draining sinus=release area for pressurized system (bacterial pressure my extrude from bone and form a sinus or ulcer to drain the infected bone)
- May form cloaca on skin
- **Cloaca=**end point for a draining sinus formed along the skin which oozes material from osteomyelitis infection
- **Margolin's ulcer**=degenerative form of cloaca (area of may turn into squamous cell carcinoma)

Rapid increase in pressure within infection site decreases blood flow to the area leading to necrosis of the bone

Osteomyelitis

Involucrum



Sequestrum

???Sail sign???

Film: lateral Skull View
- Showing increased retropharyngeal space
  - **Diff Dx for soft tissue swelling/missing bone**
    - Trauma (blood)
    - Tumors (cells)
    - Infection (pus)
- **Lateral cervical**
  - Destruction of C3 body, C4 upper body
  - Crosses multiple joints
- Dx: Osteomyelitis

Film: Sagittal MRi
- Previous multilevel Decompressive Laminectomy (L5-L1)
- Wound isn't taken care of well
- Orthopedist doesn't answer calls
- Weeping wound seen at imaging center
- Dx: Osteomyelitis
- IV antibiotics used for Tx

50% of bone has to be missing for plain film to see it

Film: lateral knee
- Sail sign in periosteium
  - Lifted off of bone
- Secondary film is bone scan showing increased uptake

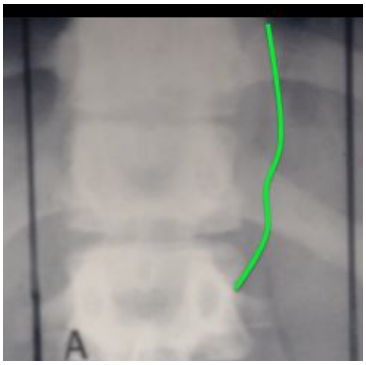
Film: AP thoracic
- Widened periosteal stripe along vertebra
- Diff Dx
  - Blood
  - Cells
  - Pus

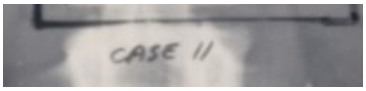
Osteomyelitis destruction of C3/4

Slide 4 in Infection tray

Osteomyelitis widened periosteal stripe

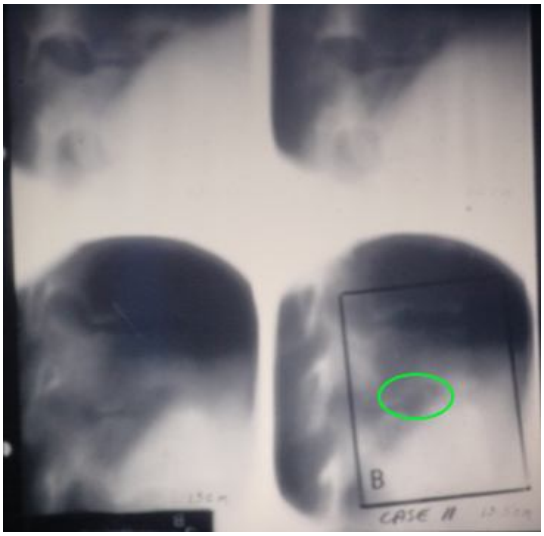
Slide 5





Osteomyelitis-tomogram

Slide 6



Film: tomogram
- Sorry I can't tell what we are looking at
- Diff Dx:
  - Discitis
  - Septicemia

Film: AP pelvis
- Pubic symphysis is destroyed!
- Pain generator is SI sourced

Film: AP shoulder
- Moth eaten bone (pin holes)
- Could be either tumor or infection
  - Infection=over a couple of weeks
  - Tumor=months/years

Kids vs adults
- Kids get sicker quicker
- Adults have more WBCs
- Adults have larger volume of blood
- Adults=insidious onset
- Kids=sudden onset
- Signs
  - Rubor
  - Tumor
  - Dolor
  - Calor
- ESR elevation early in kids, late in adults
- Adults have greater ability due to greater exposure to pathogens previously

Lecture 3

Wednesday, July 23, 2008
9:21 AM

Localized lucency=very bad thing
Widened vertebral stripe over multiple levels
- Schmorl's node will typically just be 1 level at a time
- Since on multiple levels=infection

Film: AP shoulder
- Lots of mixed density soft tissue swelling evident
  - Soft tissue w/air bubbles
- Lytic destruction and widened spacing b/t AC joint
  - Absence of distal clavicle

Film: AP Foot
- 2nd toe missing
- Diabetics lose toes quite often
- Ulceration on foot lead to osteomyelitis

Film: Bone Scan
- Osteoblastic activity seen in right foot and left shoulder
  - Crossing joint spaces=osteomyelitis
- Residual T99 seen in bladder & kidney

Film: photo of legs w/ red spots from vascular insufficiency

Film: AP knee
- Open physis-Child
- Film shows no deformity
- Severe symptomatology which doesn't always show on film
- Not enough bone change to see on plain film
  - Only after 50% change from normal do we see radiographic findings
- **Bone Scan** (same patient)
- Soft tissue phase shows increased uptake on 1 leg vs another
- Bone phase shows increased uptake seen on 1 tibia
- The speed of the infection will cause the patient distress before it shows up on plain film

Film: comparison of R and L lower extremity
- One side has normal contour of the gastrocnemius and soleus
- The opposite side has swelling where the gastrocnemius and soleus should be tapered

Film: AP foot
- DM patient has loss of neurologic Fx in lower extremity (looks Neurotrophic)
- Adjacent soft tissue swelling is not seen in Neurotrophic so it must include osteomyelitis

Brodie's Abscess=walled off supportive (pus forming) infection
- Classic pain presentation: most often at night (may wake pt up)
- Relieved by aspirin
- May go through the growth plate
- Intra process
- Tx: curettage (& packing if large enough)

Nidus=recognized central lucency

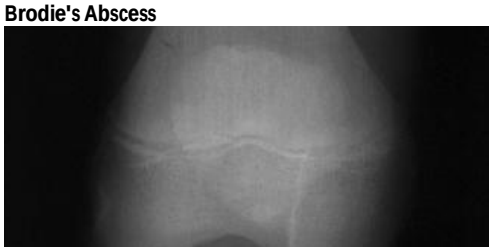
Film: AP knee
- Not much seen
- **Bone Scan**
- Increased uptake in 1 tibia
- **MRi**
- Brodie's Abscess overlying tibial tuberosity in AP view
  - **Bulls-Eye sign (aka Target Sign)**=radiographic finding associated w/ Brodie's Abscess and the appearance of the walled off bone
- Sagittal view shows abscess in posterior portion

Diff Dx (night pain relieved by aspirin)
- Brodie's Abscess
  - Larger nidus
- Osteoid Osteoma
  - Outside cortex but under periosteium (which adds bone)
  - Nidus typically <1cm

Non-suppurative infection

Osteomyelitis
Slide 3

Brodie's Abscess



Tuberculosis

Cold Abscess=classical finding of TB caused by local pH changes by organism leading to dystrophic calcification

No organism is able to be grown out of this

Commonly forms in psoas muscle

Act as slow moving compared to Staph Aureus

Acts faster than tumors

Destroys both end plates and can destroy vertebra often (creating a Gibbus formation)

Gibbus Formation=section of Hyperkyphosis/angular deformity due to vertebral fracture

Pott's Parapleligia=myelopathy due to compression of the cord due to compression from Gibbus Formation

Film: AP Chest

Central white area overlying heart but smaller

TB Granuloma

Film: AP Lumbar

Long vertebra=enlarged vertebral margin unilaterally w/ contralateral reduction due to TB infection (Pott's disease)

Structural scoliosis produced by long vertebra

Film: AP and lateral left hand

Large scale destruction of proximal phalanx of 5th digit

Cortical margin destroyed in multiple locations

Large scale soft tissue swelling

History tells us slow onset (non-suppurative)

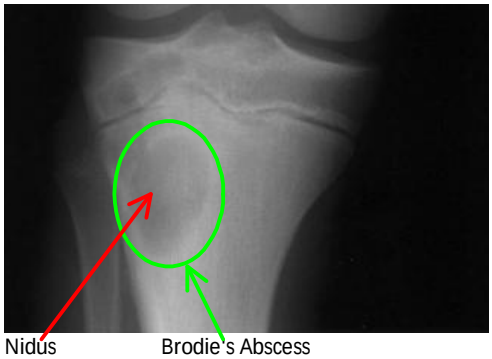
Dx: TB Dactylitis

Film: AP pelvis

Left femur head is pushed up to S2 level in the ileum

TB is present in left femur head but was not as weak

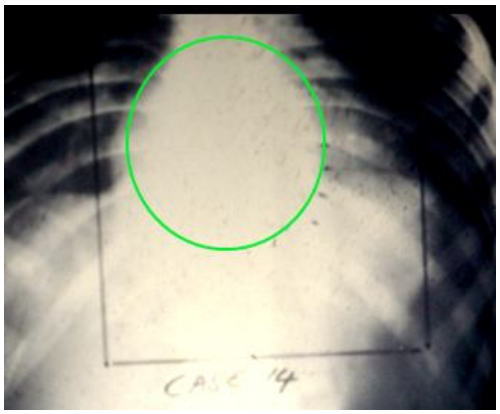
Carpal count is approximate to age for 1st 8 years



Nidus Brodie's Abscess

AP Chest

TB Granuloma



TB Dactylitis

Syphilitic

Film: AP lower extremity

Bilateral solid periosteal reaction=hallmark sign of **syphilis**

Since this is a child it is likely a congenital infection

Congenital syphilis

Transfers occurs in utero

Stats: 25-50 out of 100 die before birth and the rest have continued health problems

Bilateral symmetrical

Decreased integrity of tibia (

Wimberger Sign of Syphilis=medial tibial erosion

Wimberger Sign of Scurvy=bright, white ring around the epiphysis

Saber Shin Deformity=softening of the bone w/ anterior bowing and brightened periosteal reaction***written only***

Film: AP lower extremity

Syndesmosis b/t Tibia and Fibula is thinned due to syphilis

AP Lower Extremity-Syphilis

Fungal Infection

4-we will discuss later

Madura foot=Madura mycosis

Lecture 4

Monday, July 28, 2008
10:15 AM

Finishing up infections

Fungal infections (4)
- Case study
  - 52 year old female w/ neck pain and stiffness
  - History of headaches and dysphasia
  - Ortho exam: decreased ROM, para-cervical mass effect
  - Neurologic: dysphagia, dysphasia
    - **Dysphasia**=disordered thinking
- Radiographic Findings
  - Huge retropharyngeal space (blood, **pus**, cells)
  - Destruction of C5/C6 bodies halfway done
  - **Diff Dx**: local bone loss
    - Tumor
    - Infection-obliterates disc spaces
- 9 out of 10 osteomyelitis infections=**staph aureus**
- TB #2 (happens slowly)
- Fungal infection turned out to be **Blastomycosis**

- **Coccidioidomycosis**
  - Initial infection in lung
  - If unsure of what infection then culture
  - Mostly found in SW United States
  - **Film: AP ankle**
    - Focal bone loss
- **Histoplasmosis**
  - May be lung, liver, spleen lesion
  - Never seen as bone lesion
- **Madura Foot (maduramycosis)**
  - Tends to target foot 1st

Lecture 5

Wednesday, July 30, 2008
9:22 AM

Table 16-1 Marchiori

Table patterns of Osteopenia

	Definition	Classic examples
Generalized	Osteopenia affecting the majority of the skeleton	Senile osteoporosis Post-menopausal Hyperparathyroidism Cushing's disease Wide spread malignant disease (metastasis, multiple myeloma)
Regionalized	Osteopenia affecting one limb or section of the body	Disuse arthropathy (immobilization) Reflex sympathetic dystrophy Transient regional osteoporosis Regional migratory osteoporosis
Localized	Focal osteopenia in one or multiple discrete portions of bone	Lytic metastasis Osteomyelitis Inflammatory arthritides

