


1  **MR Imaging of Bone Marrow**

2 

MRI of marrow

- sensitive
- nonspecific
 - appearance of normal marrow highly variable
- marrow included on essentially every MRI
 - normal vs. abnormal
 - significance of variable patterns

3 

Marrow evaluation: tumor, trauma, inflammation

- T1
- IR
- fat-suppressed T2

- two in one plane, third perpendicular

4 

Marrow evaluation with gadolinium

- rarely needed
- if used, fat-suppress
 - interface between lesion and fatty marrow may be obscured

5 

Normal marrow

- red vs. yellow varies with
 - age
 - site in skeleton
 - gender
 - lifestyle
 - general health

6 

Normal conversion: long bones

- mid diaphysis to ends, reconversion opposite
- admixture appears inhomogeneous, patchy or streaked

7 

Adult pattern

- axial skeleton, sternum, ribs, distal humerus and distal femur reached by 25 years
- proximal femur
 - 35 years in men
 - 55 years in women

8 

Yellow (fatty) marrow

- high signal intensity T1
- low signal FS-T2, IR

9 

Normal focal fatty marrow

- epiphyses
- apophyses
- within vertebral bodies
 - usually at endplate
 - isolated or multiple
 - increase in frequency with increasing age

10 

Red (hematopoietic) marrow

- low signal intensity T1
- intermediate FS-T2, IR

11

Red marrow in the adult

- diffuse or focal
- homogeneous or inhomogeneous
- epiphysis/apophysis usually spared
- normal hematopoietic marrow stops abruptly at physis except with reversion in an adult

12

Reversion to red marrow

- obesity
- extremes of activity
- smoking
- chronic illness
- medications

13

Persistent red marrow

- anemia
 - sickle cell disease
 - thalassemia
- childhood illness

14

Diffuse marrow changes

- myelofibrosis
- chronic illness, chemotherapy
- infiltrative disorders
- tumor: active or treated

15

Myelofibrosis

- usually seen after chemotherapy
- usually involves epiphysis and apophysis
- low signal T1 and T2

16 

Leukemia, lymphoma

- usually focal, heterogeneous pattern
- active tumor: low signal T1, high T2
- treated tumor: low signal T1, low T2

17 

Marrow changes with cancer

- many causes
- diffuse or focal

18 

Cancer: factors altering bone marrow

- tumor within marrow
 - hematologic, metastases
- chronic illness
- chemotherapy
- radiation

19 

Treatment related changes marrow

- yellow-red reversion (illness, chemo)
- red-yellow reversion (radiation)
- treated tumor: (fibrosis)
- infarct (radiation, steroids)

20 

Image analysis

- compare sequences
 - T1

- IR or fat-sat T2
- compare with prior studies and other imaging modalities

21 

Reconversion with chemo

- diffuse
- heterogeneous

22 

Radiation

- initially edema: low T1, high T2
 - soft tissues and marrow
- later fatty replacement in marrow
 - sharp demarcation between treated and untreated tissues (ports)
 - may see geographic areas of treated lesions (low signal)

23 

Infarct

- chemotherapy (steroids)
- radiation necrosis
- blood dyscrasias

24 

Conclusion

- normal marrow has variable appearance
- history and correlative studies important

