Radiologic Features of Acromegaly

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Our Patient

• **ID/CC**
  A 29 year old Asian male visits his doctor because he notices that his hands are getting bigger

• **HPI**
  No major complaints except enlarging of hands, nose, jaw, and feet over the past 2-3 years

• **PE**
  Significant enlargement of hands and feet, broad nose, enlargement of facial tissues, frontal bossing

• **LABS**
  Growth Hormone: 18 ng/ml (nl 0-10 ng/ml)
  IGF-I: 738 ng/ml (nl 114-492 ng/ml)
Diagnosis

ACROMEGALY
ACROMEGALY

- Clinical syndrome that results from excessive secretion of growth hormone (GH) after fusion of the epiphyseal growth plates
- Annual incidence is 3-4 per million people
- Incidence is equal in men and women
- Mean age at diagnosis is 40 to 45 years
- Most common cause is GH secreting adenoma of the anterior pituitary
Clinical Manifestations

- Somatic effects due to excess GH and IGF-I which cause stimulation of growth of skin, connective tissue, cartilage, bone, viscera, and epithelial tissue
- Onset is insidious with slow progression

Clinical Manifestations

- Acrual and soft tissue overgrowth
- Articular overgrowth
- Enlarged viscera
- Cardiovascular disease
- Tumors
- Hypogonadism

Anatomy and Relations of the Pituitary Gland

Relationship of the Pituitary Gland to the Cavernous Sinus

Relationship of the Pituitary Gland to the Sella Turcica

From http://www.mythos.com/webmd/Content.aspx?
P=ENDOCC&E=6
Relationship of the Pituitary Adenoma to the Sella Turcica

A. Grade of sella turcica enlargement and/or erosion

I. Sella normal, floor may be indented
II. Sella enlarged, but floor intact
III. Localized erosion of floor
IV. Entire floor diffusely eroded

B. Type of suprasellar extension

A. No suprasellar extension of tumor
B. Suprasellar bulge does not reach floor of 3rd ventricle
C. Tumor reaches 3rd ventricle, distorting its chiasmatic recess
D. Tumor fills 3rd ventricle almost to interventricular foramen (of Monro)

Imaging Modalities

• Plain Radiographs
• MRI
• Somatostatin Receptor Scintigraphy
Plain Radiographs

- No longer routinely used for diagnosis of acromegaly
- Good for demonstrating wide variety of radiologic changes of the skeleton in patients with acromegaly
Plain Radiograph Features of Skeletal Involvement in Acromegaly
Companion Patient A

- 48 year old Italian woman presents to Mt. Auburn Hospital in 1956 with chief complaint of headache, weight gain, swollen hands, and changes in facial features
- Skull radiographs reveal an enlarged sella turcica → diagnosis of acromegaly made
- Refuses treatment for 15 years
- Finally presents to BI Hospital in 1971 for further work-up and treatment of her acromegaly
- On exam noted to have thick, coarse skin, enlarged lips and ears, separated teeth, macroglossia, marked prognathism, frontal bossing, and enlarged hands and feet
Changes in Skin Thickness

Findings:

Prominence of soft tissues of the heel measuring 40 mm

Pathophysiologic correlation: Excessive growth hormone → marked response by collagen tissue → connective tissue hyperplasia → increased thickness of skin (e.g. heel pad)

Companion Patient A Findings:

Prominence of soft tissues of the heel measuring 40 mm
Diagnostic Significance of Thickened Heel Pad

Measure shortest distance between calcaneus and plantar skin surface

Values greater than 23 mm in men and 21.5 mm in women are suggestive of acromegaly

Variation with body weight, race somewhat limits usefulness \(\rightarrow\) development of more sophisticated calculations

Differential Diagnosis of Thickened Heel Pad

1) Acromegaly
2) Generalized edema (e.g. CHF, DVT, lymphedema)
3) Infection of soft tissues
4) Normal variant; genetic (especially Black and Polynesian males)
5) Obesity
6) Trauma
7) Long-term phenytoin therapy
Abnormalities of the Skull

Findings:

- Thickened cranial vault
- Enlarged sella turcica
- Prominence of the occipital protuberance
- Elongation and projection of mandible
- Enlarged frontal sinuses

Companion Patient A

Courtesy of Ferris Hall, MD
Abnormalities of the Skull

Findings:
- Increased prominence of mandible
- Increased thickness of clavaria
- Enlarged frontal sinus
- Enlarged supraorbital ridge


Abnormalities of the Skull

Pathophysiology correlation:

Presence of pituitary neoplasm → sella turcica abnormalities

Excess growth hormone → stimulation of periosteal bone formation → mandibular enlargement, thickening of cranial vault, prominence of supraorbital ridges and facial structures
Abnormalities of the Hand and Wrist

Findings:

Widening of MCP joint spaces

Soft tissue thickening

Carpal cysts

Broadened phalangeal tufts

Pathophysiologic correlation:

Excessive growth hormone → increased chondrocytic activity → proliferation of articular cartilage (cartilage hypertrophy) → widening of articular space

Carpal cysts result suggest bone degeneration

Companion Patient A

Courtesy of Ferris Hall, MD
Abnormalities of the Hand and Wrist

Findings:
Enlargement of terminal phalangeal tuft ("spade-like")
Enlargement of terminal phalangeal base
Soft tissue thickening
Formation of pseudoforamina

