Read with the Experts

Paediatric Oncology & Hybrid Imaging

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Case 1
13yr F presented with a left neck mass
CT: enlarged lymph nodes in neck and a mediastinal mass
Biopsy: Hodgkins Disease Nodular Sclerosis
PET/CT
Bulky neck nodes and mediastinal mass
No enlarged nodes below diaphragm or
Involvement of spleen and liver:
Stage IIA

Protocol AHOD0031
Response

Table 2  Deauville criteria for interim PET interpretation [68]

<table>
<thead>
<tr>
<th>Scale level</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>No uptake</td>
</tr>
<tr>
<td>2</td>
<td>Uptake $\leq$ mediastinum</td>
</tr>
<tr>
<td>3</td>
<td>Uptake $&gt;$ mediastinum $\leq$ liver</td>
</tr>
<tr>
<td>4</td>
<td>Uptake moderately $&gt;$ liver</td>
</tr>
<tr>
<td>5</td>
<td>Uptake significantly $&gt;$ liver and new disease foci</td>
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</tbody>
</table>

J Clin Oncol 32:3048-59 2014 Barrington et al
Q 1
Response after 2 cycles
Using Deuville Criteria
Which is correct?

1. 1
2. 2
3. 3
4. 4
5. 5

SUVmax 17.9
2.6
2.0
2.9
Q2
3 mths post end Tx
No involved field radiotherapy
What is the likelihood of recurrence in this pt Stage IIA complete response?

1. high
2. moderate
3. low
4. negligible
Q2
3 mths post end Tx
No involved field radiotherapy
What is the likelihood of recurrence in this pt Stage IIA complete response?

1. high
2. moderate
3. low
4. negligible
16.7.2015  Biopsy- Nodular sclerosis HD  
High dose chemotherapy and autologous stem cell rescue
Risk Adapted Approach

• Hodgkin Lymphoma- Risk Adapted management

• RISK ADAPTED DIAGNOSTIC PROTOCOLS
  • Particularly for Surveillance Imaging
  • High Risk- more frequent imaging
    – Bulky disease, higher stage, poor responders
  • Low Risk- ? No imaging, 3-6 mths
Case 2
13 yr old girl with prolonged fever and abdo pain for 3 months.

Q3
Interpretation?
1. Physiologic reactive lymph nodes
2. Abscess
3. Physiologic bowel
4. Abnormal lymph nodes, require biopsy
5. Malignancy
Case 2
13 yr old girl with prolonged fever and abdo pain.

Q3
Interpretation?
1. Physiologic reactive lymph node
2. Abscess
3. Physiologic bowel
4. Abnormal lymph node, require biopsy
5. Malignancy

Core biopsies...reactive lymphoid tissue.
Treated as a non-specific auto-inflammatory syndrome- high dose steroids
Relapsing course over 6 mths
Auto-Inflammatory Syndrome

• Does not fit classical auto-immune conditions
• Recurrent fevers, rash, serositis, lymphadenopathy & rheumatologic symptoms e.g. joints, muscles, eyes
• No auto-reactive T cells or auto-antibodies involved
• Auto-inflammatory syndrome associated with dys-regulation of the innate immune response with subsequent episodes of acute spontaneous inflammation
Auto-Inflammatory Syndrome
Hereditary Recurrent Fever Syndromes

1. Familial Mediterranean Fever
2. Hyper IgD syndrome
3. Chronic Recurrent Relapsing Multifocal Osteomyelitis (CRMO)
4. Cryopyrinopathies
5. Blau syndrome (non-caseating granulomatous lesions inv joins, skin & eyes)
6. Papa syndrome (pyogenic sterile arthritis, pyoderma gangrenosum & acne)
7. Most have specific genetic characteristics
Case 3
14 yr old girl on treatment for a non-specific auto-inflammatory syndrome with recurrent fevers and intermittent abdo pain 6 mths.

