Lymphoma: Other Imaging Modalities

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Lecture Outline

• I - Staging
• II - Therapy Response
Historical Perspectives

- **1971**: Ann Arbor staging classification based on RT treatment field
- **1989**: Modified Ann Arbor classification based on CT
- **1999**: IWG criteria defined 5 categories based on CT imaging of lesion size
- **2007**: IHP criteria for therapy response based on PET/CT – mediastinal blood pool
- **2009**: Deauville Criteria based on PET/CT – mediastinal & Liver blood pool
- **2014**: Lugano classification based on CeCT and PET/CT
Major Features of Lugano Classification

- **Staging**
  - PET/CT for staging of FDG avid lymphomas
  - Modified Ann Arbor for extent of disease
  - Treatment directed more by limited or advanced disease and prognostic / risk factors
  - Elimination of bone marrow biopsies in HL and most diffuse large B cell NHL
Major Features of Lugano Classification

• ‘A’ and ‘B’ modifiers are only used for HL
• Elimination of routine Chest X ray
• Elimination of ‘X’ modifier, but record largest mass diameter

• Therapy Response
  • PET/CT is the basis for response assessment for all FDG avid lymphomas
  • CR includes residual masses that are not FDG avid
Major Features of Lugano Classification

- Interpretation of PET using five point scale
- Increase of single node for progressive disease; Be aware of ‘flare’ response
## Table 1 Revised staging system for primary nodal lymphomas

<table>
<thead>
<tr>
<th>Stage</th>
<th>Involvement</th>
<th>Extranodal (E) status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage I</td>
<td>One node or a group of adjacent nodes</td>
<td>Single extranodal lesions without nodal involvement</td>
</tr>
<tr>
<td>Stage II</td>
<td>Two or more nodal groups on the same side of the diaphragm</td>
<td>Stage I or II by nodal extent with limited contiguous extranodal involvement</td>
</tr>
<tr>
<td>Stage II bulky**</td>
<td>II as above with “bulky” disease</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Advanced</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage III</td>
<td>Nodes on both sides of the diaphragm</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td>Nodes above the diaphragm with spleen involvement</td>
<td></td>
</tr>
<tr>
<td>Stage IV</td>
<td>Additional non-contiguous extralymphatic involvement</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
Major issue: Access to technology and affordability
• Major issue:
  • Access and affordability

• Population 1.4 billion
• 170 PET/CTs
Ultrasound

Hypo echoic
Non Specific
Vascular

J Ultrasound Med 2015; 34:1139–1145
Radiology 2015;276: 323-338
Ultrasound - Value

- Cost effective & Access to care
- No radiation
- Aid tissue diagnosis

J Ultrasound Med 2015; 34:1139–1145
Radiology 2015;276: 323-338
Computed Tomography
CeCT - Value

- Precise lesion size – for both FDG avid and non FDG avid lesions
- Small lesions
- Non or low FDG avid lesions – therapy response
- CT guided biopsy
- Access to care
CeCT – Clinical Practice

- Non FDG avid lymphomas
  - Chronic lymphocytic leukemia (CLL) / Small lymphocytic lymphoma
  - Marginal zone lymphoma
  - Mycosis fungoides
• Non FDG avid lymphomas
  • Chronic lymphocytic leukemia (CLL) / Small lymphocytic lymphoma
  • Marginal zone lymphoma
  • Mycosis fungoides
CeCT – Clinical Practice

- Measuring lymph nodes
- Radiation therapy planning
CeCT - Staging

- CT based criteria
  - Lymph nodes:
    - 1.5 cm longest diameter in transverse plane
• CT based criteria
  • Lymph nodes:
    • 1.5 cm longest diameter in transverse plane
CeCT - Staging

- CT based criteria
  - Lymph nodes:
    - 1.5 cm longest diameter in transverse plane
CeCT - Staging

- **CT based criteria**
  - Spleen, and tonsils are considered nodal disease:
    - Lesions 1 cm longest diameter in transverse plane
CeCT - Staging

- CT based criteria
  - Extra nodal organ disease:
    - Lesions 1 cm longest diameter in transverse plane

Radiology 2015;276: 323-338
CeCT - Staging

- CT based criteria
  - Splenomegaly: 13 cm in coronal plane

Non specific
CT based criteria

Upto 6 target measurable nodes and extra-nodal sites
CeCT – Non Measurable Disease

• Non measurable disease
  • Beyond 6 target target measurable nodes and extra nodal sites
  • Difficult to measure – infiltrative growth, pleural effusion, ascites, cutaneous lesions
CeCT – Non Measurable Disease