Generalized=Osteopenia affecting the majority of the skeleton
Regionalized=Osteopenia affecting one limb or section of the body
Localized=Focal osteopenia in one or multiple discrete portions of bone

Generalized

- **Senile osteoporosis**=not enough osteoclasts due to advanced age
- **Fluoride therapy**=possible therapy to increase bone density
  - Doesn't mean good bone but lots of it
  - Absorbs X-rays well but has increased risk of fracture
- **Hyperparathyroidism**
  - Fairly clinically silent
  - Will have greater incidence than expected
- **Cushing's disease**
  - Interference of bone creation
- **Wide spread malignant disease**
  - Lytic patterns may seem like generalized osteopenia

Regionalized

- **Disuse atrophy**=immobilization decreases piezoelectric effect and decreased bone production
  - May be decreased by working contralateral joint (up to 25%)
  - Use muscles therapy and progressive loading to keep muscles from atrophying
- **Reflex sympathetic dystrophy (RSD)**
  - Relatively frequent (distant 2nd place from disuse atrophy)
  - Related to injury of sympathetic nerve can be a painful cause of regional osteopenia
  - Clinical indications
    - Loss of hair
    - Sensitivity of skin (touch/cold)
    - Decreased skin tone
    - Prior trauma
    - Chronic deep bone ache
- **Transient regional osteoporosis**
  - Idiopathic, likes the hip
  - Shows up and goes away w/out warning
  - Preserve shape by decreasing mechanical load
- **Regional migratory osteoporosis**
  - Moves around
  - Can't predict where it will show up next

Localized

- Go through benign vs aggressive list to rule out inflammatory arthritides
- **Lytic metastasis**
- **Osteomyelitis**
- **Inflammatory arthritides**
  - 1st stage of ankylosing spondylitis (Romanus lesion)

Pseudowidening of SI joint

Patterns of osteopenia

Table 14.4 in Yochum and Rowe

A=Normal vertebral body

Screen door like pattern of trabeculae

B=Osteoporosis

Thinner cortical margin

Accentuation of vertical trabeculae

Osteoblasts are following forces applied to them

Vertebral body shape is retained

Approaches fracture threshold (reorganization and decreased strength

C=Wedge shaped fracture

May be related to trauma

Intrinsic load applied causing wedged shaped vertebra

Wedge shaped vertebra definitive factors

Shape=taller in back, shorter in front

Recognize that posterior vertebral body height has maintained at least 80% of former height (loss of <20% of height)

Typically in T11-L1

Called a benign fracture

Rule out breast cancer and lung disease which may metastize to spine

D=Vertebra plana

Loss of height on anterior and interior side

Roots in bone pathology

Worry about lytic metastasis

E=Biconcave (fish vertebra)

Deepening of sup/inf end plates

No trabeculae seen

F=Angular endplate deformity (Check sign)

Statistically associated w/ aggressive bone disease

Must be investigated for underlying bone pathology

Qualitative vs quantitative assessment

Tops of femur are seen on L/s spine and F/s series

When skeleton demonstrates general osteopenia, not all bone demonstrates the same percentage of decreased bone density

Other factors that determine bone density are not the same

SEXA scanner (Single Energy X-ray Absorbtometry)

Measures density

DEXA scanner (Dual Energy X-ray Absorbtometry)

Measures bone density **and** quality

Can only assess the forearm (doesn't always show what is happening in the rest of the body)

Some models can do T-L junction, lumbar spine, femur head

30% mortality w/ hip fractures

Ward's triangle=area b/t vertical trabecular bundles from head of femur inferior femoral neck (1), lateral diagonal trabecular bundles from inferior/medial femoral neck to greater trochanter (2), and medial diagonal trabecular bundles from medial femoral head to inferior lateral portion of greater trochanter (3)

1=principle compression group

Receive weight from pelvis translating to medial cortex

2=secondary compressive group

Inter-trochanter region compressed by muscle contraction

3=principle tensile group

Has suspension function

Fibers intermingle w/ principle compression group and translates compression to lateral cortical bone

If Ward's triangle is small then bone is small

If Ward's triangle is large due to retreat of trabecular bundles

If Ward's triangle is not complete then we are at or near fracture

Quantitative CT may be done using CT machine to sample bone density by comparing Hounsfield unit assignments to known values

0 score is average for age group

35 is considered the key age for osteoporosis

Females

Lose .1-.3% bone each year 35-peri-menopause

After peri-menopause->1-3% per year linearly

Estimating your chances of developing osteoporosis

Risk factor	Category	Points	Score
Your age	Under 35 Over 35	0 25	
Your sex	Male Female	0 25	
Your race	Black	0	

Men only lose .1-.3% bone per year

Race

Has been debunked (only 1 small group study)

Body type

Farm girlfriends-hard working/non-sedentary-no risk

Small boned +25

Sender +25

Family history

Genetic role

~~Your race~~	~~Black~~ ~~Caucasian~~ ~~Oriental~~	~~0~~ ~~25~~ ~~25~~	
Your body type	Large boned Small boned Average/ Overweight Slender	0 25 0 25	
Your family history	No family history of osteoporosis Mother, grandmothers, or sisters with osteoporosis	0 25	
Additional	**Risk**	**Factors**	
If you have never been pregnant		10	
If you have experienced menopause		10	
If you have had your ovaries surgically removed		10	
If you breast fed your child/children		10	
If you are allergic to milk/dairy products		10	
If you are inactive		10	
If your daily routine is stressful		10	
If you smoke		10	
If you consume large amounts of caffeine		10	
If you drink alcoholic beverages		10	

Many additional risks factors are for women only

Diary problems=counteract w/ supplementation, exercise

Total _____

If score is	Your category is
Under 85	Lowest risk
85-175	Medium risk
175-250	High risk
Above 250	Highest risk

We should try to slow/stop loss

You can almost not restore lost bone

Supplement w/ calcium alone=no change

Supplement w/ D alone=non statistically sig reduction in loss

Supplement w/ Ca and D alone=stat sig reduction of bone loss

Exercise=decrease in rate of loss

Exercise + D + Ca=greatest non-drug reduction in loss

Conservative care home run!

Exercise + D + Ca + hormone replacement therapy

Used for people at or below fracture threshold

Activity that constitutes mechanical loading

Not swimming

Older patient who wants to exercise

Use pool as transition to full loading (water aerobics)

May help body weight issues/body image issues

Stationary cycle

Treadmill

Walk in park/mall

Good inclusion criteria/bad exclusion criteria

Film: lateral lumbar
- Codfish vertebra seen w/ increased vertical trabeculae (actually horizontal fibers are gone so they seem increased)
- Limbus vertebrae
- Looks like hemangioma (typically seen only on 1 level)

Film: circle shot lateral
- Wedged vertebra
- Good posterior height seen
- Benign pattern of collapse
- T11-L1->65+ female=good
  - No Breast/lung cancer=non cancerous

Film: lateral lumbar
- Vertical trabeculae
- Codfish vertebra seen at L4
- Cupids bow likely at L5

Film: Lateral lumbar
- No trabeculae seen inside vertebra
- Inner body density is approximately equal to soft tissue density
  - Put finger over cortical line to see

Film: lateral thoracic
- Hyperkyphosis
- Compression fracture (wedge)
- Very little difference b/t body density and ST density

Film: lateral thoracic
- Overlying aorta shows some density over anterior part of bodies
- Almost no bone density seen (about the same density as lungs)

Film: right hand AP
- Looks like generalized osteopenia but shouldn't occur in the hand due to plenty of use
- **Regionalized osteopenia-**all the carpals, metacarpals, distal wrist
  - **Reflex sympathetic dystrophy**
  - Raynaud's phenomenon

Film: AP wrist film
- Very little bone density seen
- Previous fracture of distal radius

Lecture 6

Monday, August 04, 2008
10:15 AM

Metabolic, endocrine, and nutrition category

Dr. Kuhn wrote the metabolic, Nutrition, endocrine chapters in Marchiori!!!

RSD
Fracture or surgery may prove to be trigger fracture

Film: AP Hand
Same film as last time
Looking at how thin the cortical margins are compared to
Reflex Sympathetic Dystrophy
Film: AP Wrist
Obvious fracture leading to RSD

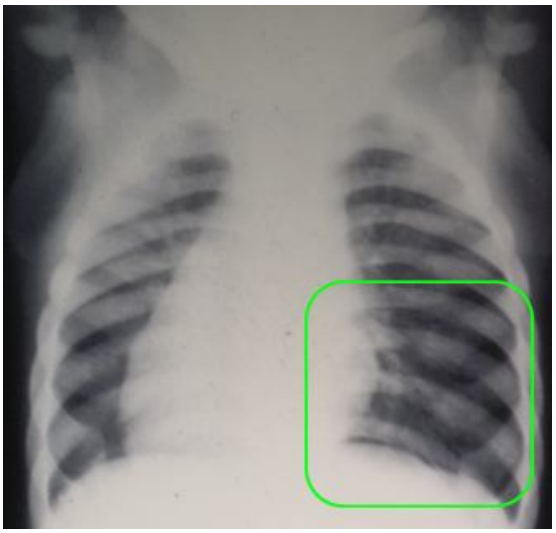
***Foot films in Marchiori

RSD
AP Wrist

Rickets
AP lower extremity

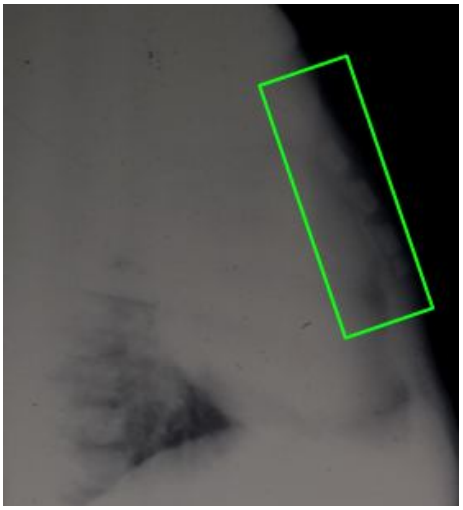
Film: AP lower extremity
Bowed femurs
Ragged metaphyseal margin
Dx: Rickets
Hypovitaminosis (low Vitamin D)
ZPC doesn't form in Rickets
Rickets rarefies the ZPC
Underlying bone may not support teeth so tooth loss may occur

AP Chest



Film: AP chest
Spatulated anterior rib
Costochondral appears like string of rosary beads ()
Film: lat chest
Rosary bead Costochondral appearance

Lat Chest



Hyperparathyroidism
Oblique hand

Lateral spine

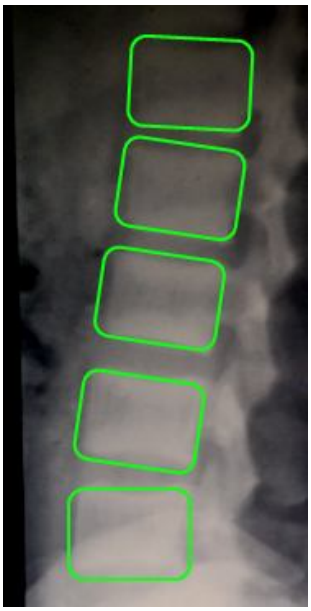
Film: oblique hand
Arteriosclerosis seen on multiple fingers
Dx: Hyperparathyroidism

Hyper parathyroidism
Arteriosclerosis
Hypercalcuria results from Hypercalcemia
Generalized hypocalcaemia
3 types
Primary
Tumor
Secondary
Starts off as renal disease
Early stages of renal failure (diuresis)
Kidney is wasting Ca so the parathyroid gland enters excessive production to keep up with the rapid loss of Ca
Tertiary
Oliguria=reduced urinary output (seen in late kidney disease
Seen in late kidney disease and may be associated w/ dialysis
Rugger Jersey=hyper parathyroidism
Sandwich vertebra=Osteopetrosis
Film: Lateral Spine

Scurvy
Scurvy sclerosis the ZPC
Weinberger's sign of Scurvy
Change at ZPC (Zone of Provisional Calcification)
Bleeding gums is large sign
Scurbutic rosary bead appearance

