THYMOMA: A NEW PARADIGM IN IMAGING STAGING AND MANAGEMENT

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OBJECTIVES

➢ To discuss updates on thymoma:
  • Staging
  • Classification
  • Treatment
  • Follow-up

➢ To discuss the role of imaging in staging, selection of treatment and its ability to predict outcome

THYMOMA

➢ Thymic neoplasms are rare and account for less than 1% of all adult malignancies
➢ Thymic epithelial neoplasms are thymoma and thymic carcinoma
➢ Thymomas are the most common primary neoplasm of the anterior mediastinum
➢ Thymomas typically occur in patients older than 40 years and affect men and women equally

THYMOMA

➢ Usually an imaging incidental finding
➢ Can produce symptoms related to local effects of tumor/metastases or associated paraneoplastic syndromes
  ✓ 40% of patients with thymoma have Myastenia Gravis
  ✓ 10% of patients with Myastenia Gravis have thymoma
  ✓ Red blood cell aplasia
  ✓ Hypogammaglobulinemia

THYMOMA

➢ Literature based on single institution series
➢ Definitions and outcomes between series vary
➢ The International Thymic Malignancy Interest Group (ITMIG): a collaboration of interested individuals around the world to develop an infrastructure that facilitates progress in this disease

ITMIG

➢ First steps
  • Development of standard outcome measures
  • Development of uniform definitions
➢ Goal:
  • Creation of a worldwide database of this disease

www.itmig.org
Masaoka-Koga Staging

- Based on gross operative findings and microscopic invasive properties of the tumor
- Correlates with outcome
- Used to guide thymoma treatment

Masaoka-Koga Staging

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
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<tbody>
<tr>
<td>Stage I</td>
<td>Macroscopically and microscopically completely encapsulated</td>
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<tr>
<td>Stage II</td>
<td>(a) Microscopic invasion into capsule&lt;br&gt;(b) Macroscopic invasion into surrounding fatty tissue or grossly adherent but not breaking through mediastinal pleura or pericardium</td>
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<tr>
<td>Stage III</td>
<td>Macroscopic invasion into neighboring organ (i.e., pericardium, great vessels, lung)</td>
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<tr>
<td>Stage IV</td>
<td>(a) Pleural or pericardial dissemination&lt;br&gt;(b) Lymphogenous or hematogenous metastasis</td>
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Adapted from Koga Pathol Int 1994

Masaoka-Koga Staging

- Final staging based on microscopy: demonstration of tumor cells crossing anatomical borders
- Correct staging requires good communication between surgeon and pathologist
- Accurate data collection requires common language and consistent definitions of stages
- ITMIG is in the process of forming these definitions

Types of Capsular Invasion

Illustrated by Dr. Cesar Moran

WHO Classification

- Type A - Medullary, spindle cell
- Type AB - Mixed
- Type B1 - Lymphocyte rich, predominantly cortical
- Type B2 - Cortical
- Type B3 - Epithelial (Well differentiated thymic carcinoma)
- Type C - Thymic carcinoma
WHO Classification

- The WHO classification of thymic neoplasms is based on histologic features
- The WHO classification is not used for staging because it:
  - Lacks adequate reproducibility
  - Is a poor predictor of prognosis
  - Has imprecise histologic criteria
  - Has several classifications that often exist in one tumor
  - Has conflicting survival curves among various studies

Chen G, Chalabreysse et al

WHO Classification

- Is in the process of being revised

Images above from one resected thymoma show four different coexisting WHO cell types in the same tumor

THYMOMA- RADIOGRAPHY

- Anterior mediastinal mass located anywhere from the thoracic inlet to the cardiophrenic angle
- Lateral radiograph allows localization in the anterior mediastinal compartment
- Smooth or lobulated contours
- Typically unilateral

THYMOMA- CT

- Usually in the anatomic location of the thymus but can occur anywhere from the neck to the cardiophrenic angle
- Typically a 1-10 cm, smooth or lobulated mass
- Homogeneous, heterogeneous or rarely cystic with mural nodules
- Calcification: coarse, punctate, linear, or curvilinear along capsule or within internal septa
- Most common metastases are “drop metastases” to the pleura

THYMOMA- MRI

- Used for tumor evaluation in patients with iodine allergy or renal failure
- No radiation risk
- Provides improved contrast resolution
- Nowadays multidetector CT with three-dimensional reformation produces diagnostic images comparable to MR
- Chemical shift technique is useful in differentiating thymic hyperplasia from thymoma

THYMOMA- NUCLEAR MEDICINE

- Nuclear medicine is rarely used for evaluation of thymoma
- CT has now replaced Thallium for evaluation of thymus
- Indium Octreotide shows uptake in thymoma and is used to identify patients who may respond to treatment with octreotide
- Small series show FDG PET has limited value in distinguishing low grade from high grade thymoma and in differentiating early from advanced stage thymoma
- Increased FDG activity can be seen in normal thymus and in thymic hyperplasia
**TREATMENT**
- Based on Masaoka-Koga staging
  - Stage I - Surgery only
  - Stage II - Surgery. Postoperative radiation is controversial, but is clearly recommended for incompletely resected tumors
  - Stage III-IVA – If identified preoperatively, should receive chemotherapy prior to surgery as it improves survival. Resectable thymomas are treated with surgery and postoperative radiotherapy. Chemotherapy is recommended in cases of incomplete resection. Unresectable tumors are initially treated with neoadjuvant chemotherapy followed by surgery and/or radiotherapy.
  - Stage IVB – Chemotherapy is recommended

**THE ROLE OF IMAGING**
- Identify patients to be treated with chemotherapy prior to surgery (stages III and IVa)
  - Identify non-operative candidates (stage IVb)
  - Identify recurrence following therapy

**CT AND STAGING**
**Obvious CT Findings associated with Stage III/IV**
- Direct signs of local invasion and pleural metastases
- Vascular involvement - Irregular luminal contour - Endoluminal soft tissue - Vascular encasement
- Pleura – Ipsilateral pleural nodules

**CT AND STAGING**
**CT Features of the Primary Tumor associated with Stage III/IV**
- Large tumor size (>7cm)
- Lobulated contour
- Infiltration of surrounding fat

**PET-CT AND STAGING**
**MD Anderson Cancer Center experience with 31 consecutive thymoma patients assessed with PET CT prior to surgery**

**RECURRENT THYMOMA**
- Late recurrence can occur even 5 or 10 years after resection and is not uncommon
- Surgery, when possible, remains the preferred therapeutic option
- Resection of recurrence improves survival
- Early detection of recurrence is important, while disease is still resectable
- Non-resectable recurrence is treated with chemotherapy and/or radiotherapy
FOLLOW-UP

Follow-up recommendations according to ITMIG

- Chest CT scan yearly for 5 years after surgical resection
- After 5 years alternate annually with chest radiograph and chest CT up to 11 years
- After 11 years: annual chest radiography only
- Chest CT every 6 months for 3 years in cases of:
  - Stage III or IVa Thymoma
  - Incomplete tumor resection
- MRI, instead of CT, may be used to minimize cumulative dose in young patients

CONCLUSION

- CT is the cross-sectional imaging modality of choice for imaging patients with thymoma
- Staging and extent of resection are the most important prognostic factors
- Tumors with a favorable outcome are those that are encapsulated and amenable to complete resection, whereas invasive and unresectable tumors have a poor prognosis regardless of their cell type or histology
- Thus, radiologists should be familiar with imaging features of advanced stage thymoma and with imaging follow up recommendations

References