PROSTATE CANCER UPDATES IN IMAGING TESTS

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Disclosures

• None
Outline

• Localization of Dominant Tumour Focus
• Local Staging
• Detection of Metastatic Disease
• Evaluation of Treatment Response
• Detection of Biomedical Recurrence
MRI Prostate

- Advanced anatomical and functional imaging modality of prostate and periprostatic tissue.
- Paradigm shift in use of MRI due to changing clinical landscape:
  - Recognition of limitations of TRUS biopsy.
  - Active surveillance is increasing used.
  - Focal therapy as an emerging concept.
- Roles of MRI by clinical scenarios
  - Local Staging for surgical/RT planning
  - Localize Tumour (Biopsy negative or biopsy naïve)
  - Monitoring for Active Surveillance
  - Identification of patient for focal therapy
  - Detection of recurrence after failed local therapy.
Tumour Detection in MRI Prostate

- Detection of a dark tumour focus in conventional T2W in bright peripheral zone is possible.

In the presence of BPH, haemorrhage and prostatitis/fibrosis, the detection of tumour can be very difficult.
Multiparametric MRI Prostate

- Addition of functional tools increases confidence in tumour detection and local staging.

<table>
<thead>
<tr>
<th>Tools</th>
<th>Biological Property Depicted</th>
</tr>
</thead>
<tbody>
<tr>
<td>DW-MRI</td>
<td>Extent of gland formation and cellular density</td>
</tr>
<tr>
<td>DCE-MRI</td>
<td>Angiogenesis, vascular permeability</td>
</tr>
<tr>
<td>$^1$H-MRSI</td>
<td>Cell membrane turnover and replacement of normal glandular tissue</td>
</tr>
</tbody>
</table>
Diffusion Weighted MRI

Essential component of mp - MRI:
- Short acquisition time and high contrast resolution.
- Increase sensitivity and specificity of tumour detection.  
  \[ \text{Woodfield CA AJR 2010} \]
- Adds confidence to detection of extra-capsular spread for inexperienced readers.

T2 W

B=1000
Diffusion Weighted MRI

- Prostate cancer - high signal intensity on DWI at high b-values and low signal intensity/value on ADC maps
- ADC values allow quantitative assessment
  - Low ADC = reduced diffusion
  - High ADC = less restriction of diffusion
  - Malignant lesions has low ADC values
Diffusion Weighted MRI

Random brownian motion

Relatively Free diffusion
Low signal DWI
High ADC

Restricted diffusion
High Signal DWI
Low ADC
Diffusion Weighted MRI

- Reduced diffusion of water in cancer – increased cellularity of malignant lesions, with reduced intra- and extracellular space.
- Cellular density also increases with higher grade tumours.
- Lower ADC value correlates with Higher Gleason score.

Tamada et al JMRI 2008, Woodfield CA AJR 2010
Prostate cancer shows early intense enhancement and washout.

DCE-MRI: High temporal resolution (<10 s) with axial T1W 3D gradient echo sequences at 3mm thickness at an injection rate of 3 mL/s.

Combined with T2WI and DWI to improve tumour localisation and local staging.
MR $^1$H Spectroscopy Imaging

- 3D Chemical shift imaging
- Highly specific “fingerprints of chemical compounds in MR spectrum”.
- **Generally abandoned** ACRIN 6659: AUC of 0.60 for MRI vs 0.58 for MRI + MRSI

Weinreb et al Radiol 2009;251:122

Normal:
Prominent citrate peak 2.6 ppm

Cancer
Prominent choline/creatine peak 3.2 + 3.0 ppm

MRI in Prostate Cancer Detection

- MpMRI has excellent sensitivity for detection of tumour foci 5mm of Gleason score 7 or more:

- For GS7, PCa detection rate is 82-88% for 5-20mm and 97% for more than 20mm foci.
- For GS>7, PCa detection rate is 93% for 5-20 mm and 100% for more than 20 mm foci.

