The Sonographic Evaluation of Diffuse Thyroid Disease and Thyroiditis

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Diffuse Thyroid Disease

- Graves’ Disease
  - (toxic diffuse goiter)
- Thyroiditis
  - Chronic lymphocytic thyroiditis (Hashimoto’s)
  - Non-specific/atrophic
  - Subacute
  - Acute inflammatory
  - Drug related/Destructive thyroiditis
Sonographic Findings of DTD

• Gland enlargement common
  – Normal volume
    19.6 +/- 4.7 ml for men, 17.5 +/- 4.2 ml for women, scaling with BMI
  – Variants: normal size and small gland

• Altered parenchymal echotexture and/or echogenicity

• Increased vascularity
  – Most marked in Graves’

• Lymphadenopathy
  – usually minimal and in the central compartment
Diffuse Thyroid Disease

- Enlarged isthmus (> 5mm)
- Decreased echogenicity
- Heterogeneous echotexture

Graves’

Normal
Enlarged Thyroid

Caveat: Normal thyroid does not extend beyond the medial edges of the carotid artery.
Enlarged Thyroid with Normal Echogenicity and Echotexture

- Normal variation-Height, BMI, Gender, Race, Age
- Mild iodine deficiency
- Medical conditions: pregnancy, renal disease
- Subclinical autoimmune thyroid disease
- Check serum TSH
Thyroid Volume and Subclinical Disease

- Retrospective analysis of 1,089 adolescents in Slovakia, mean age 17 years
- Correlated thyroid volume with TSH and TPO Abs in 50% of the population studied
- Assessed whether enlarged thyroid volume had a relationship with subclinical or early thyroid dysfunction

<table>
<thead>
<tr>
<th>Gland Volume</th>
<th>Proportion of Cohort</th>
<th>% TPO Positive</th>
<th>TSH &gt; 4.5 mU/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5 mL/m²</td>
<td>81%</td>
<td></td>
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<tr>
<td>5-7 mL/m²</td>
<td>13%</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>&gt; 7 mL/m²</td>
<td>6%</td>
<td>21%</td>
<td>10%</td>
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</table>
Diffuse Inflammatory Thyroid Disease

- **Thyroiditis**
  - Graves Disease
    1. (toxic diffuse goiter)
  - Chronic lymphocytic thyroiditis (Hashimoto’s)
  - Subacute thyroiditis (granulomatous or de Quervain’s, silent lymphocytic and postpartum)
  - Reidel’s thyroiditis
Graves’ Disease: Sonographic Appearance

- Marked increase in gland size; less commonly normal or minimally enlarged
- Echotexture may be normal or diffusely hypoechoic
- Smooth or lobular surface contour
Graves’ Disease
Graves’ Disease

- Diffuse increased vascularity: “thyroid inferno”
- Prominent extra-thyroidal vessels
- Peak systolic velocity of 40 cm/sec or higher has 96% sensitivity and 95% specificity for GD

33 yo female with Graves
33 yo female with Graves
42 yo with Graves
42 yo with Graves

Tubercle of Zuckerkandl
Tubercle of Zuckerkandl
Role of Sonography in Graves’ Disease

• CDUS may be used to confirm diagnosis in lieu of I-123 scan
  – sensitivity of CDUS (95% vs. 97%) and specificity (95% vs. 99%) for Dx of GD

• Screening for occult cancer
  – Sonography identified 68/426 (16%) focal nodules vs. 9/462 (2.1%) on I-123 scan
  – Thyroid cancer found in 30/68 (48%) of these patients

• All patients with GD should be screened by US-management changed to surgical

Cappelli C et al, Eur J Rad 2008; 65;99-103
Graves’ with Occult PTC
Graves with Occult PTC
Graves with multiple small PTCs and metastatic LNs
Chronic Lymphocytic (Hashimoto's) thyroiditis

- Autoimmune disease occurring most frequently in middle aged women, with strong familial predisposition
- Patients may be eu-, hypo- or hyperthyroid
- Patient may be goitrous or agoitrous to palpation
- Chronic lymphocytic infiltration, lymphocytic germinal centers, destruction/apoptosis of thyroid follicles and fibrosis
  - Results typical US appearance and hypothyroidism
Chronic Lymphocytic (Hashimoto’s) Thyroiditis
Sonographic Appearance of Chronic Lymphocytic Thyroiditis

• **Gland size**
  – enlarged, normal or small

• **Parenchymal echogenicity**
  – Diffuse or patchy regions of hypoechogenicity
  – May precede antibody positivity (15% pts)
  – Fibrosis common