SUVmax20

Q4
Interpretation?
1. Physiologic reactive lymph node
2. Abscess
3. Physiologic bowel
4. Abnormal lymph nodes, require biopsy
5. Malignancy
14 yr old girl on treatment for a non-specific auto-inflammatory syndrome with recurrent fevers and abdo pain.

Q4

Interpretation?
1. Physiologic reactive lymph node
2. Abscess
3. Physiologic bowel
4. Abnormal lymph node, require biopsy
5. Malignancy

Excision biopsy...anaplastic large cell lymphoma
Case 4
11 yr old boy with fever, cervical lymphadenopathy and splenomegaly.

SUVmax 6.9-7.4

Q5. What is the next test?
1. CT
2. MRI
3. US
4. Biopsy
5. None of the above
Ultrasound Neck

Enlarged nodes, mild increase in vascularity
Is the vascularity normal?
Are the nodes normal morphology?
Case 4
11 yr old boy with fever, cervical lymphadenopathy and splenomegaly.

Biopsy: Kikuchi Disease
Histiocytic necrotising lymphadenitis
Self limited auto-immune process
Lymphadenitis from apoptotic cell death
induced by cytotoxic T lymphocytes

Auto-immune dysfunction
Case 5
14yr Male  R humeral osteogenic sarcoma
2004 Rx Chemotherapy and proximal R resection, humeral prosthesis
Completed treatment 8/2005
Routine FU CT showed solitary pulmonary Metastasis- surgically resected.
Further chemotherapy
Time since prosthesis inserted 12 mths
First PET scan 26/10/2006

SUVmax 1.2
Peri-prosthetic activity
Time since prosthesis

26.10.06 12 mths
SUVmax 1.2

11.10.07 24 mths + pulm recurrence
SUVmax 6.2
Peri-prosthetic activity
Time since prosthesis

26.10.06 12 mths
SUVmax 1.2

11.10.07 24 mths + pulm recurrence
SUVmax 6.2

Q6
FDG uptake around proximal prosthesis is:
1. Within normal for a prosthesis
2. Infection
3. Loosening
4. Stress reaction
5. Recurrence of OS
Peri-prosthetic activity

Time since prosthesis
26.10.06 12 mths
11.10.07 24 mths + pulm recurrence

Resection of right upper lobe metastasis
24.01.08 post chemo

Q7
What is happening in the proximal right humerus and lungs?
1. Recurrence and lung scar tissue
2. Recurrence and lung metastasis
3. Loosening and lung scar tissue
4. Infection and lung scar tissue
5. Loosening or infection and lung metastasis
Peri-prosthetic activity

Time since prosthesis
26.10.06 12 mths
11.10.07 24 mths + pulm recurrence
24.01.08 chemo + R lung resection

Further resection of R upper lobe
and 8 weeks later

Answer:
Local recurrence and lung metastases
- forequarter amputation & lung resection
**Points to note:**

**Remodelling:**
- Usually mild linear uptake around the prosthesis
- No focal areas

**Recurrence:**
- Focal asymmetrical
- No bone at the site of recurrence
Case 6
2 yr male with limp
Pain on movement of R leg
PET/CT: R ilium, R 4th rib, L temporal bone (mastoid process, petrous bone)

Biopsy: Langerhan cell histiocytosis

Q8
Differential Diagnosis
1. Ewings sarcoma & metastases
2. Osteogenic sarcoma & metastases
3. Multifocal Osteomyelitis
4. Histiocytosis
5. None of the above
Chemotherapy
Prednisolone & Vinblastine
3 months

Good response to therapy
Langerhan Cell Histiocytosis

Baylor College of Medicine & Texas Childrens Cancer Center

Comparison of FDG-PET Scans to Conventional Radiography and Bone Scans in Management of Langerhan Cell Histiocytosis

Pts 44 PET scans: 102

<table>
<thead>
<tr>
<th>TABLE I. Overall Comparison of PET Scan Results versus Other Imaging Modalities</th>
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<tbody>
<tr>
<td>Scan comparisons</td>
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<tr>
<td>------------------</td>
</tr>
<tr>
<td>Bone scan</td>
</tr>
<tr>
<td>MRI</td>
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<tr>
<td>CT</td>
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<tr>
<td>Plain film</td>
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Number of lesions found by PET as compared to “other”.