*Hoeks CM Eur Urol 2012*
MpMRI in Prostate Cancer Detection

- Inter-reader variability is a concern for MpMRI.
- PIRADS v2 introduced at RSNA 2014
  - “simple system” with 39 prostate sectors,
  - Score PZ on DWI,
  - Score TZ on T2W,
  - DCE of secondary importance.
  - Score of 1-5 but really “Yes”, “Maybe”, “No”
MpMRI in Prostate Cancer Detection

- MpMRI detect anterior tumours as well as tumours at apex missed by systematic biopsy.
  - *Hoeks CM Radiol 2013, Lemaitre L Eur Radiol 2009*

- Before repeat biopsy for benign biopsy results, MpMRI recommended with view to MR guided or MRI-TRUS fusion biopsy [III,B]
  - *ESMO Practice Guidelines 2015*
MpMRI in Prostate Cancer Detection

- MpMRI detects more aggressive PCa foci of GS7 and above.  
  *Turkbey B et al J Urol Nov 2011*

- Potential as a pre-biopsy triage test to increase detection of significant PCa foci with a few trials published.  

MRI is not recommended routinely prior to initial prostate biopsy, but emerging data suggest that, in men undergoing initial biopsy, targeting using MRI/ultrasound fusion may increase the detection of clinically significant, higher-risk (Gleason grade ≥ 4+3) disease while lowering the detection of lower-risk (Gleason sum 6 or lower-volume Gleason grade 3+4) disease. All men with indications for biopsy should receive the standard 12-core TRUS-guided biopsy regardless of MRI results.

Follow-up for benign biopsy results – consider multiparametric MRI and/or refined prostate biopsy techniques image guidance using MRI/ultrasound fusion, transperineal, or saturation prostate biopsies.

Role of MpMRI in diagnosis

- Detection of dominant tumour focus (clinically significant higher risk cancer)
- Options for Targeted Biopsy
  - MRI guided biopsy
  - MRI guided TRUS/TPUS fusion biopsy
  - MRI guided TRUS/TPUS cognitive biopsy
Prostate Cancer Risk Classification

Based on PSA findings, Clinical/DRE results and histopathological findings:

- **Low-risk**: PSA <10 ng/mL, and biopsy Gleason score ≤6, Gleason Grade Group 1 or clinical stage T1–T2a

- **Intermediate-risk**: PSA 10–20 ng/mL, Gleason score 7 (3+4=7/GGG 2 or GS 4+3+7/GGG 3) or clinical stage T2b-T2c.

- **High-risk Localised**: PSA >20 ng/mL, Gleason score 8–10, or clinical stage T2c.

- **High-risk Locally Advanced**: Any PSA, any GS cT3-4, or cN+

*ESMO Practice Guidelines, Parker C et al Ann Oncol 2015, NCCN v2/2017*
Low Risk Prostate Cancer

• Options: radical surgery, radiation therapy or active surveillance.
• 15.6% have higher grade cancer on final histology

*Thompson et al N Engl J Med 2004*

• Presence of higher % of positive cores, length of core involvement, PSA density are associated with risk of understaging.

*Parker C et al Ann Oncol 2015*

• **Very Low risk**: PSA<10 ng/mL, GS ≤6/Gleason Group 1, and Clin stage T1c, <3 cores positive, each core <50% +ve, PSA density <0.15 ng/mL/g

  *(ESMO Practice Guidelines 2015, NCCN guidelines v2 2017)*

• MpMRI can detect higher grade cancers and has potential to exclude significant cancer in stratification of patients considering active surveillance and in planning nerve and continence sparing surgery.
Prostate Cancer

Intermediate-risk patients: Being staged for curative intent.
- Risk of extra-prostatic spread rises significantly.
- DRE understages cancer.
- Role of MRI in detecting extra-capsular disease by means of a “staging protocol” [2b, A].

High-risk patients: Risk of metastasis
- Bone scintigraphy and CT scan or whole-body MRI or choline PET to detect skeletal or nodal metastases [III, B]

EAU Guidelines 2015
ESMO Practice Guidelines 2015
AJCC 8th Ed: Radiological Considerations

1) T Stage: MRI most useful for demarcation of extent of primary tumour and extraprostatic extension.

2) Nodal Involvement: Both CT and MRI understages nodal involvement.

3) Bony Metastasis: T99m standard for osteoblastic bony metastasis.