• **Vascularity**
  – Variable, correlates with immune response

• **Lymphadenopathy**
  – Common in the central compartment
Hashimoto’s Thyroiditis

Normal

$\downarrow 3 \text{ mm}$

Hashimoto’s

$7 \text{ mm}$
Hashimoto’s Thyroiditis

- Multiple hypoechoic, ill-defined “nodules” 1-6mm in size
- Geographic hypoechoic areas
- Linear white lines representing fibrosis
- Interrupted capsule
- Variable vascularity
Hashimoto’s Thyroiditis:

- Normal follicles
- Lymphocytic infiltration
- Fibrosis
Hashimoto's Thyroiditis: Patchy Hypoechoic Pseudonodules

- Lymphocytes deposits (hypoechoic foci)
- Fibrosis (hyperechoic bands)
- Diffuse vascularity - often along fibrous bands
- White lines are fibrous bands that "outline" pseudonodules or tiny pockets of lymphocytes
Micronodular Not “Multinodular Goiter” or “Innumerable Small Nodules”

Sagittal

Sagittal

Transverse

PSEUDO-NODULE #1
Benign Giraffe Nodule

Bonavita AJR Am 2009;193:207-13.; Virmani AJR Am J Roentgenol. 2011;196:891-5; Photo provided by Dr. R. Levine
“Patchy” thyroiditis vs. nodules
Are these nodules ??
Cleft sign
Cleft Sign
Hashimoto’s thyroiditis

- Over time the gland tends to become more hypoechoic and enlarged with white fibrous bands
- “Pseudonodular” sonographic appearance
- Palpable surface nodularity
- End-stage may be a small and irregular gland

PSEUDO-NODULE #2
Association of Papillary Cancer with Hashimoto Thyroiditis

- Reported higher prevalence of PTC with HT—varies from 0.3% to 22.5%
  - Dailey ME et al, Arch Surg, 1995; 70:291
  - Matsubayashi S et al, JCEM 1995; 80; 3421
- Expression of the RET/PTC fusion gene is a marker of PTC in HT
  - Wirtschafter A et al, Laryngoscope 1997; 107:95
- Fas/Fas ligand expression in HT
  - (inducer of apoptosis in PTC)
    - Giordano C et al, Science 1997; 275:960
PTC in Hashimoto’s

Papillary carcinoma

Longitudinal view

Transverse view
Appearance of PTC in HT glands

- Typical PTC features overlap with HT features
  - Hypoechochogenicity, solid consistency, irregular or infiltrating margins
- Key finding is pattern of calcifications
  - Clustered microcalcifications or dystrophic calcifications
  - Asymmetrical lobar involvement

Ohmori N et al, Internal Medicine (Japanese Society of Internal Medicine) 2007; 46; 547.
PTC in Hashimoto’s
Infiltrating PTC in CLT

Microcalcifications throughout the right lobe without a focal mass
Case: 21 yo female with enlarged thyroid on physical exam
Diagnosis??
Diffuse Sclerosing Variant of Papillary Thyroid Cancer

- Reported to account for 0.8% to 5.3% of papillary thyroid carcinomas
- Patients present with a diffuse goiter
- Mostly are euthyroid, but can also be hypothyroid or hyperthyroid
- Most frequently in young females
- Mistaken clinically for benign disease particularly thyroiditis - pts may be antibody positive but uninvolved thyroid does not show thyroiditis
- Most patients have lymph node metastases at the time of diagnosis and lung metastases are common
- Similar cure rates c/w classic PTC
Psammoma bodies
Hashimoto’s thyroiditis is often asymmetric
Can be a solitary focal lesion
Accounts for up to 10% of focal lesions
May still require FNA
Dilemma: Nodules in patients with Diffuse thyroid disease

- May have patchy irregular areas that are pseudo-nodules
  - Tend to be small (under 15 mm), hyperechoic and non-calcified
  - Larger lesions or those with irregular margins raise concern for a neoplasm
- Focal calcifications and asymmetric calcifications should be considered suspect for papillary carcinoma
Hyperechoic Lesions in CLT

Most likely to be changes of thyroiditis
Echogenic PTC
Echogenic PTC with LN Mets
Thyroid Lymphoma

• Pre-existing Hashimoto’s thyroiditis
  - Rapid growth over weeks-months
  - Usually in the elderly >65 years old
• Asymmetric or symmetric growth
• Extremely hypoechoic without increase vascularity by Doppler
Malignant Lymphoma