***Weinberger's sign of Syphilis*Remember**

Sandwich vertebra=Osteopetrosis
Film: Lateral Spine



Scurvy
    Scurvy sclerosis the ZPC
Weinberger's sign of Scurvy
    Change at ZPC (Zone of Provisional Calcification)
    Bleeding gums is large sign
Scurbutic rosary bead appearance

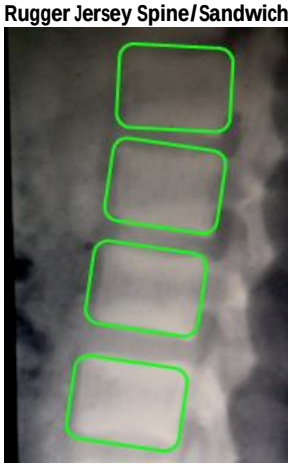
***Weinberger's sign of Syphilis*Remember**

Lecture 7

Wednesday, August 06, 2008
9:15 AM

Film: lateral thoracic spin
- Rugger Jersey spine/Sandwich vertebra
- Could be Osteopetrosis or Hyperparathyroidism
  - Differentiate w/ lab findings
  - Anemia=Osteopetrosis
  - Increased serum Ca=hyperparathyroidism

Rugger Jersey Spine/Sandwich Vertebra



Film: AP hand view
- Acroosteolysis (along radial side of metacarpals and phalanges noted
  - Is also seen in Scleroderma but cannot be b/c no soft tissue changes
  - Also seen in Pyknodysostosis
- Hand films are the most reliable films to see hyperparathyroidism

Secondary hyperparathyroidism

Acroosteolysis

Film: B/L hands
- Wider than normal bone width
- Sclerosed cortical margin
- **Acromegaly=**elevation of growth hormone but growth plates are closed
  - Intramembranous ossification is where we are seeing changes
  - Length/width ratio
  - Hand will appear wide/squatty
  - May have decreased joint spaces due to ligamentous limitation leading to early onset DJD

Film: Lateral foot
- Bone spurring seen on anterior portion of the calcaneus
- Dx: **Acromegaly**
- Findings: increased heel pad thickness
  - Hypertrophic change on calcaneus at Achilles insertion and plantar apeneurosis insertion

Film: lateral skull
- Findings: double floor sign
- Dx: pituitary tumor causing increased growth hormone production leading to Acromegaly
  - Sella turcica measurement has great specificity but poor
- Pituitary tumor may cause distortion of sella turcica into a **J** shape

Film: lateral skull
- Dx: Acromegaly
- **Lantern jaw (Aka prognathism)=**Elongation and thickening of jawbone
- Loss of teeth are seen

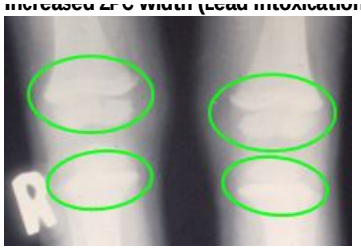
Film: lateral chest
- That is a terrible view of anything
- Long term use of corticosteroids
- Hyperkyphosis doesn't begin to describe this
  - This person's head is below their mid thoracic spine
  - They are freaking bent at 90 degrees

Heavy metal intoxication
- Lead poisoning
  - Netter slide of toxicity
  - **Basophilic stippling**=dots w/in RBCs caused by lead poisoning

Increased ZPC width (Lead intoxication)

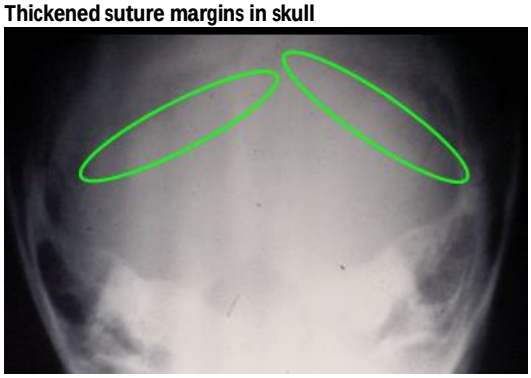
Lead gets integrated into growing bone (ZPCs)
- Increased whiteness and thickness (maybe **double layer**)
- ZPCs

Increased ZPC width (Lead intoxication)



Film: Skull View
- Thickening along margins of sutures due to lead incorporation

Thickened suture margins in skull



Histiocytosis X

Eosinophilic granuloma
- If we don't make the situation worse then they will recover completely
- Should not have recurrent attacks
- Not a brittle bone disease but decreased strength is present
- **Film: lateral thoracic**
  - Spontaneous collapse of vertebral body
  - **Silver dollar sign**=looks like silver dollar on its side
  - Maintenance of disc space above and below
- **Film: AP pelvis**
  - Widened portion of femoral diaphysis w/ lucency seen
  - **Disappearing bone**=bone will feel and function pretty normal
- **Film: lower extremity**
  - **???Aunt mini lesion=**disappearing bone that re-appears???
- **Film: lateral cervical**
  - Loss of space b/t C3/4
  - Loss of cortical margin (local lucency)
  - C4's body is messed up
  - Do we have disc space?
    - Could be infection
  - Needle aspiration will show granulation tissue and eosinophils

Hemochromatosis
- **Film: PA left hand**
  - Hook on distal end of 3rd metacarpal (may show up on other metacarpals/metatarsals as well)
  - Strongly associated w/ hemochromatosis
  - Finding: non-osteophytic growths

Stone in salivary gland not shown
Uterine fibroid not shown

Tumors

Category of tumors
- Metastasis-starts somewhere else and moves to bone, Most common aggressive tumor to skeleton
  - Osteosarcoma
  - Ewing's sarcoma
  - Multiple myeloma=most common primary tumor to skeleton
- Benign-longest list (know it, ID it, forget it)
  - Hemangioma=Most common primary benign tumor to spine

Tumor-like
- Padgett's-great imitator
  - Will be tested on classic form
- Fibrous dysplasia-great imitator
  - Will be tested on classic form

Metastasis
- Table 11.4 in Yochum (radiologic presentation of metastatic carcinoma)
  - Bone doesn't have a wide response range
    - Lytic=goes away
    - Blastic=builds up
    - Combo of lytic and blastic
  - **Blastic metastasis**=Prostate, carcinoid, lymphoma (only 3 that don't reliably do lysis)
- Table 11.5 radiologic features of metastatic carcinoma to bone
  - General
    - Axial skeleton predilection
    - Multiple sites
  - Osteolytic mets 75%
  - Osteoblastic 15%
  - Others 10%
- Table 11.6
  - 2:1 ratio of metastasis to bone: tumor in bone
  - Never have joint involvement (that will be infection)
- **Statistically high areas of metastatic distribution**
  - Skull
  - Shoulder
  - Ribs
  - Spine
  - Pelvis
  - Proximal femur
  - Nothing beyond knee or elbow
- **Batson's Plexus**
  - More like portal vein system than systemic veins
  - NO VALVES!!!
  - Venous plexus that traverses from the proximal femur, pelvis, along the spine, ribs, shoulders, and skull
  - Pretty much the same site of high areas of metastatic distribution
- Most common primary sites that metastasize to skeleton
  - Lung
  - Breast
  - Prostate
  - Kidney
- Most common primary aggressive=**multiple myeloma** has negative bone scan

Create a most common list (good for part 2 national board, also fun Dx and positioning)

Film: AP lower cervical view
- Big soft tissue in front of vertebral body
  - Diff Dx: blood, pus, cells
- Behind soft tissue mass we are missing a vertebral body=lysis
- Top 2 sites males=lung and kidney
- Top 2 sites females=breast and lung

	Benign	**Aggressive**	**Aggressive**
		Primary	Secondary (metastasis)
Age (Decades)	123	1234567	4567
Size 0-6 cm 6+ cm	 +++ +	 + +++	 + +++
Monostotic	+++	+++	++
Polyostotic	+	+	+++
Cortical destruction	-	+++	+++
Periosteal reaction			
Solid	+++	+	-
Laminated	++	++	-
Spiculated	-	+++	+
Codman's	++	++	+
Destruction			
Geographic	+++	+	-
Motheaten	-	+++	+++
Permeative (1 mm)	-	+++	+++
Margins			
Sharp	+++	+	+
Imperceptible	-	+++	+++
Matrix	+++	++	-
Soft tissue mass	-	+++	+
Joint space	-	-	-

- \- Absent
- \+ Occasionally
- ++ Common
- +++ Very common

Lecture 8

Monday, August 11, 2008
10:12 AM

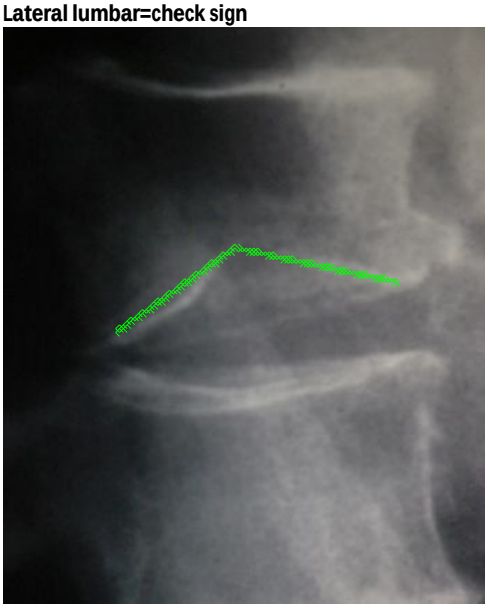
Film: lateral C spine
- Local lucency
- Doesn't cross the joint space (not infection)
- Enlargement of pre-vertebral space
  - Blood-moves up and down the facial planes
  - Puss-not an infection
  - Cells

Differential of lytic stuff
- Female
  - Lung
  - Breast
- Male
  - Lung
  - Kidney

Film: lateral lumbar
- **Check sign**=angular end plate deformity
  - Think pathology 1st until proven otherwise

Film: lateral lumbar
- Decreased disc space L3-L4 and check sign seen
- No subchondral sclerosis

Lateral lumbar=check sign



AP Lumbar-winking owl sign

Film: AP Lumbar
- Winking owl sign=missing pedicle

Film: lateral c/s
- Local lucency
- Lytic mets is 1st thought

Film: lateral L/s
- Lumbar body is not concave in anterior portion
- There is a S-shape to the front of the vertebra
- Associated bone scan
  - + result seen
- 3 weeks later another lateral lumbar shows huge check sign and further distortion (compression deformity)

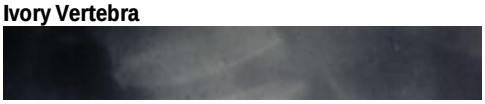
Film: AP lumbar
- Missing L3 pedicle
- Lytic mets is most common cause of 'winking owl sign'

Film: lateral thoracic
- Wedge shape fracture-must maintain 80% of pre collapse height
  - If beyond 20% collapse=**Vertebra Plana**

Film: PA shoulder
- Sometimes see pseudotumor/pseudocyst on plain film but that disappears w/ external rotation
- True lytic mass will not disappear w/ rotation
- Biopsy of tumor to determine origin

Film: lateral Lumbar
- Normally L3, L4 look similar but in this case L4 looks like L5 (which is

