Lugano classification: Role of PET-CT in lymphoma follow-up

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Disclosures

• No disclosures
Objectives

• Review Lugano recommendations
• Review the role of PET in lymphoma treatment response
• Demonstration of Lugano classification through cases of lymphoma follow-up
Introduction

Lymphoma

- 80,000 new cases in the USA in 2014
- Males and whites at higher risk overall
- Increased incidence with age
  - But B/T-cell lymphomas primarily in childhood
- WHO classification in 2001
  - Built upon REAL and FAB
  - Based on morphology, immunophenotype, cytogenic features, molecular features, clinical traits, etiology, and pathogenesis
## Introduction

### Lymphoma

<table>
<thead>
<tr>
<th>Stage Description</th>
<th>Hodgkin</th>
<th>Non-Hodgkin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited stage</td>
<td>Chemotherapy (ABVD), radiation therapy</td>
<td>R-CHOP, involved-field radiotherapy</td>
</tr>
<tr>
<td>Advanced stage</td>
<td>Combination chemotherapy (ABVD)</td>
<td>R-CHOP, with or without radiation therapy</td>
</tr>
<tr>
<td>Bulky disease</td>
<td>Radiation therapy</td>
<td>(non-applicable to NHL)</td>
</tr>
<tr>
<td>Refractory or relapse</td>
<td>Second-line chemotherapy</td>
<td>Targeted biologic therapies</td>
</tr>
<tr>
<td></td>
<td>High-dose therapy with autologous stem cell transplant</td>
<td>Radiotherapy if not already given first-line</td>
</tr>
</tbody>
</table>
Introduction

Why do PET/CT?

• Commonly used, not officially incorporated in Ann Arbor

• PET-CT the standard for assessment in most lymphomas
  – Has replaced PET alone
    • Improved nodal and extra-nodal staging
  – Recommended for FDG-avid lesions
  – Useful for initial staging with baseline allowing more accurate response assessment
  – Useful in end-of-therapy assessment
Introduction

Why do PET/CT?

• The Deauville 5 point scale
  – Score to assess degrees of response at interim and end of treatment

• Interim PET is superior to CT to assess early response
  – Quantitative measures need further validation for role in response assessment

• End of treatment PET is standard of care for detecting remission in FDG-avid lymphomas
  – If residual metabolically active tissue found, biopsy is recommended
  – Its further role is still being evaluated
# Lymphoma

## Score and response criteria

<table>
<thead>
<tr>
<th>Score</th>
<th>Uptake</th>
<th>Response</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>None</td>
<td>Complete metabolic response</td>
<td>With or without residual mass, No FDG-avid bone marrow</td>
</tr>
<tr>
<td>2</td>
<td>Below mediastinal blood pool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Above mediastinal but not exceeding uptake in liver</td>
<td>Partial metabolic response (residual disease if end)</td>
<td>Reduced uptake compared with baseline, Residual masses of any size</td>
</tr>
<tr>
<td>4</td>
<td>Slightly-to-moderately higher than liver</td>
<td>No metabolic response</td>
<td>No obvious change in FDG uptake</td>
</tr>
<tr>
<td>5</td>
<td>Markedly elevated compared to liver (data suggests &gt;2-3 times)</td>
<td>Progression</td>
<td>Increased uptake from baseline, New FDG-avid foci consistent with lymphoma</td>
</tr>
</tbody>
</table>

- FDG uptake greater than liver often seen at interim in those with complete response at end of treatment
- FDG uptake greater than mediastinum but less than liver has a good prognosis in HL, DLBCL, and follicular lymphomas
Lymphoma

Implications of FDG-avid activity on interim PET-CT
- It is currently not recommended to change therapy based on findings at interim, unless obvious progression is present
- Decrease in FDG uptake seen before conventional imaging shows volume reduction, allowing better response assessment at interim

Implications of FDG-avid activity on end-of-treatment PET-CT
- Negative scan excludes residual tumor with high certainty (HL and DLBCL)
- Risk of recurrence higher with residual disease >2 cm despite negative PET/CT
- Surveillance scans after remission have high false-positive, and are NOT recommended
PET Deauville Score

Case 1: Deauville 1

Deauville 1
- Initial: no uptake
- Interim: complete metabolic response. No residual uptake, ±residual mass

Clinical context
- Pretreatment staging
- Small bowel resection and anastomosis
  - Pathology-proven DLBCL

Small bowel anastomosis
PET Deauville Score

Case 1: Deauville 1 Part 1

Findings: Deauville 1. ¹Regions of mild uptake in region of anastomosis consistent with inflammation. ²Mild uptake along the anterior abdominal midline scar. No other abnormal foci.
Clinical Context: declined chemotherapy, suspicion of recurrence.
1 11.1x8.3x11cm, 2 2.3x2.1cm
PET Deauville Score

Case 1: Deauville 1 Part 3

Clinical context: 6 cycles R-CHOP, gastrojejunostomy, left hemicolecтомy with end colostomy.
Deauville 2

- Initial: Residual uptake less than or equal to mediastinal blood pool
- Interim: **Complete metabolic response.** As above, ±residual mass.