- Nodular pattern
  - Homogeneously hypoechoic with lobulated but well defined border; enhanced though transmission
- Diffuse-asymmetric enlargement
- Mixed

Ito Y et al, World J Surg 2010; 34:1171-80,
Thyroid Lymphoma

Small and atrophic right lobe

Enlarged and hypoechoic left lobe
Thyroid Lymphoma

- Enlarged left lobe
- Hypoechoic, lobulated lesion
- Good through transmission
Hashimoto’s with Unilateral Lateral Cervical Lymphadenopathy
56 yo woman with CLT
56 yo woman with CLT
56 yo woman with CLT
70 yo female; July 2015
70 yo female; August 2015
70 yo F

July 6 x 7 x 9 mm

August 10 x 10 x 17 mm
70 yo female; Sept 2015

11x 14 x 19 mm
Diagnosis????

Any additional details helpful???
Subacute Thyroiditis
Subacute Thyroiditis-“DeQuervains”

- 0.16 to 0.36% of thyroid disease
- Usually a viral infection
- Usually an adult female with thyroid tenderness, systemic systems
- May have thyrotoxicosis or be euthyroid
- Hypoechoic patchy or nodular areas that resolve
- Variable vascularity
  - Usually hypovascular in acute phase
  - Maybe highly vascular and simulate Graves Disease
Subacute Thyroiditis

• 27 patients (25F/2M; ages 30-69y, mean 47)

• Dx established by
  – Elevated ESR and neck pain in 21 pts
  – Neck pain/suppressed TSH/neg TPO Abs in 5 pts
  – HyperT with no uptake on I-123 scan in 1 pt
  – 7 patients refereed for suspected ST excluded, 4 with Graves, 3 with CLT

Frates MC. J Ultra Med 2013;32:505
Subacute Thyroiditis

**Findings**

<table>
<thead>
<tr>
<th>Hypoechoic regions</th>
<th>n (%)</th>
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<tbody>
<tr>
<td>Bilateral</td>
<td>16</td>
</tr>
<tr>
<td>Unilateral</td>
<td>5</td>
</tr>
<tr>
<td>Diffusely heterogeneous</td>
<td>6 (22%)</td>
</tr>
<tr>
<td>Bilateral</td>
<td>4</td>
</tr>
<tr>
<td>Unilateral</td>
<td>2</td>
</tr>
<tr>
<td>Affected portion enlarged</td>
<td>21 (78%)</td>
</tr>
</tbody>
</table>

Frates MC. J Ultra Med2013;32:505
Subacute Thyroiditis

Findings

Color Doppler of affected portion
- Decreased 19 (95%)
- Increased 1 (5%)
- Not done 7

Lymph nodes
- Mildly enlarged 16 (67%)
- Normal 8 (33%)

Frates MC. J Ultra Med2013;32:505
Subacute Thyroiditis

- F/U sonography available in 8 patients
- In 3 patients follow up US within 1 to 8 weeks showed enlargement of the hypoechogenicity bilaterally in 1 patient and involvement of the contralateral side in 2 pts
- 5 patients had a normal gland assessed at 3 months (2 pts), 6 months (1 pt), after 1 year (2 pts)

Frates MC. J Ultra Med 2013;32:505
43 yo female patient with a swollen and painful thyroid

Subacute Thyroiditis
One year later
55 yo with h/o lymphoma and neck pain
55 yo with h/o lymphoma and neck pain
One year later
One year later
One year later
Atrophic Thyroiditis

- Autoimmune thyroid disease
- Small and atrophic gland
- Maybe hypoechoic or normal echogenicity
- Normal of low uptake on I-123 scan
Amiodarone-Induced Thyrotoxicosis (AIT)

- More commonly patients develop hypothyroidism due to iodine content
- The minority develop thyrotoxicosis
- Type 1 is an iodine load induced hyperthyroidism which occurs in abnormal glands (MNG or Graves); increased vascularity
- Type 2 is a destructive thyroiditis; normal gland; normal or decreased vascularity; low/absent uptake on RAIU
74 yo man on Amiodarone for several years now with hyperthyroidism

Type II AIT; low flow on CDUS
Interferon related Thyroiditis: Serum TSH 12mU/L
• Sonographic markers of autoimmune thyroid disease include enlarged size, heterogeneous echotexture, increased vascularity, but are not specific
• Clinical information is key
• Differentiation of “pseudo-nodules” from true nodules and tumors may be challenging
  – Asymmetric calcifications
  – Unilateral large LNS