4) Visceral Metastasis: CT and MRI useful for visceral metastasis but visceral metastases are infrequent for initial staging.
MpMRI in T staging

- MpMRI currently most useful imaging test for local staging [2b, A]

- Extraprostatic extension into periprostatic adipose tissue, neurovascular bundle and bladder neck - Stage T3a

EAU Guidelines 2015

Right NVB invasion

Right ECE – focal bulge
MpMRI in T staging

- Seminal vesicle invasion (SVI) corresponds to stage 3b
Imaging Metastases in Prostate Cancer

Patients who develop metastatic disease:
• Most have only bony metastasis (62%)
• Bone and soft tissue metastasis (12%)
• Soft tissue metastases mostly in lymph nodes.
• Visceral metastases (liver, lungs and other sites) are infrequent at initial relapse (2%)
• Prevalence of visceral metastases increases with advancing disease (15-21% in mCRPC) and in aggressive histologic variants (up to 50%)

Padhani AR Euro Urol 2106
<table>
<thead>
<tr>
<th>Clinical guidelines (year)</th>
<th>Imaging for bone metastases</th>
<th>Imaging for soft tissue metastases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Criteria</td>
<td>Modality</td>
</tr>
<tr>
<td>National Comprehensive Cancer Network (2015)</td>
<td>cT1 disease and PSA &gt;20 ng/ml or cT2 disease and PSA &gt;10 ng/ml or Gleason score ≥8 or cT3/T4 disease, symptomatic</td>
<td>Bone scan</td>
</tr>
<tr>
<td>UK National Institute for Health and Care Excellence (2014)</td>
<td>When hormonal therapy is being deferred through watchful waiting to asymptomatic men who are at high risk of developing bone complications (2008) Do not routinely offer to men with low-risk localized disease (2008)</td>
<td>Bone scan</td>
</tr>
<tr>
<td>European Association of Urology (2015)</td>
<td>Gleason score ≥8, or ≥cT3/T4, or PSA &gt;10 ng/ml, or symptomatic</td>
<td>Bone scan, in equivocal cases can use 1H-C MRS, PET-CT, 18F-NaF-PET-CT, or whole-body MRI</td>
</tr>
<tr>
<td>Prostate Cancer Radiographic Assessments for Detection of Advanced Recurrence Group (2014)</td>
<td>Scan patients with high-risk and intermediate-risk disease who have at least two of the following: PSA &gt;10 ng/ml, Gleason score ≥7, or palpable disease (≥pT2b)</td>
<td>Bone scan</td>
</tr>
<tr>
<td>American College of Radiology (2013)</td>
<td>PSA ≥20 ng/ml or Gleason score 8–10 or clinical stage ≥T2c</td>
<td>Bone scan (a score of 8 out of 10 is classed as usually appropriate), whole-body 18F-FDG-PET-CT (a score of 4 out of 10 is classed as usually not appropriate)</td>
</tr>
<tr>
<td>European Society for Medical Oncology (2013)</td>
<td>cT3 or cT4 or Gleason score &gt;7 or PSA &gt;20</td>
<td>Bone scan</td>
</tr>
<tr>
<td>American Urological Association (2011)</td>
<td>PSA ≥20 ng/ml or Gleason score ≥8 or ≥cT2c</td>
<td>Bone scan and CT</td>
</tr>
<tr>
<td>Elongate's Classification and Regression Tree (2010)</td>
<td>Gleason score ≥6 or ≥cT2 disease and PSA &gt;10 ng/ml, or symptomatic</td>
<td>Bone scan</td>
</tr>
</tbody>
</table>

Nodal Staging

- **CT and MRI** indirectly assess nodal invasion by measurement of nodal short axis diameter.
- Sensitivity is <40% with 10mm threshold.
- Recommended in NCCN v2 2017 Guidelines for:
  - T3, T4
  - T1, T2 with normogram predicting >10% risk of nodal metastases (but level of evidence is low).
- **Choline PET-CT**: better pooled sensitivity of 60% than CT or MRI but limitations in microscopic disease in normal size nodes at lower serum PSA
- **MRI with ultra-small particles of iron oxide (USPIOs)** improves detection of microscopic nodal metastases but is limited by lack of availability.
  - Hovel AM Eur Radiol 2004
Imaging in Advanced Prostate Cancer

• **Bone and CT scans are the mainstay**:
  - widely available, low cost, easily standardized and incorporated into clinical practice and trial guidelines.

• **Bone scan**
  - uptake of Tc99m radiotracers related to osteoblastic activity and does not reflect full burden of metastasis in bone marrow.