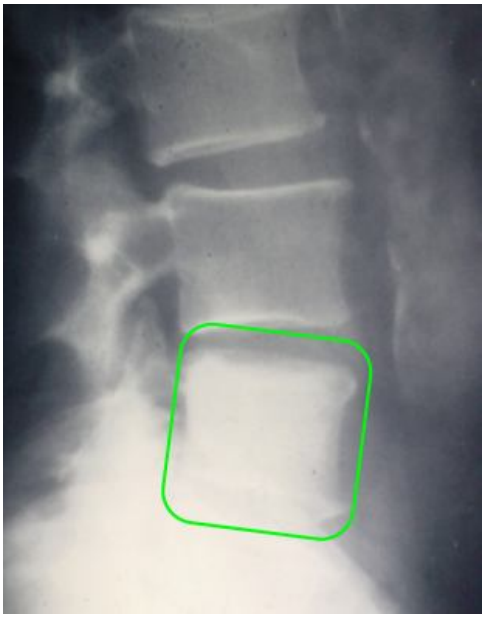
Ivory Vertebra



covered by 2 ilium)
L4 is to blastic
Osteoblastic metastasis

Ivory vertebra differential

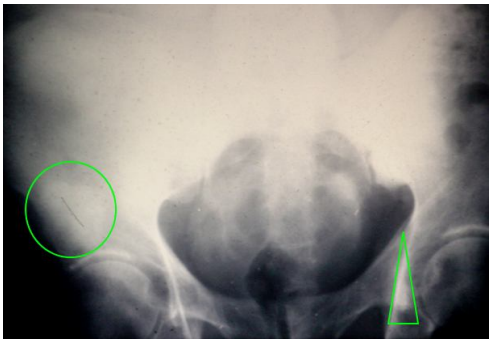
Osteoblastic metastasis (50+ years old)
Women=breast
Males=prostate
Padgett's disease (3rd stage) (50+ years old)
Thickens cortex and coarsens trabecular pattern
Lymphoma (20-40 years old)



Osteoblastic mets

Film: AP pelvis

Apparent OCI but not really
Mass above right femur, changes in left teardrop distance
Osteoblastic mets (breast)



AP Lumbar Local lucency (mets or bone island)

Film: AP Lumbar

White mass overlying a pedicle
So local and bright it must be osteoblastic disease
Could be bone island or bone metastasis
Age will be your differentiator

Primary tumors

Lytic skull pattern decision tree

Rain drop skull-multiple myeloma
Uniform hole sizes
Metastasis is more common
Will have blood spreading of tumor emboli
Will not be symmetrical
Padgett's=**osteoporosis circumscripta**

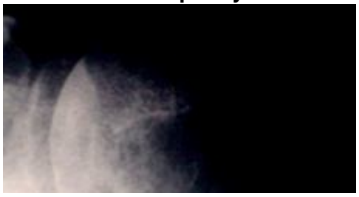
Multiple myeloma

Will not show 'hot' on bone scan
Inhibition of osteoblastic activity
Want MR
Want immunoglobulin electorphoresis

AP shoulder: Multiple Myeloma

Film: AP shoulder

Dx: Multiple Myeloma
Most aggressive patterns of bone destruction
Moth eaten=larger holes , uneven size
Permeative pattern of destruction=smaller holes w/ even sizes
Lack of periosteal reaction
Generalized osteopenia



Film: AP shoulder

Dx: Multiple Myeloma

Most aggressive patterns of bone destruction

Moth eaten=larger holes , uneven size

Permeative pattern of destruction=smaller holes w/ even sizes

Lack of periosteal reaction

Generalized osteopenia

Lecture 9

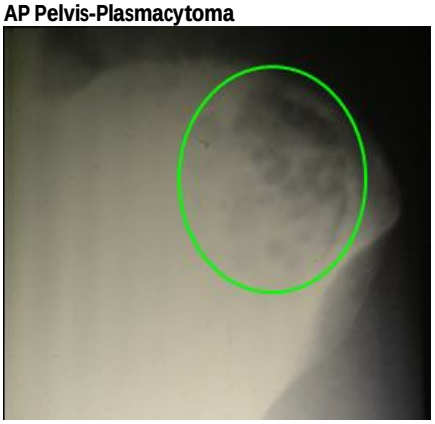
Wednesday, August 13, 2008
9:17 AM

Continued **Multiple Myeloma**
- A primary cancer which produces uniform sized lytic lesions
- Causes suppression of osteoblastic activity (why the bone scan will be negative)
- Bence Jones protein is associated w/ Multiple Myeloma (only elevated in 40% of cases)
  - Use as inclusive criteria
- **Immunoglobulin electrophoresis**=great test for Multiple Myeloma
  - May be GADEM
- Biopsy is the gold standard for diagnosing Multiple Myeloma
- Red marrow spaces may be taken over by tumor resulting in Normocytic, normochromic anemia (made correctly but just not enough)

Film: lateral lumbar
- Compression deformity of L4, L3 (vertebra plana at L4)
- Generalized osteopenia
- Cold on bone scan
- **Dx**: must be Multiple Myeloma

Film: lateral C-spine
- C4 has bubbly expansile lesion w/ protrusion into tracheal space
- Local lucency seen in body
  - Infection or tumor
- **Hx**: dealing with pain for weeks to months (rules out infection)
- Diff Dx
  - Male-lung
  - Female-breast/lung
  - Primary bone tumor
- Perform bone scan-comes back negative
- MRi and biopsy performed
  - Histology is same as MM
  - MR shows only in one place
- **Dx**: **Solitary Plasmacytoma**
  - 30% will stay same
  - 70% will progress to multiple myeloma

AP Pelvis-Plasmacytoma

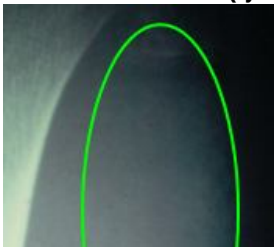


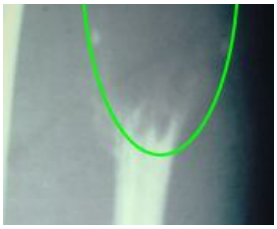
Film: AP knee
- Young adult male (closure of growth plates almost finished)
- Don't think mets due to age/history
- **Diff Dx**:
  - Ewing's sarcoma
    - Predominates diaphyseal area of bones
    - Hair on end periosteal reaction
    - Osteosarcoma
    - Strong association w/ metaphysis of long bones
  - **Osteosarcoma**
    - Double matrix tumor (makes it great at absorbing bone)
    - #1 location=distal fever
    - #2 location=proximal tibia
    - VERY aggressive tumor
- **Dx**: Osteosarcoma

AP knee-Osteosarcoma

Film: AP knee
- Proximal portion of fibula is GONE!
- This is the most aggressive form of Osteosarcoma

AP knee-Osteosarcoma (Lytic) of fibula





AP Shoulder-Osteosarcoma

Film: AP shoulder

Destruction/lytic but doesn't cross joint space

Osteosarcoma

May present w/ brush like periosteal reaction

Codman's cuff (Codman's triangle)=laminated periosteal response that gets punctured in middle w/ ragged ends on borders

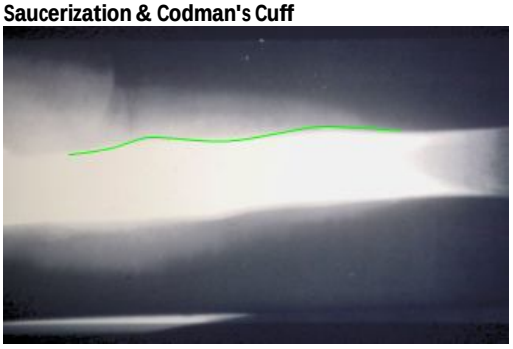
Saucerization=tea cup and saucer appearance provides 3 diff

Ewing's sarcoma

Osteomyelitis

Stress fracture

Saucerization & Codman's Cuff



Film: AP femur/knee

Only 1 Quasi-malignant tumor=**Giant Cell Tumor**

20% aggressive

Mostly silent history

Youngish age range

Loves going to end of the bone (subchondral)

ID by biopsy and find giant cells in tumor

Film: AP knee

Local lucency seen above and behind the patella

Small zone of transition=more benign

Lateral view

Shows more defined outline

Padgett's will convert from a mixed phase presentation to a blastic presentation

AP knee-Osteochondroma

Film: AP knee

Osteochondroma

Looks like Supracondylar process but isn't on humerus and points away from joint

"Coat-hanger exostosis"

Cartilage will be at tip

Similar **sessile lesion**

Fracture=most common complication

May also present neurovascular compression

HME=Hereditary Multiple Exostosis

Looks like lots of osteochondroma

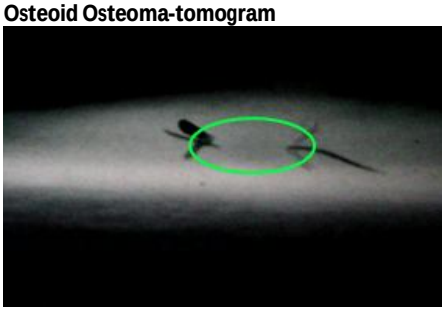
Film: lateral lumbar

Hemangioma=most common benign tumor of spine
May think osteoporosis but isn't generalized
Barrel shaped vertebra (may exacerbate central canal stenosis)
Very bloody lesions w/ altered haemostatic responses (bleed out)
Corduroy vertebra=pattern made by increased trabecular pattern
Also predilicts to mandible
On CT the tumor is pushing the horizontal trabeculae around
See it, name it, forget it

Film: AP tibia

Diff Dx Night pain relieved by aspirin (both have nidus)
Brodie's abscess
Osteoid Osteoma
Extra cortical

Osteoid Osteoma-tomogram



Shows up hot on bone scan

Osteoid Osteoma-bone scan

Film: AP hand

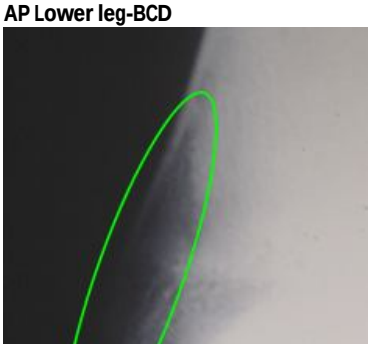
Enchondroma=most common benign appearing, tumor of the hand (foot) w/ a clear matrix
Some cortical stretch (but no destruction)
May become **chondrosarcoma**
Most common complication=fracture

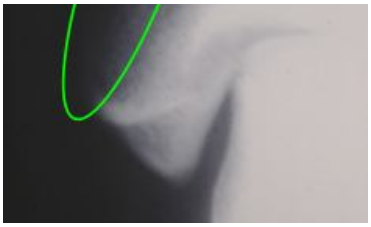
AP hand Enchondroma

Film: AP lower leg

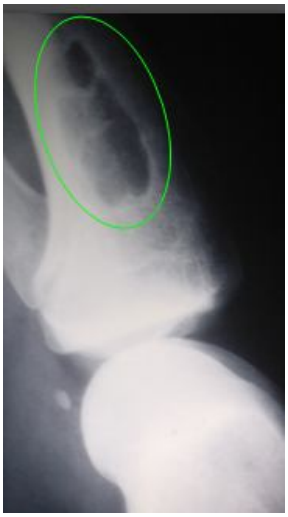
Benign fibroCortical Defect=intercortical lucency lesion
Will usually fill in and can't find
Clinically silent
Tx: drill holes=body will fill in

AP Lower leg-BCD





Lateral knee-FCD



Film lateral knee

Non Fibrocortical defect

Like BCD but will not fill in over time

Clinically silent

Tx: drill holes=body will fill in

Film: AP shoulder

Aneurismal Bone Cyst=most likely benign tumor to cross growth plate

Like aunt mini lesion

Loves metaphysis

Film: Lateral foot

Intraosseous Lipoma

Most common tumor of calcaneus

Most common tumor w/ central calcified nidus

Can fracture

Film: AP skull

Tumor like

Padgett's disease

Starts lytic then moves mixed then blastic

Osteoporosis circumscripta=pattern of lucency in skull

Cotton tipped skull=Sclerotic change of skull

Skull changes may lead to decrease CN function due to closing of foramen

Film: AP/Lateral lumbar

Dx: Padgett's

Picture framed vertebra=thickened cortical margin

Sclerotic cortical margin w/out decreased joint space

Lab testing up to 20x normal **alkaline phosphatase**

Film: AP femur neck

Padgett's

Trabecular pattern is seen more so than needed

May decrease femur neck angle (turns into shepard's crook)

