CT, MR & PET Imaging in Thyroid Disease

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Thyroid CT & MR

► Limited utility of both
  ▪ Poor discrimination of thyroid tissue
    ▪ Benign & malignant – may look identical
    ▪ Some lesions not evident at all
  ▪ No functional information
► Iodinated CT IV contrast is contraindicated with thyroid carcinoma

Thyroid CT & MR

► Anatomy
  ▪ Size, location
  ▪ Compression, displacement, invasion
► Morphology
  ▪ CT: heterogeneity, cysts, calcifications
  ▪ MR: heterogeneity, cysts
► Nodes
Most frequent indications

► “Thyroid mass”
  ▪ What is it? Where is it? How many?
► “Large thyroid mass / tumor”
  ▪ Tumor extent? Invasion of structures?
► “Evaluate extent of MNG”
  ▪ Substernal? Retrotracheal?
► “Evaluate for recurrent thyroid tumor”
  ▪ Thyroid bed & nodes

MR or CT for thyroid mass

► Well-defined → ?
  ▪ Colloid cyst, adenoma, malignant, MNG
► Invasive → Malignant
  ▪ Papillary, follicular, anaplastic, NHL, MTC
  ▪ Mass + adenopathy → Metastatic thyroid, lymphoma,
MR: Variable T2 signal. Variable T1 signal & Variable contrast enhancement

Anaplastic carcinoma

MTC
31yF

55yM

"Evaluate MNG"

Thyroid lymphoma

"Evaluate MNG"
Arms down (Neck CT)
Arms up (Chest CT)

46yM past history thyroidectomy for MTC
45yF. Prior thyroidectomy for papillary ca Elevated TGB, 131-I scan + in lower neck Ultrasound NAD

**Thyroid & PET/CT**

- **Normal thyroid uptake**
  - Diffuse, focal, asymmetric OR none
- **Thyroid pathology**
  - Goiter, adenoma, thyroiditis may show uptake
  - Well differentiated tumors may not take up FDG
  - ≥30-60% focal uptake = malignancy

**CT/PET – Tissue metabolism**

- **18**Fluorodeoxyglucose-PET (**18**FDG-PET)
  - Positron emission from fluorine decay
- **FDG**=Glucose analog
  - Taken up, phosphorylated, can’t exit cell
- **Uptake reflects cell metabolism**
  - Many malignant cells have ↑ metabolism
  - Many inflammatory processes too
**FDG-PET Pitfalls**

- Normal structures may have uptake
  - Lymphoid & salivary tissue, muscles
- Benign lesions can have high uptake
  - Adenomas, thyroiditis
- Malignant tumors may **not** have high uptake, or have variable uptake
  - DTCa, MTC

**Diffuse Thyroid Uptake**

- ↑TSH, ↓Free T4 (Subclinical)

**Multinodular goiter**

**Thyroid Tumors & PET/CT**

- Iodine uptake inversely proportional to glucose metabolism
- Tumor uptake related to degree of differentiation
  - Well-diff. $^{131}$I +thyroid tumor → FDG neg.
  - Less differentiated (neg $^{131}$I+↑Tgb)
- FDG uptake Hürthle cell
- Variable uptake: Medullary thyroid
53yM Hx papillary thyroid carcinoma. Thyroidectomy, MRND & revision ND Persistently elevated thyroglobulin

PET ‘incidentalomas’

► FDG-PET for non-thyroid reasons
  ▪ 2.2-2.3% unexpected focal thyroid uptake
  ▪ Kang et al, 1330 pts. Mets/ cancer screening
    ▪ 26.7% incidence of thyroid malignancy
      J Clin Endo Metab 2003;88:4100-4
  ▪ Cohen et al, 4525 pts
    ▪ 47% incidence of thyroid malignancy
      Surgery 2001;130:941-6

63yF with vaginal melanoma

Papillary thyroid carcinoma
MR, CT & PET

► MR & CT
  - Excellent anatomic but limited morphologic information

► FDG-PET
  - Specific indications for tumor imaging
    - Poorly differentiated/ high-grade DTCa
    - Rising Thyroglobulin, negative $^{131}$I scan
    - NHL, Hürthle cell

Most frequent indications

► “Thyroid mass”
  - U/S

► “Large thyroid mass / tumor”
  - MR

► “Evaluate extent of MNG”
  - CT – non con (neck study, arms down)

► “Evaluate for recurrent thyroid tumor”
  - U/S, MR, PET

thank you!

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