• **CT scan**
  - directly evaluate metastatic disease, provide means of detecting and measuring lesions – useful for disease detection and response evaluation.
  - Detects lytic (in addition to sclerotic) metastasis
  - Unable to diagnose response or progression of sclerotic metastasis
  - Bony metastasis detection inferior to WB-MRI and PET-CT scans especially for nonlytic and nonsclerotic metastases.
Bone Scan for Staging

**Tc99M Bone Scan** – Staging
- NCCN guidelines v2 2017:
  - T1 and PSA >=20
  - T2 and PSA >= 10
  - T3 or T4
  - GS 8 or more
  - **symptomatic patients**, independent of PSA level, Gleason score or clinical stage. Abuzallouf S, J Urol 2004

Limitations in Staging:
- Low Sensitivity (osteoblastic)
- Requires radiography or MRI for detection of pathological fractures and complications.
Bone Scan Response Evaluation

- Progression criteria requires emergence of new lesions (2 or more).
- Pitfall of false positive “flare reaction”
  - within 8-12 weeks of treatment initiation. Need to obtain second confirmatory bone scan after another 6 weeks while treatment is continued (2+2 rule). This may result in delays in confirming true progression.
- Diffuse super scan – unable to identify new disease on follow-up.
Bone Metastases

- MRI more sensitive and specific than bone scan and targeted radiography in detection of bone metastases. (Sen/Spec of 98-100%)
- Also detects pathological fractures and complications like cord compression.
Wb-MRI for Nodal and Bone Metastases

• More sensitive and specific than combined bone scan, targeted radiography and abdominopelvic CT.

  *Pasaglou V, Prostate 2014*

• Meta-analysis of 27 studies – MRI more sensitive than choline PET-CT and bone scan for detection of bone metastases.
  • Pooled sensitivity of CH-PET/CT, WB-MRI and BS were 91%, 97% and 79%
  • Pooled specificity of CH-PET/CT, WB-MRI and BS were 99%, 95% and 82%

  *Shen G, Skeletal Radiol 2014*
Wb-MRI for Nodal and Bone Metastases

- ESUR guidelines recommended a bone and nodal MR algorithm for systemic staging of prostate cancer.
  
  Barentsz JO et al, Eur Radiol 2012

- A combined prostate MR and whole body MR protocol including DWI is technically robust for both loco regional staging and evaluation of nodal and bony metastases.

- Advantages include:
  - A single study for local and systemic staging, thus improving patient’s convenience.
  - WB-MR is well tolerated and all patients in this study completed examination without complications.

Abstract presented at AOCR 2014
66 years old male with prostate cancer GS4+4 (PSA=90 ng/ml)

Local Staging: T2 hypointense focus in the right peripheral zone with restricted diffusion and focal bulge.

Tumor focus in the right peripheral zone as well as right extra-capsular extension.

The ADC value of the focus was 0.503 X 10^-3 mm² which confirms the presence of tumor focus compared to normal left peripheral lobe ADC value of 1.237 x 10^-3 mm².
Combined MR Prostate and wb-MRI

• Nodal Staging:

• Enlarged right external iliac lymphadenopathy (arrow)
Combined MR Prostate and wb-MRI

- Bony metastasis (arrow) involving the right pubic bone which is visible on coronal T1w and Ax T1W with restricted diffusion on Ax DWI images (arrow).
- Incidental note is made of a bursa (circle) in front of the right hip joint medial to the ilio psoas muscle.
WB-MRI

• Metastasis detection in advanced cancers more accurate than bone scan and CT scan
• Potential for more accurate assessment of therapy response of bone metastasis.
• Need for standardization of acquisition, interpretation and reporting of WB-MRI – MET-RADS-P
**MET-RADS-P: Standardization of WB-MRI**

Table 2 – Sequence components for whole-body magnetic resonance imaging examinations

