The added value of multislice SPECT/CT in patients with equivocal bony metastasis from carcinoma of the prostate

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Introduction

- CaP is one of the most common malignancies in men
  - 70% have bone metastases at postmortem
  - Most with M0 disease are alive at 10y, only 7% of those with M1

- For >30y bone scintigraphy using $^{99m}$Tc-labelled diphosphonates has been the mainstay for detection of metastatic disease

- NICE (2002) indications for bone scan in new CaP
  - All patients with serum PSA $\geq$10ng/mL or Gleason score $\geq$ 7
  - If PSA $\leq$ 10ng/mL incidence of metastatic disease is 0 – 1.9%
Introduction

# Introduction

<table>
<thead>
<tr>
<th></th>
<th><strong>Pro’s</strong></th>
<th><strong>Con’s</strong></th>
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<tbody>
<tr>
<td><strong>Bone scintigraphy</strong></td>
<td>• High sensitivity</td>
<td>• Low specificity</td>
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<td></td>
<td>• Widely available, well documented</td>
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<tr>
<td></td>
<td>• Cost effective</td>
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<td><strong>SPECT</strong></td>
<td>• Better anatomical localization</td>
<td>• Difficulty localizing anatomy in vertebral column</td>
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<tr>
<td></td>
<td>• Improved sensitivity and specificity</td>
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<td><strong>SPECT/CT</strong></td>
<td>• Fused functional and anatomical imaging</td>
<td>• ↑ radiation dose</td>
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<td>• High sensitivity &amp; specificity</td>
<td>• 1.5x cost of BS</td>
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</table>
Introduction

- Superior diagnostic performance with SPECT/CT for equivocal lesions
  - Horger et al. (2004) – 85% correct SPECT/CT, 36% correct SPECT
  - Romer et al. (2006) – definite diagnosis in 90% of lesions equivocal on SPECT
  - Utsonomiya et al. (2006) – AUC >95% for fused images
Objectives

- Assess the added value of SPECT/CT in diagnosing bony metastasis in CaP
  - Inter-observer agreement
  - Diagnostic confidence
Sample selection

- 35 men all scanned at GSTT between 4/2006 and 4/2008
  - Age range 50-87, mean 71y
  - All had bone scan, SPECT and SPECT/CT

- Patients at various disease stages
  - New diagnosis, watchful waiting, in receipt of treatment
Method

Image review

- 2 qualified specialists in Nuclear Medicine
  - Blinded to all clinical details except Δ
  - Reviewed bone scintigraphy, SPECT and SPECT/CT images for each patient (1-week delay between reviews)
  - Worked independently

- Lesion by lesion diagnosis
  - Diagnostic confidence rated on 4-point scale, 1=Benign, 2=Possibly benign, 3=Possibly malignant, 4=Malignant
Method

Statistical analysis

- Descriptive statistics
- Cohen’s weighted Kappa
Results

Lesion foci

- 43 areas of increased tracer uptake
  - 29 spine, 6 ribs, 6 pelvis, 1 femur, 1 SI joint

Inter-observer agreement (weighted Kappa)

- Bone scintigraphy: 0.45 (moderate agreement), $p < 0.0001$
- SPECT: 0.57 (moderate agreement), $p < 0.0001$
- SPECT/CT: 0.87 (near perfect agreement), $p < 0.0001$
Results

<table>
<thead>
<tr>
<th>Scan</th>
<th>Malignant</th>
<th>Possibly malignant</th>
<th>Possibly benign</th>
<th>Benign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planar</td>
<td>11%</td>
<td>27%</td>
<td>42%</td>
<td>20%</td>
</tr>
<tr>
<td>SPECT</td>
<td>19%</td>
<td>29%</td>
<td>24%</td>
<td>2%</td>
</tr>
<tr>
<td>SPECT/CT</td>
<td>28%</td>
<td>2%</td>
<td>66%</td>
<td>4%</td>
</tr>
</tbody>
</table>
Results

- 57% of confidence ratings given ‘equivocal’ on planar and SPECT scans
- 6% of confidence ratings given ‘equivocal’ on SPECT/CT
- 6 vertebral lesions in 5 patients were reclassified on review of SPECT/CT
  - 4 lesions reclassified benign
  - 2 lesions reclassified malignant
Results

64y old, 9Hx of trauma
Gleason score 10
Possibly malignant
Results
Results
Results
Results

MRI follow-up
Results
Results
Radiation exposure

- Approx 7mSv in total
  - BS and SPECT (5mSv)
  - Low mA CT (approx 2mSv / 40cm)

- Overall risk of fatal Ca in the 50 – 85y age group (assuming uniform whole body exposure)
  - 0.035% - 0.007% (ARSAC 2006)
Conclusions

- The addition of SPECT/CT
  - Improved specificity by better anatomical localization
  - Enhanced diagnostic confidence of observers
  - Increased inter-observer agreement

- Potential benefits of adopting SPECT/CT for the diagnosis of metastases from CaP
  - Shorter diagnostic workup for patients with equivocal lesions
  - Quicker time to Rx, aim = 100% on Rx within 1 month of referral (97.7% now)
  - One-stop shop – reduced need for further imaging studies
Next steps

- Further research
  - Prospective trial with gold-standard diagnosis

- Cost-benefit analysis
  - Decision tree analysis
  - Follow-up (what further Ix, when, cost, time to diagnosis and treatment)
References & further reading