Bone softening disorder

Film: AP pelvis

Brim sign=thickened pelvic rim

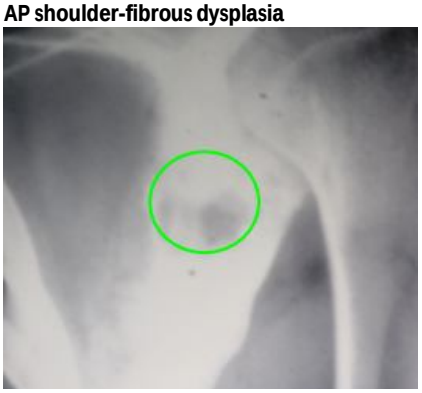
Sclerosis over entire pelvis

Protrusio acetabuli

Padgett's can also be a great imitator

Film: AP shoulder

AP shoulder-fibrous dysplasia



Fibrous dysplasia=never has calcium within center

Extremely irritating to periosteium and endosteum

Rind of sclerosis=irritation of periosteium and endosteum causes a rind like sclerotic margin

Café au lae spots may be present

Also present in **neurofibromatosis**

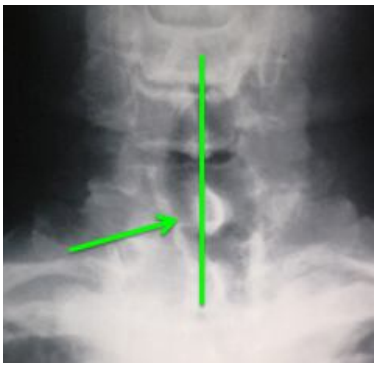
May pressure erode the bone

Film: AP cervical

Neurofibromatosis

Can push tracheal air shadow (shown on)

AP Cervical-neurofibromatosis



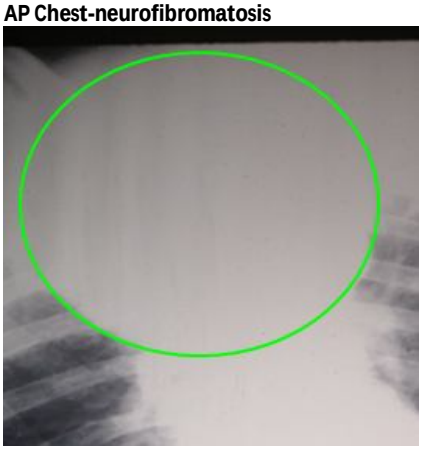
Film: AP chest

Café au lae spots

Coast of California appearance=smooth and consistent (fibrous dysplasia)

Coast of Maine=rough and inconsistent margin (neurofibromatosis)

AP Chest-neurofibromatosis



Film: oblique cervical

Oblique cervical-neurofibromatosis

Study Guide: Infection

Wednesday, July 23, 2008
9:29 AM

6804 Diagnostic Imaging II —INFECTION-review sheets
Dr. Kuhn

A. Infection categories
   a. Suppurative Osteomyelitis
   b. Non Suppurative Osteomyelitis
   c. Syphilitic
   d. Mycotic
B. Most common organism associated with osteomyelitis?
   a. Staph. Aureus
C. Organism, which demonstrates a predilection for the SI, SC and Spinal Joints
   a. Pseudomonas – gets the "S Joints." Mostly associated with drug addicts
D. Organism seen to affect humerus in newborns
   a. Streptococcus B
E. Most likely age range for osteomyelitis
   a. Typically between 2 and 12 with 3:1 male to female
F. Is osteomyelitis typically monoostotic or polysystolic
   a. Monoostotic
G. Affected population in cases of osteomyelitis
   a. Immunosuppressed
   b. Alcoholics
   c. Newborns
   d. Drug addicts – predisposed to Pseudomonas infections of the S joints
H. Is osteomyelits a primary or secondary process
I. Where is it most likely to start?
   a. Commonly large tubular bones in extremities [femur]. Tibia humerus and radius are also favorite spots.
J. How does it spread to bone?
   a. **Hematogenous**
      i. Deposition into blood stream of organisms that may reach distal skeletal sites. MOST COMMON
   b. **From contiguous source of infection**
      i. Extend into bone from adjacent contaminated site
      ii. Cutaneous, sinus and dental infections are common sites of origin for adjacent osteomyelits
   c. **Direct implantation**
      i. Result of direct penetrating injures or puncture wounds, such as those by nail, splinter or glass common on feet. Open fractures could be a source of direct implantation
   d. **Postoperative infection**
      i. Contamination of surgical sites

K. Define the following
   a. Sequestrum: (pg. 1374 – 1375)
      ○When periosteal and subperiosteal are involved in an inflammatory process there is a loss of blood supply to the cortical bone rendering it necrotic. Cortical and medullary infarcts result in the formation of a sequestrum, or dead bone.
   b. Involcrum: (pg. 1374 – 1375)

○During osteomyelitis as the pus from the infection lifts the periosteum; it causes a modest degree of new bone proliferation and pain. The periosteal new bone is the body's attempt to wall off the infective process. This bony collar is often referred to as the involucrum.

c. Cloaca: (pg. 1375)
   - The occurrence of a defect that may develop in the involucrum is referred to as a cloaca. The functions of these defects is to allow the continued discharge (decompression) of inflammatory products from the bone and has been referred to empyema necessitates. These cloacae are most frequently associated with chronic osteomyelitis, which is stubborn in its response to conventional antibiotic therapy.

d. Marjolin's ulcer: (1375)
   - One rare but significant complication of the draining sinus (cloaca) is the development of a squamous cell carcinoma within the channel of the cloaca. This ulcerative channel and malignant transformation is found only with chronic osteomyelitis and may be referred to as Marjolin's ulcer.

e. Saucerization:

f. Brodie's abscess: (1386 – 1391)
   - It is defined as a localized, aborted form of suppurative osteomyelitis. The abscess is depicted as an oval, elipitical, or seriginous radiolucency with no visible matrix surrounded by a halo or doughnut rim of heavy reactive sclerosis.

L. List the clinical features for the child with osteomyelitis (pg 1385)
   - Early diagnosis is important and clinical signs and symptoms precede plain film findings by 7 – 10 days in the appendicular skeleton and 21 days in the spine. Young patients present with acute systemic symptoms. The most frequently affected age range is 2 – 12 years; 3:1 males. Affects tubular bones, most commonly the femur.

M. List the clinical features for the adult with osteomyelitis: (pg. 1385)
   - It is basically the same as in the adult except adult patients present with symptoms that vary and tend to be more chronic.

N. List the radiographic features for osteomyelitis (pg. 1385)
   - Bone scans are the earliest means of diagnosis
   - Radiographic latent period for plan films: extremities 10 days, spine 21 days
   - Soft tissue alterations: elevated fat plans, obliterated fat planes, increased density, and paraspinal edema.
   - Bone changes: Moth eaten bone destruction, usually metaphyseal in origin. Periosteal new bone formation. Sequestrum. Involucrum. Joint space destruction. Epiphysis often spared if physis is open. Loss of disk height, with spine involvement. Vertebral destruction and collapse.

O. How to differentiate between infection and neoplasm
   a. Infection respects no boundaries – therefore it crosses jt margins
   b. Manifests visible bony changes in a short amount of time

P. Define the following
   a. Gibbus – angular deformity, found in TB of spine
   b. Long vertebra – altered vertebra that has become longer than it is wide due to long standing gibbus formation just above it. Only found in patients in which the vertebral growth centers were not closed at the time of infection. Found in TB of spine
   c. Pott's paraplegia – a rare complication of Pott's disease. Pressure paraplegia results from collapse of vertebral bodies, extensive granulation tissue and detached sequestra from the vertebral bodies. May have sudden onset
   d. Cold abscess – coalition of several nodes due to their walls deteriorating (p1412)
      i. Speckled white pattern in bone and soft tissue
      ii. No longer an active process

Q. For TB complete the following

a. Compared to the rate of progression of suppurative infections how does TB compare (table 12-3 p 1412)
    i. TB – slower progression (months)
    ii. Suppurative – quick (2 weeks)
b. Where do TB infections begin
    i. Respiratory Tract (upper lungs)
c. How do they spread
    i. Initially via inhalation or ingestion
    ii. Hematogenous spread of a primary focus in the respiratory tract leads to infection of musculoskeletal system
d. Where are resistant strains more common today?
    i. An overuse of the same antibiotics
e. Why is TB on the rise again in USA?
    i. Modern travel
    ii. Immigration of groups from areas where TB is still endemic (Prevalent in or restricted to a particular region, community, or group of people).

R. For Fungal Infections:
a. m/c fungal infection worldwide? Maduramycosis (Madura Foot): comes from direct contact to fecal matter with bare feet that have an exposed wound, very common in Africa
b. m/c fungal infection in the SW US? Coccidioidomycosis: favorite cites are bony prominences-acromian, med and lat maleoli, and patella; just needs a blood supply to the bone to cause damage
c. m/c fungal infection in the northern US? Blastomycosis: spores went airborn from a landslide and the 52 y/o woman inhaled them, she had increased prevertebral soft tissue space on her cervical x-ray. Use a methaline blue for staining of this fungus
d. m/c fungal infection in the Miss. and ohio river valley? Histoplasmosis; soft tissue fungus that does not migrate to bone

S. For Syphilis:
a. Two types: Congenital and Acquired
b. Pathomechanics: Congenital- is passed from mother to child through the placenta after the 4 month of gestation. Acquired- is seen in adults as a consequence of poor behavior; sexually transmitted
c. Key radiographic features of the m/c type-congenital
-phase 1: Metaphysitis
- present at birth or shortly after
    - lodging of spirochetes beneath the fetal growth plates produces a metaphysitis in which the normal vascular fountain underneath the cartilage is replaced by syphilitic granulation tissue
    - bone formation and remodeling in the zone of primary ossification is decreased or absent
    - creates radiolucent mestahyseal bands, these bands often lead to metaphyseal irregulatity with fragmentation and infracions = *sawtoothed appearance;* often bilateral and symmetrical, m/c the upper extremities
    - knees, shoulders, and wrists are the m/c affected areas
    - often symmetrical erosive defects occur on the medial surfaces of the proximal ends of the tibiae, representing *Wimberger's sign of congenital syphilis*
    - doesn't affect cartilage
    - lesions of phase 1 heal quickly with Tx

-phase 2: Periostitis
    - periosteum may be infiltrated by syphilitic granulation tissue, creating a solid or laminated rxn
    - the periosteal response is often diffuse and symmetrical, affecting nearly all of the

major long bones
- complete remission with Tx

-phase 3: Osteitis
- only get if have not received Tx
- extension of infectious focus
- reactive sclerosis surrounds the osteolytic lesions, with associated periostitis of the long tubular bones
- extensive periostitis and cortical overgrowth may create an undulating, dense contour to the long tubular bones
- frequently, both tibiae will be involved, creating the classic *saber shin*; anterior bowing of the tibia is characteristic, with osteolytic defects scattered throughout the bone

-Additional Features
- will find multiple swollen, non painful joints, called Clutton's jts
- deformity of the teeth, creating peg-shaped, hypoplastic, and notched teeth, Hutchinson's teeth

a. definitions of Wimberger's sign, Saw tooth, and Saber shin are in above descriptions

Study Guide: NME

Friday, August 15, 2008
8:16 AM

1. Osteoporosis

A. Know the 3 patterns of osteopenia and the most common causes of each

1. Generalized: An "all over" loss of bone density, especially in the axial components of the spine, pelvis, and proximal long bones. The most common cause is postmenopausal status and aging.

2. Regionalized: Loss of bone density in one region or segment of the body. Most common cause is immobilization such as after a fracture. Other causes are Sudex atrophy and transient regional osteoporosis.

3.Localized: Focal losses of bone density affecting a relatively small area of bone are usually the result of local disease such as inflammatory arthritis, neoplasm, or infection.