Radiology 2015;276: 323-338
CeCT – Thymus - Normal

A  7 months

B  6 years

C  13 years

D  20 years
CeCT – Therapy Response

• When
  • Non FDG avid lymphomas
  • At baseline, if CeCT was performed and demonstrated additional lesions than PET/CT
  • No FDG PET/CT performed at baseline
  • For stage I-II favorable HL (NCCN) – early therapy assessment
CeCT – Therapy Response

NCCN Guidelines Version 2.2015
Hodgkin Lymphoma

Classical Hodgkin Lymphoma
Stage IA, IIA Favorable
(Continued from HODG-2)

Primary Treatment
ABVD alone

ABVD x 2 cycles
Stage IA, IIA Favorable

ABVD x 3 cycles (category 2B)

Restage with diagnostic CT of areas of initial disease

Complete response (CR) or unconfirmed complete response (CRu) on CT

ABVD x 2 cycles (total 4)

Restage with PET/CT

Partial response (PR) on CT

ABVD x 4 cycles (total 6)

Deauville 1-3°

Deauville 1-2°

Deauville 3-4°

Deauville 5°

Restage with PET/CT

ABVD x 1 cycle (total 4)

Deauville 4°

ISRT

Deauville 5°

Biopsy

Deauville 4°

ISRT

Deauville 5°

Biopsy

ISRT

See Follow-up (HODG-12)

See Follow-up (HODG-12)

See Refractory Disease (HODG-13)

See Follow-up (HODG-12)

See Refractory Disease (HODG-13)
CeCT – Therapy Response

- Complete Response
- Partial Response
- Stable Disease
- Progressive Disease
CeCT – Therapy Response

• Complete Response
  • Target nodes / nodal mass regress < 1.5cm longest diameter
  • No extra lymphatic sites of disease
  • Non measured lesions absent
  • Organs: Regress to normal
  • No new lesions
  • Bone marrow: normal by morphology
CeCT – Therapy Response

- Partial Response
  - > 50% decrease in SPD of up to 6 target measurable nodes or lesions
    - Measurement of small nodes
  - Non measurable lesions: Absent / Normal/ regressed / NO increase
  - Organ: Spleen must have regressed > 50% in length beyond normal
- No new lesions
CeCT – Therapy Response

• Stable Disease
  • < 50% decrease in SPD of up to 6 dominant, measurable nodes and extra nodal sites
  • Non measurable lesions and Organs: No increase consistent with progression
  • No new lesions
  • No criteria for progressive disease are met
CeCT – Therapy Response

- Progressive Disease
  - An individual node must be
    - LD > 1.5cm
    - Increase > 50% of PPD from nadir (LDt x SDt)
  - An increase LDt or SDt from nadir
    - 0.5 cm for lesions < 2 cm
    - 1 cm for lesions > 2 cm
CeCT – Therapy Response

- Progressive Disease
- Splenomegaly: > 50% increase of the extent of prior increase beyond baseline
- If no prior splenomegaly: > 2cm increase from baseline
- New or recurrent splenomegaly
CeCT – Therapy Response

- Progressive Disease
  - New Lesions
    - Any new node > 1.5 cm in any axis
    - Any extranodal site > 1 cm in any axis
    - Disease of any size unequivocally attributable to lymphoma
MRI: CNS Lymphoma

T1 + C
Immuno-competent patient

T1 + C
Immuno-compromised patient
MRI: CNS Lymphoma
MRI: CNS Lymphoma

Leptomeningeal Spread

T2

T1 + C

Leptomeningeal Spread

MRI: CNS Lymphoma

Meningeal Spread

T1 + C

Meningeal Spread
MRI: CNS Lymphoma

Perineural Spread – Right Oculomotor Nerve

T1 + C

AJR 2015; 205:604–617
Intra-thecal methotrexate therapy

MRI – CNS Lymphoma – Therapy Response

Baseline

Post 6 cycles

4 months Post Tx

Intra-thecal methotrexate therapy
MRI – CNS Lymphoma – Therapy Response

Intra-thecal methotrexate therapy

Baseline

Post 7 cycles

Intra-thecal methotrexate therapy

AJR 2015; 205:604–617
High soft tissue resolution provides accurate extent of the disease – even for FDG avid lymphomas

Modality of choice for staging & therapy response for CNS lymphoma
• Chest, abdomen and pelvic CT – most commonly used for lymphoma staging and therapy response assessment in the world – due to lack of access to PET/CT
In the era of Lugano classification and PET/CT availability, CT is valuable for:

- non FDG avid lymphomas
- measuring lesion size and
- radiation therapy planning
For CNS lymphoma, MRI is the modality of choice for staging & therapy response due to excellent soft tissue resolution.
Thank you

- Diana Paez
- Thomas Pascual
- Enrique Estrada
- Other IAEA staff
American College of Nuclear Medicine

- www.acnmonline.org

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  - Academy of NM & MI