Pathophysiologic correlation: Stimulation of periosteal bone formation \(\rightarrow\) enlargement of phalanges, phalangeal tufts especially

Abnormalities of the Foot

Findings: Soft tissue enlargement, widening of the MTP joints, prominence of terminal phalangeal tufts and bases, pseudoforamina

Differential Diagnosis of Phalangeal Tuft Enlargement

1) Normal variant
   Must take into account patient’s gender and occupation

2) Acromegaly
Abnormalities of the Vertebral Column

Findings: Increase in thoracic vertebral body AP diameter due to bone formation on anterior aspect of vertebrae

Findings: Increased concavity on posterior aspect of lumbar vertebral bodies (scalloped vertebrae) related to excessive resorption of bone

Companion Patient A

Findings: “…suggestion of new bone formation involving the anterior aspects of the vertebral bodies.”

Companion Patient A

Noted on plain radiographs to have degenerative disease in joints of shoulders, fingers, wrists, knees
Articular Abnormalities

- Radiologic joint abnormalities seen most frequently in knee, glenohumeral joint, and hip
- Two main categories: cartilage hypertrophy and cartilaginous and bony degeneration
- Radiologic features of acromeglic degenerative changes (joint space narrowing, cyst formation, osteophyte formation) can be confused with primary degenerative joint disease (osteoarthritis)
Acromegalic Arthropathy or Osteoarthritis?

• If joint space is wide → Acromegaly
• If joint space is narrow → Differential diagnosis rests on distribution of arthropathy

Acromegaly involves shoulders, elbows, and MCP joints, which are unusual sites for primary osteoarthritis
Additional Plain Radiograph Features of Skeletal Involvement

- **Abnormalities of the Thoracic Cage**
  May appear enlarged due to elongation and enlargement of the anterior ribs (particularly first ribs) and medial clavicles
  Prominence of costochondral junction (acromegalic rosary) due to GH mediated reactivation of endochondral ossification

- **Abnormalities of the Pelvis**
  Enlargement and “beaking” of pubis symphysis
  Bony proliferation at ligament attachment sites (enthesopathy)

- **Abnormalities of the Long Bones**
  Narrowing of diaphysis due to predominant bone resorption
Imaging Modalities

- Plain Radiographs
- MRI
- Somatostatin Receptor Scintigraphy
MRI

- Method of choice in detecting pituitary adenomas
- Can detect tumors as small as 2 mm in diameter
- Can accurately identify dimensions and anatomic extent of tumor
- Compared to CT
  Superior soft tissue contrast
  More sensitive in defining the extrasellar extent of the adenomas and in detecting cavernous sinus invasion
Any Role for CT?

• Postcontrast CT scans previously used for imaging of adenoma and assessment of bone erosions or cavernous sinus invasion

• Unable to detect small adenomas due to poor contrast resolution and similar enhancing characteristics between adenomas and normal pituitary gland

• Advantage over MRI → superior in demonstrating cortical bone → critical in cases of pituitary adenomas causing deformity or erosion of the sellar floor

• CT scans may be more useful than MRI in selected patients in whom the bony anatomy of the floor of the sella turcica needs to be visualized
Findings: 5 mm x 11 mm x 10 mm low signal, non-enhancing lesion in left side of pituitary consistent with adenoma
Imaging Modalities

- Plain Radiographs
- MRI
- Somatostatin Receptor Scintigraphy
Somatostatin Receptor Scintigraphy

- Based on underlying principle that GH adenomas express somatostatin receptors
- Radiolabeled octreotide is used as the detector allowing somatostatin receptor positive tissues to be visualized
- Non-specific since somatostatin receptors are also widely expressed by normal endocrine tissue → high incidence of false positives
- Physiologic distribution of octreotide includes the digestive tract → masking of abdominal tumors by normal octreotide uptake in this region
- Implications for medical therapy → increased uptake on octreotide scan predicts success of treatment with somatostatin analogs
Companion Patient B

- 43 year old woman presents with clinical findings of acromegaly
- Pituitary MRI was negative
- Underwent octreotide scan for further work-up of possible pituitary adenoma
- Visualization done after 4 and 24 hours
Companion Patient B

Initial 4 hour whole body image

Findings: Normal activity involving the kidneys, liver, and spleen. Normal accumulation in bladder. No evidence of focal abnormal increased tracer activity.
Companion Patient B

24 hour whole body image

Findings:
Normal uptake visualized in thyroid, kidneys, liver spleen, and non-specific GI uptake

Focal increased uptake at the region of the skull base

Courtesy of Kevin Donohoe, MD
Companion Patient B

Left lateral view of head

Findings:

Normal uptake visualized in thyroid

Localized uptake at base of skull corresponding to location of pituitary fossa

Impression: Abnormal uptake of octreotide in region of the pituitary fossa, suggestive of adenoma

Courtesy of Kevin Donohoe, MD
Our Patient

• On 12/4/02 underwent selective transsphenoidal surgical resection of pituitary microadenoma
• Pathology of showed strong staining for growth hormone
• One day post-op GH level reduced to 2 ng/ml
• One month post-op reports improvement in hand swelling
• As of 1/29/03 GH levels reduced to less than 1 ng/ml and IGF-I level was 250
References

References Cont.

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