2. How can we assess bone density?

A. Quantitative CT
B. Dual Photon Absorptiometry (I guess this is DEXA)
C. Single Photon Absorptiometry
D. Radiogrametry

3. For Postmenopausal Osteoporosis

Clinical Features:

A. Presentation is usually in the 5^{th} or 6^{th} decades in females by a ratio of 4:1
B. Usually causes pain only when complicated by fracture and deformity, especially in the spine
C. No lab findings useful

Key radiographic features:

A. increased bony radiolucency
B. cortical thinning
C. altered trabecular patterns
D. fracture deformity

Table 14-3

Decreased bone density
Trabecular changes
    Accentuation of primary trabeculae (pseudo-hemangiomatous appearance)
Washed out appearance
Cortical thinning
Changes to vertebral shape
    Vertebra plana (pancake vertebra or silver dollar vertebra)
    Wedged vertebra
    Biconcave deformities (fish vertebra)
    Localized endplate deformities
    (chart continued)
    Schmorl's nodes

Review Figures 14.4, 14.10
see text pages 1501 and 1504

A. Briefly define senile osteoporosis (1497)

Reduction in bone quantity w/ the actual quality of the bone remaining normal, in this form of osteoporosis it is associated w/ old people.

B. For Reflex Dystrophy: (1508-1509)
   a. Define the entity
   Aka: posttraumatic osteoporosis, Sudeck's atrophy, acute bone atrophy, casalgia
   Def: complex regional pain syndrome to emphasize the multisys. Disturbances of the somatic, psychological, and behavioral aspects of the pt's life
      b. Key clinical features

   *Characterized by an acute onset of painful regional osteoporosis, usually following trivial trauma
   *Progressive onset of pain, stiffness, swelling, and atrophy@ and distal to the site of injury over a 3-6 month period
   *Characteristic changes can be classified into 3 distinct stages: 1) acute/hyperemic 2) dystrophic/ischemic 3) atrophic
   *Recovery slow over many months, may never completely heal w/ residual atrophy, contracture, and joint stiffness

   c. Key radiographic features

   *Rapidity of appearance and progression of osteoporosis
      -early: bone appears mottled
      -later: entire bone density is diminished
   *Bone scans will always be negative

   d. Discuss likely etiologies

   *Reflex overactivity of the sympathetic nervous sys. That mediates trophic changes in bone and soft tissues in response to external stimulus
   *Hyperemia of bone augments osteoclastic resorption, which rapidly demineralizes the involved skeletal structures.

C. Define disuse and immobilization osteoporosis (1509)

*Regional osteoporosis resulting from traumatic injuries that are immobilized, motor paralysis, and inflammatory lesions of bones and joints
      i. immobilization inhibits osteoblastic activity while osteoclastic-mediated bone resorption is accelerated

*Four patterns of osteoporosis: uniform, spotty, bands, cortical/scalloping

7. Osteomalacia
   a. Defined = bone softening, abnormal (K-Mart) bone; the skeletal endpoint of many, many different diseases
      i. Osteopenia = decreased bone density (just a quantitative description)
      ii. Osteoporosis = normal bone, but less of it (qualitative and quantitative description)
   b. M/C examples (table 14.4)
      i. *Deficiency* – Vit D, calcium, phosphorus, dietary chelators
      ii. *Absorption* – gastric abnormalities, biliary diseases, enteric malabsorption

iii. *Renal tubular* – proximal tubular lesions, proximal and distal tubular lesions, distal tubular lesions (primary and secondary)
iv. *Renal osteodystrophy*
v. *Unusual forms and associations* – fibrous dysplasia, neurofibromatosis, neoplasm, anticonvulsant drugs (Dilantin), hypophosphatasia

c. Radiographic features
i. Decreases bone density – 2º to diminished bone mineral content
ii. Coarsened trabecular pattern – from overall loss of bony trabeculae
iii. Loss of cortical definition – thinner and altered in structure
iv. Pseudo-fractures – bilateral and symmetrical linear radiolucencies; Paget's fibrous dysplasia, rickets, hyperphosphatasia
v. Deformities – (in weight bearing bones) protrusio acetabuli, bowing of femur and tibia

d. Common complications – fracture from trivial trauma, progressive bone deformities

8. Rickets = systemic osteomalacia in an infant or young child
a. Cause – deficiency in Vit D, phosphorous, calcium
i. In the past – primary
ii. Today – renal rickets or secondary hyperparathyroidism
b. Clinical features – short in stature, bowed long bones
c. Radiographic features – "rickets rarifies the ZPC," rachitic rosary (bulbous spade-like ribs)
d. Treatment – Vit D, sunlight exposure
9. Scurvy = Barlow's Disease, hypovitaminosis C
a. Cause – long-term deficiency of Vit C
b. Clinical features – petechiae, bleeding gums, melena, hematuria
c. Radiographic features – "scurvy scleroses the ZPC," scorbutic rosary (bowed, spade-like ribs), generalized osteopenia, Wimberger's sign (ring epiphysis)
d. Treatment – Vit C therapy

D. For osteomalacia: (1511-1514)

a. Define the term
metabolic disorder that alters the quality of bone
-lack of calcium salts being deposited in osteoid tissue
-"soft bones"

b. List the most common examples (table 14.4)
<u>Deficiency</u>:
*Vit. D
*Calcium
*Phosphorous
*Dietary chelators
<u>Absorption</u>:
*Gastric abnormalities
*Biliary Ds.
*Enteric malabsorption
<u>Renal tubular</u>:
*Proximal tubular lesions
*Proximal and distal tubular lesions
*Distal tubular lesions (tubular acidosis), primary and secondary
<u>Renal Osteodystrophy</u>
<u>Unusual forms and associations:</u>
*Fibrous dysplasia
*Neurofibromatosis

*Anticonvulsant Rx (Dilantin)
*Hypophosphatasia

c. Radiographic features
d. Common complications

E. Define rickets
   a. Causes
   b. Clinical features
   c. Radiographic features
   d. Treatment

F. **Define Scurvy (Barlow's disease, Hypervitaminosis C) – Pg 1516-1517**
   a. Cause

Vitamin C deficiency results in impaired collagen synthesis. Must be at least 4 months of avitaminosis before symptoms and skeletal changes become apparent. The typical pathological manifestations of vitamin C deficiency are noted in dentine, osteoid, and capillary vessel wall tissues. Pathological changes are a function of the rate of growth of the affected tissues; hence, the bone changes are often observed only in infants during periods of rapid bone growth.
<u>Initial symptoms</u> are nonspecific and include the following: Loss of appetite, Peevishness, Poor weight gain, Diarrhea, Tachypnea, Fever
<u>Specific symptoms</u> include the following: Irritability, Pain and tenderness of the legs, Pseudoparalysis, Swelling over the long bones, Hemorrhage.

   b. Clinical features

Hypovitaminosis C which affects mainly infants fed solely on pasteurized milk.
Latent period of months
Usually age 8-14
Spontaneous hemorrhages, swelling, irritability, pain, lying motionless (frog-Legged), and costal rosary.
Serum ascorbic acid < 0.6mg/100ml

   c. Radiographic features

Osteopenia
Dense Zone of provisional calcification
Ring epiphysis (Winberger's sign)
Corner (angle) sign
Pelken's spur
Scorbutic zone (Trummerfeld's zone)
Subperiosteal hemmorage

   d. Treatment

Vitamin C therapy – all changes are reversible although Frankel's line (dense zone of provisional calcification) may remain. Adequate diet http://www.wrongdiagnosis.com/treat/diet_changes.htm - *sources include citrus fruits (lemons, limes, oranges), Berries, Capsicum, Parsley, Pawpaw, Leafy green vegetables*

G. **Hyperparathyroidism [HPT] – Pg 1517-1523**

This condition of excessive calcium in the blood, called hypercalcemia, is what usually signals the doctor that something may be wrong with the parathyroid glands. In 85 percent of people with this disorder, a benign tumor (adenoma) has formed on one of the parathyroid glands, causing it to become overactive. In most other cases, the excess hormone comes from two or more enlarged parathyroid glands, a condition called hyperplasia. Very rarely, hyperparathyroidism is caused by cancer of a parathyroid gland.

a. Define 3 forms of HPT

1. *Primary hyperparathyroidism: elvevated parathormone stimulates osteoblastic resorption, liberating calcium and phosphorus into the bloodstream. Phosphorus is mor readily excreted and, owing to the constant calcium-phosphorus product, calcium is retained disturbing the homeostasis. The net result is hypercalcemia and hypophosphatemia.*
   This is the most common cause of hypercalcelmia and may be owing to parathyroid adenoma, carcinoma, hyperplasia or ectopic tumors producing parathormone type substances.
   Characteristically there are elevated levels of parathormone, hypercalcemia, and hypophosphatemia.
2. *Secondary hyperparathyroidism: a combination of calcium loss and abnormal renal vitamin D formation creates continuous hypocalcemia and increase the release of parathormone and bone resorption.*
   Complication of chronic renal disease, allowing for persistent loss of calcium and phosphorus thus stimulating the parathormone release
3. *Tertiary hyperparathyroidism: the parathormone gland acting independently of serum calcium levels.(from dialysis/renal failure)*

b. Clinical features

Affects women 3:1
Clinical profile of women 30-50 y/o with weakness, lethargy, polydipsia, and polyuria
Weak and hypotonic muscles
Kidneys Calculus formation (maybe the reason why patient presents for examination)
Bone tenderness
Increase alkaline phospatase level in the presence of bone disease
Elevated parathormone concentration

c. Radiographic features

Subperiosteal resorption
Subarticular resorption and associated vascular calcification
Widened jt space and irregular jt margins
Brown tumors and chondrocalcinosis
Soft tissue calcification
Classic salt and pepper appearance of the skull
Rugger Jersey Spine
Target Sites:

Hand: *subperiosteal resorption, radial margins of proximal and middle phalanges of the 2nd and 3rd digits, w/ acro-osteolysis*
Skull: *salt and pepper, resorption of lamina dura*
Spine: *osteopenia, trbecular accentuation, endplate concavities, rugger jersey spine, widened sacroiliac jts, DRSA manifesting as loss of endplate, vertebral body destruction, and decreases disc height.*
DRSA – Dialysis related spondyloarthropathy

d. Treatment

Surgery to remove the enlarged gland (or glands) is the only treatment for the disorder and cures it in 95 percent of cases. Patients who are symptom-free, whose blood calcium is only slightly elevated, and whose kidneys and bones are normal, may wish to talk to their doctor about long-term monitoring.
Biphosphonates are currently used to inactivate osteoblastic activity.

Estrogen therapy may be beneficial in postmenopausal women to reduce the severity of osteoporosis.

11.) ACROMEGALY

a.) Cause: Increased growth hormone in skeletally mature person
b.) Clinical Features –

- thick joint – hip, knee, spine
- facial : malocclusion, prominent forehead, thickend tongue, broad, large forehead
- thickened skin on hands

c.) Radiographic Features

- Heel sign – heel pad > 20 mm
- Skull – sella turcica enlargement, sinus overgrowth, malocclusion
- Hand and food – widened shafts, bony protuberances, enlarged distal tufts (spade-like), widened jt. Spaces
- Spine – platyspondlyl, hyperostoses, widened disc and facet spaces, posterior body scalloping, widened ADI

I. **Heavy metal intoxication**

a. Clincial features

Abdominal pain
Encephalopathy
Disturbances of the nervous system

b. Radiologic features

Linear, transverse densities at the metaphyses (lead lines)/ radiodense metaphyseal bands
Remodeling abnormalities

J. **Histiocytosis X-Focus on eosinophilic granuloma** aka: Langerhans cell histiocytosis LCH

a. Cause

It is of unknown origin but the hallmark of the disease is an abnormal proliferation of reticulo- endothelial cells, predominantly the histiocyte from which the disease derives it's name.
(intense proliferation of reticulohistiocytic cells)
3 Types

b. Clinical features

Eosinophilic Granuloma: 60-80% of Histiocytosis X, age 5 - 10 yrs, presentation: bone pain, local swelling, irritability,
Bones: *50 - 75% solitary / monostotic, skull/mandible (50%): "punched-out" lucencies, "hole within a hole", "button sequestrum", "floating teeth", spine/pelvis (25%): vertebra plana* http://chorus.rad.mcw.edu/doc/00848.html *(most common pediatric cause), long bones (15%): medullary lucency +/- thin sclerotic rim*
Lungs: *involved in <10%, signals worse prognosis, apical reticulonodular infiltrates, honeycomb lung.*

c. Radiographic features

Letterer-Siwe disease*: Skeletal lesions are infrequent; lytic lesions in the calvaria. Uncommon long bone lesions stimulate Ewing's sarcoma*

Hand-Schuller-Christian Disease: *Polyostotic destructive foci in and immature skeleton with lesions occurring anywhere particularly in the skull, pelvis and long bone. Lesion as a wide spectrum of appearances from benign geographic from to a permeative, cortex destroying malignant process.*
Lesions may consist of multiple lytic defects involving the entire bone frem the diaphysis to the metaphisis. Coalescence creates larger defects with bevele cortex, producing the whole-within-hole appearance.
Eosinophilic Granuloma:

Study Guide: Neoplasia

Friday, August 15, 2008
8:19 AM

Study Guide for Tumors

Tumor material is divided between Metastasis, Primary Tumors, Secondary Tumors, and Tumor like conditions.

