Effect of Iodinated Contrast Media on Thyroid Function

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Iodine and Thyroid Function
- Iodine needed for thyroid hormone synthesis
- 150 µg/dL: required daily iodine intake in adults (US)
- 14.5 µg/dL: median urinary iodine (UI) excretion
- 5.3% of population exceeded UI of 50 µg/dL
- 1.3% of population exceeded UI of 100 µg/dL
- Thyroid gland has intrinsic regulatory mechanism in presence of excess iodide
  - Shows transient (~2 days) ↓ in thyroid hormone synthesis

Iodine Content of Contrast Media

<table>
<thead>
<tr>
<th>Agents</th>
<th>Iodine Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diatrizoate meglumine sodium</td>
<td>370 mg/mL</td>
</tr>
<tr>
<td>Iodized oil</td>
<td>360 mg/mL</td>
</tr>
<tr>
<td>Iopanoic acid (e.g., Telepaque)</td>
<td>333 mg/tablet</td>
</tr>
<tr>
<td>Ipodate (e.g., Oragrafin)</td>
<td>308 mg/capsule</td>
</tr>
<tr>
<td>Iothalamate (e.g., Angio-Conray)</td>
<td>480 mg/mL</td>
</tr>
<tr>
<td>Metrizamide (e.g., Amipaque)</td>
<td>483 mg/mL (before dilution)</td>
</tr>
</tbody>
</table>

Mechanism of Iodine-Induced Hypothyroidism
- Inhibit thyroid hormone synthesis
- ↑ intrathyroidal inorganic iodine concentration due to continued iodine uptake
- Probable downregulation of sodium-iodide symporter (NIS)
- Iodine provides inhibitory effects to thyroid peroxidase (TPO)
Incidence of Iodine-Induced Hyperthyroidism and Risk Factors?

- Majority of patients clinically euthyroid
- Up to 1.7% have iodine-induced hyperthyroidism (iodine deficient areas)
- Multinodular thyroid disease patients
- Grave’s Disease
- Iodine deficiency
- Presence of ectopic thyroid tissue (i.e. tongue or thorax)
- Abnormal thyroid tissue autoregulation
- Geriatric patients
- Co-administration of other sources of iodine excess

Patients at risk

Roti E & Uberti ED. Thyroid 2001;11:493-500

Commonly Used Iodine-Containing Drugs

- Sodium iodide
- Potassium iodide
- Iodinated contrast media
- Iodized oil
- Labeled radiopharmaceuticals
- Iodinated serum proteins
- Iodinated albumin
- Iodinated protein solutions

Effects of Iodinated Contrast Media in Thyroid Function Within 1st Week of Load

- Objective
  - Investigate time course of free thyroid hormones and TSH levels in euthyroid patients within 1st week after application of radiocontrast agents
- Methods
  - Prospective study (n = 22)
  - Serum levels of TSH, FT4, FT3 assessed 2 days prior and daily for up to 7 days after application of radiocontrast agents

Gartner W & Weissel M. Thyroid 2004;521-524

Results and Conclusion

- Mean TSH levels increased significantly 3 - 5 days after iodine load (mean: 536 mg iodine/kg)
  - 32% of patients had peak concentrations on day 3 (r=0.794, p< 0.0001)
  - 18% (n = 4) of patients had TSH increased above normal (max level observed: 6.4 µU/mL)
  - FT4 and FT3 remained unchanged

- Application of high amounts of iodine may cause subclinical hypothyroidism even in euthyroid patients
- At higher risk: basal TSH levels > 2 µU/mL

Gartner W & Weissel M. Thyroid 2004;521-524

Case Reports of Contrast Media-Induced Thyrotoxicosis

- Cohort of 24,600 CT scans performed over a 3-year period
  - 7 multinodular goiter patients developed severe iodine-induced hyperthyroidism
  - Received total dose of 3 - 12 mg free iodine in non-ionic contrast media
- After CT of thyroid using 100 mL iohexol
  - 8 of 22 patients had temporary change in thyroid function
  - 4 patients showed increases in TSH levels
  - 4 patients developed temporary hyperthyroidism over 1 month period

1 DeBruin TJW. Lancet 1994;343:1160-1161
2 Nygaard B et al. Acad Radiol 1998;5:409-414

Case Reports of Contrast Media-Induced Thyrotoxicosis cont...

- Geriatric population with subclinical hyperthyroidism
  - ↑ free T4 and ↓ TSH as long as 8 weeks post-injection
  - 7 of 28 cases of hyperthyroidism seen over 20 months in Australia
  - Geriatric population whom had iopamidol 370 mg/mL
  - Condition self-limited
  - 60 hyperthyroid patients over 70 years old

- 23% exposure to iodinated contrast media within previous 6 months

Treatment of Iodine-Induced Hypothyroidism

- Generally treatment not recommended
- Some may need thyroid hormone replacement therapy
- In euthyroid patients, thyroid function returns to normal
- Recovery times may vary from 2 – 8 weeks
- Old radiocontrast dyes (e.g., Lipiodol) may persist for months or years
- New radiocontrast dyes (e.g., diatrizoate meglumine sodium and metrizamide) gets cleared very quickly

Markou K et al. Thyroid 2001;11:501-510

Guidelines for Use of Contrast Medium with Hyperthyroidism Risk Factors

- Idiopathic contrast medium-induced hyperthyroidism
- Development of hyperthyroidism after iodinated contrast media
- Age
- Patients with hyperthyroid function
- Some patients with multinodular goiter and thyroid autonomy, especially if they are elderly or have low serum thyrotropin levels
- Recommendations
- Nephrotoxic is generally not necessary
- Diabetes or renal disease should be closely monitored by endocrinologist after iodinated contrast medium injection
- Non-iatrogenic hyperthyroidism due to iodine-containing imaging may be given by an endocrinologist
- In patients with severe renal failure
- Interventional radiographic contrast media should not be given to patients at risk

Van der Molen AJ et al. Eur Radiol 2004;14:902-907