PET detects LCH activity and early response to therapy with greater accuracy than other imaging in bone and soft tissues.
Case 7
12 yr F : thyroid nodule L side & L loco-regional disease.
FNAB Bethesda V  Papillary carcinoma diffuse sclerosing variant
Total thyroidectomy 20.5.13.
Withdrawal T4
TSH 47.5mIU/L
Tg 52.8ug/L
RAI: 3GBq I^{131}

Wt 38kg
5.5GBq 70kg

Total Body I^{131}
$^{131}\text{I}$ SPECT/CT

Thyroid bed

L neck level II
Q9. What next?
1. Wait another 6 months repeat $^{123}$I diagnostic scan
2. Neck ultrasound
3. Repeat Therapy dose $^{131}$I
4. FDG PET/CT scan
5. Surgery
Q9. What next?
1. Wait another 6 months repeat $^{123}$I diagnostic scan
2. Neck ultrasound------ no abnormal LNs
3. Repeat Therapy dose $^{131}$I
4. FDG PET/CT scan
5. Surgery

Stimulated
Tg 81.45ug/L
Q9. What next?
1. Wait another 6 months repeat $^{123}$I diagnostic scan
2. Neck ultrasound------ no abnormal LNs
3. Repeat Therapy dose $^{131}$I
4. FDG PET/CT scan
5. Surgery

Stimulated
Tg 81.45ug/L
18F-FDG PET/CT

30/1/14

Surgery: Left neck dissection
Ultrasound: mark nodes in L neck and correlate with abnormal PET study

Surgery: L neck dissection- extensive levels 2,3,4

Histopath: 2x Level 3 / 4 nodes positive

Genetic tests: ALK mutation
- Anaplastic thyroid cancer

Reason:
Clonal heterogeneity of differentiated and anaplastic cells
\(^{131}\text{I}\) treated the iodine avid cells but not the anaplastic cells

Potential for ALK inhibitors in management
Thyroid cancer

• $^{18}$F-FDG PET/CT is used in evaluation of patients with:
  – Raised Tg
  – No evidence of recurrent or refractory disease on US, $^{123}$I/$^{131}$I WBS or other imaging
  – Rare in paediatric / young adolescent DTC

• Positive FDG uptake indicates
  – Anaplastic poorly differentiated (Iodine neg) or de-differentiation of thyroid cancer cells (Iodine pos- neg)
  – Poor prognosis with reduced OS
4 yr old boy 100 days post stem cell transplant for MPS type II, persistent fevers.

Q10
Regarding these lymph nodes:
1. Physiological appearance
2. “Benign reactive” lymph nodes
3. Malignancy
4. Autoimmune dysfunction
5. EBV driven process

SUVmax 17.6
SUVmax 14.3
4 yr old boy 100 days post stem cell transplant for MPS type II, persistent fevers.

SUVmax 17.3

High EBV serum load
Biopsy: EBV reactivation Rx Rituximab

Q10
Regarding these lymph nodes:
1. Physiological appearance
2. “Benign reactive” lymph nodes
3. Malignancy
4. Autoimmune dysfunction
5. EBV driven process
Post Transplant Lymphoproliferative Disease (PTLD)

1. Solid organ and Bone Marrow Transplant
2. Broad spectrum of lymphoproliferative disease
   a. Kidney transplant (1-10%)
   b. Liver Tx (6-20%)
   c. Thoracic organ Tx (3-24%)
   d. Small intestine Tx (20-32%)
3. Pediatrics > adults
4. Symptoms & signs = primary EBV infections- fever, sweats, general malaise, enlarged tonsils, lymphadenopathy
5. Abnormal lymphoid hyperplasia to malignant lymphoma
6 yr Male Liver Transplant 2005 for PFIC.

Core Biopsy: Burkitts lymphoma