<table>
<thead>
<tr>
<th>Sequence description</th>
<th>Core protocol</th>
<th>Extensions for comprehensive assessments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Whole spine-sagittal, T1 W, TSE, 4–5 mm slice thickness</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>2 Whole spine-sagittal, STIR (preferred) or fat suppressed T2 W, 4–5 mm slice thickness</td>
<td>Yes</td>
<td>–</td>
</tr>
<tr>
<td>3 Whole body (vertex to mid thighs)-T1 W, GRE Dixon technique. Fat image reconstructions are mandatory</td>
<td>Axial (5 mm) or coronal (2 mm)</td>
<td>Axial and coronal</td>
</tr>
<tr>
<td>- A 3D FSE T1 W sequence offering multiplanar capability may be performed as an alternative to replace sequences 1 and 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Whole body (skull base to mid-thighs)-axial, diffusion weighted, STIR fat suppression, 5–7 mm contiguous slicing, multiple stations</td>
<td>2 b-values (b50–100 s/mm^2 and b800–1000 s/mm^2)</td>
<td>3 b-values (additional b500–600 s/mm^2)</td>
</tr>
<tr>
<td>- ADC calculations with mono-exponential data fitting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Coronal b800–1000 multiplanar reconstructions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 3D-MIP reconstructions of highest b-value images</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Whole body (vertex to mid thighs)-axial, T2 W, TSE without fat-suppression, 5 mm contiguous slicing, multiple stations, preferably matching the diffusion weighted images</td>
<td>Option</td>
<td>Yes</td>
</tr>
<tr>
<td>6 Regional assessments including dedicated prostate, small field of view spine, brain studies, and contrast enhancement</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

ADC = apparent diffusion coefficient; FSE = fast spin echo; GRE = gradient echo; MIP = maximum intensity projection; STIR = short tau inversion recovery; TSE = turbo spin echo; W = weighted; 3D = three dimensional.

- 5–7 mm, axial imaging may be chosen to match section thickness of diffusion weighted imaging to facilitate image review.
- b800–1000 images from all diffusion imaging stations are grouped and reconstructed as contiguous, two-dimensional coronal, 5-mm slices.
- Whole body three-dimensional maximum intensity projection images, displayed as rotating images, using an inverted grayscale.

MET-RADS-P: WB-MRI Protocol

76 year old previously treated low dose brachytherapy for Pca, now with BCR (PSA 8.9 ng/mL)

Clinical Question: Suitability for Salvage Therapy?

Extensive Bony Metastasis, no need for dedicated local staging prostate MRI

MET-RADS-P Standardized Reporting

- Standard reporting template for staging and evaluation is also proposed.
- WB-MRI and MET-RADS-P now being evaluated in clinical trials to assess impact on clinical mx.

Table 3 – METastasis Reporting and Data System for Prostate Cancer regional response assessment categories

<table>
<thead>
<tr>
<th>RAC</th>
<th>Classification</th>
<th>Region</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Highly likely to be responding</td>
<td>Local, nodal, and visceral bone</td>
<td>Changes characterizing primary disease. Consistent with RECIST v1.1/PNG criteria for unequivocal response (partial/complete; see below)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Changes characterizing primary disease. Consistent with RECIST v1.1/PNG criteria for unequivocal response (partial/complete; see below)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Evidence of progression, but not enough to fulfill criteria for RAC 4.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Changes characterizing primary disease. Evidence of progression, but not enough to fulfill criteria for RAC 4.</td>
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<td></td>
<td></td>
<td></td>
<td>Evidence of progression, but not enough to fulfill criteria for RAC 4.</td>
</tr>
<tr>
<td>2</td>
<td>Likely to be responding</td>
<td>Local, nodal, and visceral bone</td>
<td>Changes characterizing primary disease. Evidence of progression, but not enough to fulfill criteria for RAC 3.</td>
</tr>
<tr>
<td>3</td>
<td>No change</td>
<td></td>
<td>No change in size or number of lesions. Evidence of progression, but not enough to fulfill criteria for RAC 3.</td>
</tr>
<tr>
<td>4</td>
<td>Likely to be progressing</td>
<td>Local, nodal, and visceral bone</td>
<td>Changes characterizing primary disease. Evidence of progression, but not enough to fulfill criteria for RAC 2.</td>
</tr>
<tr>
<td>5</td>
<td>Highly likely to be progressing</td>
<td>Local, nodal, and visceral bone</td>
<td>Changes characterizing primary disease. Evidence of progression, but not enough to fulfill criteria for RAC 1.</td>
</tr>
</tbody>
</table>

Biochemical Recurrence

• In patients with BCR after RT considered for local salvage therapy, prostate MpMRI may be used to localise abnormal areas and guide biopsy (3, C).

EUA guidelines 2015

• Local recurrence after RP: imaging needed only if histological proof is mandatory before salvage Rx or localization change treatment planning.

• 70 year old male, post radical prostatectomy, PSA 20.9 ng/ml
Localized salvage therapies for suspected local failure such as salvage EBRT after RP are most effective during early PSA recurrence (<0.5 ng/ml).