**Clinical context**
- Hodgkin lymphoma for staging

**PET Deauville Score**

**Case 2: Deauville 2**

- Bilateral supraclavicular
- Bilateral hilar and internal mammary, deep right anterior chest wall
- Heterogenous splenic
Findings: **Deauville 5.** 1 Extensive FDG-avid lymphadenopathy above the diaphragm (mediastinum, bilateral supraclavicular, bilateral hilar, bilateral internal mammary chains, deep right anterior chest wall), 2 heterogeneous FDG-avid accumulation in the spleen.
PET Deauville Score

Case 2: Deauville 2 Part 2

Clinical context: Stage III Hodgkin lymphoma, completed chemotherapy.
Findings: **Deauville 2. Complete metabolic response.** Mild uptake in superior mediastinum less than mediastinal blood pool. No residual uptake in the abdomen or pelvis.
PET Deauville Score

Case 3: Deauville 3

Deauville 3
- Initial: uptake greater than mediastinal blood pool but not greater than liver
- Interim: **complete metabolic response.** As above, ±residual mass

Clinical context
- Transformed lymphoma
- Re-staging

Right vertex of skull
Right pre-auricular
Skin overlying bridge of nose
Distal left tibia
Findings: **Deauville 5.** ¹Focal activity in skin overlying right vertex of skull, ²bridge of nose, and ³right-preauricular region. Focal activity within ⁴both inguinal regions. Focal activity ⁵left distal tibia.
Clinical context: post chemotherapy.

PET Deauville Score

Case 4: Deauville 4

Deauville 4
- Initial: Uptake moderately greater than liver
- Interim: **Partial metabolic response** if reduced compared to baseline with residual mass or any size.
  **No metabolic response** if no obvious change in FDG uptake.

Clinical context:
- Extensive B cell lymphoma
- Staging

![Diagram showing sites of involvement: Right cervical, Heterogenous liver, Periportal, Heterogenous spleen, Mesenteric, Right pelvic brim, Diffuse bony disease.]

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PET Deauville Score

Case 4: Deauville 4 Part 1

Findings: **Deauville 5.** ¹left IIb cervical node, ²extensive upper abdominal involvement (periportal, peripancreatic, aortocaval, paraaortic, mesenteric nodes, heterogenous liver and splenic involvement, pancreatic head), ³right pelvic brim nodes, ⁴extensive bony involvement.
Clinical context: post 6 cycles of CHOP-R
Deauville 5

- Initial: Uptake markedly greater than liver
- Interim: **Progression.** Increased uptake from baseline, or new FDG-avid foci consistent with lymphoma.

Clinical context:
- Staging of aggressive lymphoma

PET Deauville Score

**Case 5: Deauville 5**

- Lower neck, supraclavicular
- Right axillary, retroclavicular
- Extensive mediastinal
- Cardiophrenic
- Right retrocaval
- Celiac axis
Findings: **Deauville 5.** Extensive lymphadenopathy above the diaphragm: right neck, bilateral lower neck, bilateral supraclavicular, right retroclavicular, right axillary, cardiophrenic, mediastinal. **Celiac axis and retrocaval lymphadenopathy.**
Clinical context: progression on CHOP-R chemotherapy.
Findings: **Deauville 5. Progressive disease.** Progressive disease ¹ above and ² below the diaphragm.
Deauville X

- New areas of increased uptake likely unrelated to lymphoma

Clinical context
- Post-surgical DLBCL

Findings
- **Deauville X.** Mild accumulation in the left inguinal region consistent with post-operative change.
Conclusion
Role of PET/CT

FDG PET/CT plays a key role in the reassessment in lymphoma

The Deauville 5-point score has been validated as a tool for interim evaluation in lymphoma

- Benefits include less interobserver variability

Interim PET/CT superior to CT alone to detect early response, however treatment should not be changed unless there is clear progression of disease

End of treatment PET-CT more accurate than CT

- HL early and advanced
  - Positive predictive value >90%, negative predictive value 95-100%

- Aggressive NHL
  - Positive predictive value 50-100%, negative predictive value 80-100%

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Bibliography:


Thank You

Additional cases available upon request (PET-CT staging, CT staging, CT reassessment)