Must review Tables: 7.5, 11.1, 11.2, 11.4, 11.5, 11.6, 11.9, 11.10, 11.11
Must review figures: 11.2, 11.3
Look in Normal variance packet it is also very good.

1. Metastasis:
    a. Define
        i. Metastatic bone tumors are the most common malignant tumors of the skeleton.
        ii. 70% are malignant tumors are metastatic in origin
        iii. 30% are primary in nature
        iv. Most malignant tumors of bone are metastases from a primary extraskeletal focus, the majority are epithelial in origin

Table 11.1 Overview of Common Malignant Bone Lesions

Primary (30%)		Secondary 70%		
Multiple Myeloma (m/c)		Lytic 75%	Blastic 15%	Mixed 10%
Osteosarcoma (second m/c)		Lung	Prostate	Prostate
Chondrosarcoma (third m/c)		Breast	Breast	Breast
Ewing's Sarcoma (fourth m/c)				

Table 11.2 Most Common Causes for Osseous Metastases

Population	Lytic	Blastic
Female	Breast (80%)	Breast (10%)
Male	Lung (75%)	Prostate (80%)
Young (<20 years)	Neuroblastoma (80%)	Hodgkin's (50%)

Table 11-5	Radiologic Features of Metastatic Carcinoma to Bone
General	
Axial skeleton predilection	
Multiple sites	
Osteolytic metastases (75%)	
Cortical and trabecular destruction	
Lack of periosteal response	
Moth-eaten, permeative destruction	
Small or absent soft tissue mass	

Multiple sites	
Variants (Lung, thyroid, kidney); solitary espansile soap bubble lesions	
Osteoblastic metastases (15%)	
Localized or diffuse increased bone density	
Poorly defined margins	
Multiple sites	
Mixed metastases (10%)	
Combination of blastic and lytic features	

b. Most common primary sites of cancer associated with metastasis to bone are: **Breast, Lung, Prostate, Kidney, Thyroid, and Bowel.**

c. Key Clinical Features
   i. Age:
      1. Most patients presenting with skeletal metastases are in their second half of life, M/C past the 4th decade
      2. Children <5 yoa caused by **Neuroblastoma**
      3. 10-20 yoa caused by **Ewing's sarcoma and Osteosarcoma**
      4. 20-35 yoa casued by **Hodgkin's lyphoma**

   ii. Appearance at presentation:
      1. Most patients present with a history of **recent weight loss**, **appear cachectic**, and experience **anemia and fever** in advanced stages of the disease
      2. Secondary skeletal deposits create the first symptoms of the carcinomatous process. Common w/ carcinoma of the thyroid, liver, and kidney
      3. Sign and symptoms are pain and pathologic fracture. Pain is insidious onset w/ bouts of remission and exacerbation.

   iii. Key laboratory Findings
      1. Elevated **erythrocyte sedimentation rate (ESR)** is often present but not pathognomic of metastatic disease
      2. Elevation of **serum calcium** may occur in diffuse osteolytic metastatic carcinoma. Serurm calcium in most cases, even if lytic, are normal.
      3. Alkaline phosphatase is frequently elevated in blastic metastaic lesions but overall is a insensitive indicator of bone metastasis.
      4. Prostate Specific Antigen (PSA) is elevated >10ng/mL in cancer patients which the prostate gland tumor has broken through

d. Lytic vs. Blastic Metastasis

Lytic Metastasis	Blastic Metastasis
M/C Primary	M/C Primary
(M) 1. Lung	(M) 1. Prostate
(F) 1. Lung	(F) 1. Breast
2. Breast	

e. Key radiographic features for each:

Table 11.4 Radiologic Presentation of Metastatic Carcinoma

Primary Organ Involvement	Lytic (%)	Mixed (%)	Blastic (%)
Breast	80	10	10
Lung	75	20	5
Real Wilm's Tumor	80 80	10 20	10 ---
Urinary bladder	90	10	---
Thyroid	90	10	---
Prostate	10	10	80
Salivary glands	100	---	---
Neuroblastoma	80	15	---
Esophagus	85	10	5
Stomach	90	10	---
Colon or rectum	75	5	20
Pancreas	80	10	10
Liver	70	30	---
Gallbladder	90	10	---
Uterine cervix	90	8	2
Uterine corpus	90	10	---
Ovary	90	7	---
Testis	75	5	20
Skin carcinoma	95	5	---
Malignant melanoma	90	10	---
Carcinoid	5	15	80
Hodgkin's Lymphoma	40	10	50

f. Provide the differential dx. of pedicle destruction (table 11.9)

Table 11.9	Differential Diagnosis of Pedicle Destruction
Congenital Agenesis (Contralateral Pedicular Sclerosis) Hypolasia	
Neoplasm Benign Aneurysmal bone cyst Osteoblastoma Neurofibroma Osteoid osteoma Malignant Lytic metastasis Myeloma (rare	

Surgery Removal	

2. Features of Primary Malignant vs. secondary tumors. (Table 11.6)

Malignant Bone Neoplasms: Differentiating Radiologic Features between Primary and Secondary lesions

Feature	**Primary**	**Secondary**
Incidence	30%	70%
Expansion of bone	+++	+
Joint involvement	---	---
Length of lesion	>6cm	2-4cm
Periosteal response	+++	+++
Solitary lesion	+++	+
Multiple lesions	+	+++
Soft tissue mass	+++	+

3. List 3 ways in which tumors can spread from a primary the site to bone.
    a. **Direct Extension**
        i. Direct invasion into a bone may occur from a soft tissue tumor lying adjacent to or near the bone.
        ii. An example is carcinoma of the uterus which is known to cause direct extension to the iliac bones
    b. **Lymphatic Dissemination**
        i. This is uncommon. It is thought that the absence of lymphatic channels in bone marrow is the reason for the relatively low incidence of lymphatic seeding of bone.
    c. **Hematogenous Dissemination**
        i. Spread through blood vessels, particularly the veins, is the most common pathway for tumor emboli. The three most commonly seeded in this manner are the lungs, liver, and the axial skeleton.
        ii. **Batson's Venous Plexus** are valveless veins where blood can reflux when intrathoracic and intra-abdominal increases. Batson's plexus also provides a series of venous passageways by which cancer cells can be directly seeded into bones. **(Figures 11.2 and 11.3)**

4. What is the most common primary malignancy of bone?
    a. Multiple Myeloma

    b. What does it look like on a bone scan?
        i. Bone scans are cold or normal except at sites of pathological fractures, which will be focally hot.
            1. This occurs because Multiple Myeloma causes the release of Osteoclast Activating Factor by the plasma cell. Bone scans depend on Osteoblastic activity. So when there is a fracture osteoblastic activity occurs.

    c. Where is it primarily located
        i. Located primarily in the spine.
        ii. Also located in the pelvis skull, ribs, and scapula.

d. Key clinical features.
    i. 75% of patients are between 50-70 yoa and 2:1 male preponderance
    ii. LB Pain is the cardinal initial symptom relieved with bedrest and aggravated with weight. With sciatica
    iii. Bacterial infections occur in 10% of cases most respiratory in nature.
    iv. Pathological fracture is common complication

e. Key radiologic findings.
    i. Bone Scans are cold
    ii. Gross osteoporosis may be the only early sign
    iii. Punched lesions are the radiologic hallmark of myeloma
    iv. Vertebra plana or wrinkled vertebra is characteristic.
    v. **Raindrop skull (lytic myeloma defects)** and pedicle sign of myeloma (preservation of pedicles) occur.
    vi. **"Moth Eaten," Permeative lesions**
    vii. **Foggy cortical – Medullary border**

f. Key laboratory features.
    i. 40% show Bence Jones' proteinuria.
    ii. Immnoglobulin Electrophoresis – to Elevation of IgG
    iii. May have infections do to decreased WBCs
    iv. Normocytic, normochromic anemia

g. Prognosis
    i. 90% die within 3 years.
    ii. Tx is usually radiotherapy, chemotherapy, and on occasion, local excision.

5. Define Solitary Plasmacytoma
    Localized form of plasma cell proliferation

a. Key clinical features
    i. Most common bones affected: manible, ilium, vertebrae, ribs, proximal femur, and scapula.

b. Key radiographic features
    i. The typical lesion has a geographic, soap bubbled, highly expansile radiographic appearance.

c. Common Complications
    i. **70% of solitary plasmacytoma lesions develop into diffuse multiple myeloma**

6. Osteosarcoma (also look in normal variance packet)
    -Is a primary malignant tumor of bone; it is derived from undifferentiated connective tissue and forms neoplastic osteoid

a. How common is Osteosarcoma? Age group?
    i. It is the second most common primary malignant bone tumor, representing 20% of all primary malignant bone tumors.
    ii. It is 2x more common than chondrosarcoma, 3x more frequent than Ewings sarcoma.
    iii. 75% of cases occur in the **10-25 year age range**, with 2:1 male predominance.

b. Key clinical features.
    i. Painful swelling of the involved limb is a common presenting symptom
    ii. The metaphyses of the distal femur, proximal tibia, and proximal humerus are the most common sites.
    iii. Only 3.5-7% occur in the spine

c. Key radiologic features
    i. The classic lesion presents as a permeative or ivory medullary lesion in the metaphysis of a long tubular bone with a poorly defined zone of transition.
    ii. A sunburst or sunray periosteal response is characteristic
        1. Sunburst= periosteal reaction that often takes place within an extracortical, dense soft tissue mass that displays transverse spicules or radiating striations.
    iii. Often, Codman's triangle is found associated with the destructive lesions
        1. This is a reactive response to the lifting of the periosteum and is not pathognomonic for osteosarcoma b/c it may also be found in benign conditions such as traumatic periostitis, osteomyelitis, eosinophilic granuloma, and thyroid acropachy.
    iv. Cortical disruption with soft tissue mass formation, often growing to large dimensions, occurs. The peripheral edge of an eccentric lobulated mass whose margins are roughened and irregular may be referred to as the cumulus cloud appearance.

d. Prognosis
    i. A 20% 5-year survival rate has been traditional; studies using intensive chemotherapy report 80% survival rate
    ii. Amputation has offered the best tx when the lesion is surgically accessible.