*Pfister D, Eur Urol 65:1034–1043*

**Choline based (F18 or C11) PET** –
- Low sensitivity and specificity for BCR when PSA is low
- Not recommended if PSA < 1ng/ml (3, A)

*EUA guidelines 2015*

**Prostatic –specific membrane antigen (PSMA)**
- Transmembrane protein overexpressed in PCa cells.
- G68 PSMA PET – emerging tech for detection of cancer spread in late stage PCa and biochemical recurrence (BCR).
- Early studies show significantly higher detection of BCR at low PSA levels.

Ga-68-PSMA ligand PET

- Recent meta-analysis of 16 articles, 1309 patients
  Perera M et al Eur Urol. 2016 Jun 27

- Overall 40% positive in primary staging and 76% positive in Biochemical Recurrence

- Detection of recurrence in low PSA levels.

<table>
<thead>
<tr>
<th>PSA levels (ng/ml)</th>
<th>Detection rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;2</td>
<td>95%</td>
</tr>
<tr>
<td>1 - 2</td>
<td>76%</td>
</tr>
<tr>
<td>0.2 - 1</td>
<td>58%</td>
</tr>
<tr>
<td>0 – 0.2</td>
<td>42%</td>
</tr>
</tbody>
</table>

- Implication: Use of restaging PSMA PET/CT for patients with early PSA recurrence may detect oligometastatic cancer amenable to targeted therapies such as surgery or EBRT and allow delaying of potential morbidity associated with systemic salvage therapies.
Applications of 68 Ga-PSMA PET-CT

- **Localization of Prostate Cancer in Biochemical Recurrence**  
  (mainly retrospective data)
  - Low PSA (0.2 to 10 ng/mL)
  - High Sensitivity in shorter PSA doubling time.
- **Primary Staging in high risk disease**
  - Improved sensitivity for nodal and bony metastasis still under investigation.
  - **False positive** in benign lesions (thyroid adenoma, Paget’s disease, schwannoma, TB, adrenal adenoma, splenic sarcoidosis, coeliac ganglion uptake mimic adenopathy) as well as solid tumours (eg colon, breast, RCC, HCC) and neo vasculature.
  - **False negatives** (advanced metastatic castration resistance prostate cancer metastasis can lose PSMA expression)

Wolfgang P F, Eur J Nuc Med 2017; Rauscher I, Cancer Imaging 2017  
Ga-68-PSMA HBED PET/CT in Recurrent Disease after Radical Prostatectomy

6 months post radical prostatectomy & pelvic lymphadenectomy. Gleason 4+4, margin positive. PSA 12.4 ng/dl, PSA doubling time 2 months
Histology: recurrence Gleason 4+4

(Slide courtesy of Dr Winnie Lam, Nuc Med SGH)
Ga-68-PSMA HEBD PET in Recurrent Disease after Radical Prostatectomy

- Radical prostatectomy 10 years ago. Gleason 3+4, pT3b.
- PSA started rising 1 year later, started ADT.
- Castrate resistant prostate cancer (CRPC) 2 years later. PSA went up to 5.

(Slide courtesy of Dr Winnie Lam, Nuc Med, SGH)
Ga-68-PSMA HEBD PET in Recurrent Disease after Radical Prostatectomy

- 67 year old post radical prostatectomy
- PSA rising from 0.6 to 1
Ga-68-PSMA HEBD PET in Recurrent Disease after Radical Prostatectomy

- 67 year old post radical prostatectomy
- PSA rising from 0.6 to 1
Ga-68-PSMA HEBD PET in Recurrent Disease after Radical Prostatectomy
The future?

$^{68}$Ga-PSMA–PET–MRI: 50-year-old patient who had a rising serum PSA value (16 ng/ml at imaging) and two tumour-negative previous biopsy samples.

PSMA-based radio-ligand therapy is emerging.

Conclusion

Paradigm shift in roles of MpMRI Prostate from

- A local staging tool for surgical/RT planning to
- Localization of Tumour (Biopsy negative or biopsy naïve)
- Monitoring for Active Surveillance
- Identification of patient for focal therapy
- Detection of recurrence after failed local therapy
Conclusion

- CT and bone scan – mainstay in systemic staging of high risk groups and follow-up monitoring of metastatic disease with its limitations.
- Wb-MRI with DWI is an emerging tool.
- New Tracer (Ga-68 PSMA) PET is a promising modality for systemic staging and detection of recurrence after radical prostatectomy.
Thank you for your attention!