7. Chondrosarcoma

-Is a malignant tumor of chondrogenic origin that remains essentially cartilaginous throughout its evolution.

a. How common is Chondrosarcoma? What age group?
    i. Represents the third most common primary malignant bone tumor, following multiple myeloma and osteosarcoma.
    ii. Age group is 40-60 years 2:1 male predominance.

b. Key clinical features
    i. Pain usually presents late in the disease process, often after large soft tissue masses develop
    ii. Severe pain follows pathologic fracture
    iii. ? The most common sites are the pelvis, proximal femur and humerus, ribs, scapula, sternum, craniofacial bones, distal femur, and proximal tibia. The normal variance notes states that Chonndrosarcoma is the m/c primary malignant tumor of the hand. And Used to an enchondroma.

c. Key radiological features
    i. Round or oval radiolucencies with ill-defined margins evident.
    ii. Lesions re metaphseal or diaphyseal
    iii. Endosteal scalloping occurs secondary to pressure erosion from the enlarging lobular mass
    iv. Popcorn matrix calcification in the lesion occurs in 2/3 of cases; 1/3 are purely radiolucent

v. Laminated or speculated periosteal response occurs
vi. Metastatic disease is usually to lung

d. Prognosis
i. Prognosis is good, with 90% survival after early surgery

8. Ewing's sarcoma

-Is a primitive primary malignant tumor of bone it is composed of tumor cells derived from the connective tissue framework of bone marrow

a. How common? Age group?
i. 7% of all primary bone tumors. 4th m/c primary malignant bone tumor behind (multiple myeloma, osteosarcoma, and chondrosarcoma).
ii. 10-25 years of age

b. Key clinical features
i. Mimics: Infection; systemic signs of slight fever, secondary anemia leukocytosis, and increase ESR
ii. Affects long tubular bones of the Lower extremity.

c. Key radiologic features
i. Saucerization: Cortical saucerization is a characteristic sign. This irregular defect effaces the outside of the bone occasionally, exhibiting a marginal scalloping effect. Figure 11-129 pg. 1204.
ii. Classic presentation is a **diaphyseal** permeative lesion with a delicate onion skin or peel periosteal response.
iii. The most common primary malignant bone tumor to metastasize to bone

9. Fibrosarcoma

-primary malignant bone tumor that produces varying amounts of collagen and has no tendency to form tumor bone, osteoid, or cartilage, either in its primary site or in its metastases.

a. Age group?
i. 30-50 years of age

b. Key clinical features.
i. 2 types of lesions meduallary and periosteal
ii. pain and swelling for long duration
iii. the metaphysis is the classic location
iv. Most occur about the knee, femur, tibia, and humerus

c. Key radiological features
i. Highly destructive meduallary lesion, lytic and placed within long bone
ii. Produces the largest soft-tissue mass of all primary malignant tumors

10. Giant cell tumor (Quasimalignant)

-Is a neoplasm that originates from non-bone forming supportive connective tissue of the marrow. Contains multiple nucleated giant cells

a. Clinical Features
i. Males:
1. Tumor tends to be malignant
ii. Females:

1. Tumor tends to be benign

iii. 80% are benign, 60% are lytic

b. Key Radiologic features
   i. Most lesions begin in metaphysis and extend to subarticular location.
   ii. Thin, expanded cortex, which gives the Soap Bubble Pattern in 40%
   iii. May have delicate periosteal reaction.
   iv. M/c in distal femor and proximal tibia

c. Most worrisome complication
   i. 20% of the time could be malignant

11. Osteochondroma
-Not to be confused with the congenital anomaly called **Suprachondylar process.**
-Also known as **Coat-hanger exostosis**
-Is a bony exostosis projecting from the external surface of a bone; usually has a cartilaginous cap.

a. Key clinical features
   i. Occurs ~20 yoa
   ii. Points away from the joint, there is no ligament
   iii. Most are asymptomatic. M/c complaint is a painless mass around the joint

b. Key radiological features
   i. 2 types of Osteochondroma:
      1. *Sessile:* On a broad, flat base and no stalk; common in the humerus and scapula.
      2. *Pedunculated:* On a long stalk, with a **cauliflower top.** Extending away from the joint.
   ii. Coat-hanger exostosis represents the pedunculated.
   iii. Has a continuous cortex until you reach the tip. Then it is cartilaginous

c. Most common complication
   i. Aggressive biopsy
   ii. Trauma or fractures then can become malignant.

12. Briefly define HME:
-Hereditary Multiple Exostosis is an inherited autosomal dominant metaphyseal overgrowth that is characterized by multiple osteochondromas

a. Key radiological features
   i. Multiple, painless lumps and bumps around joints
   ii. Bayonet deformity of the wrist
   iii. Broad metaphyses
   iv. Calcified cauliflower cartilaginous caps

13. ABC (Aneurysmal Bone Cyst)
-lesion consisting of a cystic cavity filled with blood.

a. Key clinical features?
   i. 75% 5-20 yoa
   ii. Previous history of trauma. 80% occur in long bone (femur, tibia and spine)

b. Key radiological features

i. Only benign bone tumor known to cross the epiphyseal plate
ii. Cortical ballooning or Blown-out appearance
iii. Periostel buttressing at the edge of the lesion is characteristic.

14. Hemangioma
-Hemangioma, a primary benign neoplasm, is a slowly growing lesion of bone composed of newly formed capillary, cavernous or venous vessels.

a. Key clinical features
i. M/c primary benign tumor of the spine
ii. No history of going malignant

b. Key radiologic features
i. **Corduroy cloth or striated vertebra** appearance which is accentuated vertical trabeculae.
ii. Barrel shaped vertebra
iii. In the skull,, it appears as one large lesion. Most occur in the frontal bone, creating a round or oval radiolucency, radiating sunburst or poked-wheel appearance

15. What is an Osteoma?
-A cortical bone tumor with a smooth contour and a continuous cortex
-Are found:
Ocuping parts of the skull that SHB spaces (sinuses)
Attached to the skull as a raised lesion

a. What syndrome includes the Osteoma as part of its classic presentation?
i. **Gardener's Syndrome**

16. Define Bone Island ("Enostoma")
a. Benign, extra bone within bone.

17. Osteoid Osteoma
a. Shares a common presenting complaint with what process?
i. Brodie's Abscess
1. The radiolucent nidus of Brodie's is much larger (>1 or 2cm)
2. Hole will be in the marrow
3. The halo rim of sclerosis surrounding the nidus is much thicker and more irregular

b. Key clinical features.
i. Pain at night relieved by aspirin
ii. A "blister" on the bone between the cortex and the periosteum. Might show up as a hole or nidus, which is lucent.

c. Key radiologic features.
i. The nidus or hole is usually surrounded by sclerosis.

18. Enchondroma
-Can malignantly degenerate into **chondrosarcoma**
a. Key clinical features.
i. m/c primary benign tumor of the hand
ii. Can be Solitary or multiple (called Ollier's Disease)
1. Solitary enchondroma, is a benign tumor arising in the cartilage in

the metaphysis as the physis goes away.
iii. Usually a painless incidental finding
iv. Most common complication is pathological fracture

b. Key radiological features.
i. The bone looks less dense do to cartilage tissue within the bone
ii. 40% will uptake Ca++, giving a speckled appearance- a round lesion with polka dots

c. What is Ollier's disease? (Multiple enchondromatosis)
i. Enchondroma's in multiple sites

Tumor-Like Conditions

19. Paget's Disease (aka ***Osteitis Deformans***)
-Is a bone disease of unknown origin characterized by osteolysis followed by extensive attempts at repair.

a. Mimics: Paget's disease mimics a Hemangioma. Hemangioma for the vertebral bodies produces a vertically striated pattern, which may closely mimic the vertical trabeculae of Paget's disease.

b. Most likely site: Pelvis
Least likely site is the Fibula

c. List the 4 phases and describe each
i. Stage one: Osteolytic, Destructive, or Monophasic stage- Osteoclastic over activity creates gross loss of bone density described as **osteoporosis circumscripta**
ii. Stage two: Combined, Mixed, or Biphasic stage – M/c encountered. Reflection of both destruction **(Lytic)** and production of bone **(Blastic)**. Characterized by cortical thickening, increased radiopacity and accentuation of trabecular patterns with lucent areas mixed.
iii. Stage three: Sclerotic or Ivory Stage – Uniform thickening of trabeculae with **ivory appearance**
iv. Stage Four: Malignant Degeneration – Lethal stage

d. Clinical Features of Paget's
i. 2:1 males, m/c after 55
ii. 90% are asymptomatic. Pain, when present, is low intensity and may be associated with bowing deformities or fractures
iii. Increased hat size because enlargement of the calvaria

e. Radiological features
i. Bone scan will be hot
ii. Skull will demonstrate in earl lesions Osteoporosis circumscripta (described in c). More advanced or combined stage demonstrates cotton wool appearance, which is fuzzy, poorly defined edges of sclerotic areas.
iii. Spine will demonstrate squared-off picture frame vertebra, which is thickened and enlarged vertebral endplates giving a squared look.
iv. Homogenous increases radiopacity of vertebral body and creates an ivory vertebra
1. The 3 m/c causes of an ivory vertebra are: osteoblastic metastatic carcinoma, Paget's disease, and Hodgkins lmphoma

Table 11-10 Solitary Ivory Vertebra

Common Causes	Uncommon Causes
Osteoblastic metastasis	Sarcoidosis
Hodgkin's Lymphoma	Chordoma
Paget's disease	Myeloma
Degenerative sclerosis	Osteosarcoma
Osteomyelitis (fungal or chronic)	Ewings sarcoma
Idiopathic	Osteoid osteoma
	Osteoblastoma
	Bone island

Table 11-11 Differential Diagnosis of an Ivory Vertebra

Factor	Blastic Metastases	Paget's Disease	Hodgkin's Disease
Age (years)	>45	>50	20-40
Increased density	+++	+++	+++
Expansion	----	+++	
Anterior Scalloping	----	----	+++
Acid phosphatase	+++	----	----
Alkaline phosphataes	++	+++	++

v. Pelvis includes protrusio acetabuli with Kohler's teardrop and thickening of pelvic brim
vi. Long bones: the tibia is the m/c lytic site

f. Complications
   i. Deformity of bone include: Shepherd' crook deformity of the proximal femur (coxa vara), Saber shin (ant. Tibial bowing), Protrusio acetabuli.
   ii. Cranial nerve neuropathies b/c foramen get smaller.
   iii. Linked to increased wear and tear, early DJD
   iv. Increased alkaline phospatase (up to 20x normal)

20. Fibrous Dysplasia pg. 1345
-is a disorder of unknown cause in which skeletal aberrations constitute the cardinal feature.

a. Key clinical features.
   i. Café au Lait spots with a "coast of Maine" appearance, pigmentation changes
   ii. Common in late childhood before puberty during skeletal growth
   iii. Polystotic m/c for derormities

b. Key Radiological features
   i. Clear zone in the center with a "Ground Galss Appearance" – beveled / fine fuzzy opaque edges
   ii. Stimulates blastic reaction of surrounding tissue = "Rind of Sclerosis"
   iii. Can change the contour of bone (expansile), with widening of meduallary,

endostal thinning and scalloping
iv. Sheperds crook deformity common

21. Coast of Maine Café au Lait spots is associated with **Polystatic fibrous dysphasia**
22. Coast of California Café au Lait spots are associated with **Neurofibromatosis**
23. Most common malignancy of bone? **METS**
24. Most common primary malignancy of bone? **Multiple Myeloma**
25. Most common benign tumor of the hand? **Enchondroma**
26. Most common Primary malignancy of the hand? **Chondrosarcoma**
27. Most common benign tumor to a growth plate? **ABC (Aneurysmal Bone Cyst)**
28. Most common benign tumor of the spine? **Hemangioma**
29. Define Solitary Bone Cyst? **Is not a true neoplasm of bone but rather a fluid-filled cyst that is lined with a thin layer of fibrous tissue**
30. Fibrocortical bone defect?
31. Non-Ossifying Fibroma

Table 7-5 Radiologic Criteria of Benign and Aggressive Lesions

Criteria	Benign	Primary aggressive	Secondary aggressive
Age (decades)	1-3	1-7	4-7
Size			
0-6cm	+++	+	+
6+cm	+	+++	+++
Monostotic	+++	+++	++
Polystotic	+	+	+++
Cortical destruction	----	+++	+++
Periosteal reaction			
Solid	+++	+	----
Laminated	++	++	----
Spiculated	----	+++	+
Codman's	++	++	+
Destruction			
Geographical	+++	+	----
Moth-eaten	----	+++	+++
Permeative	----	+++	+++
Margins			
Sharp	+++	+	+

Imperceptible	----	+++	+++
Matrix	+++	++	----
Soft tissue mass	----	+++	+
Joint space	----	----	----