MOLECULAR IMAGING TARGETED THERAPIES: Ga$^{68}$/Lu$^{177}$ PSMA IN PROSTATE CANCER

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Disclosures

• Founder - Theranostics Australia
Outline

• What is PET?
• What is radionuclide therapy?
• What is Theranostics?
• How does this relate to prostate cancer?
• Current trials
PET

• Positron
• Emission
• Tomography

• Positron Emitters
  – Unstable isotopes, excess +ve charge
  – Mostly cyclotron produced
  – N-13, C-11, O-15, F-18 (Cu-64, Y-86, etc)
PET

- Tag isotope (e.g. C-11, F-18) to chemical (e.g. glucose, amino acid) or use unstable isotope itself (e.g. F-18)

- Inject and image with PET camera
Perth Cyclotron Installation

DECEMBER 2002 - SIR CHARLES GAIRDNER HOSPITAL, PERTH
Perth Cyclotron & Bunker

Features:
- Maze Entry
- Wall Thickness 1.2 - 1.8 m
- Existing Wall
- Additional Construction
The WA Cyclotron
Perth Radiopharmaceutical Lab
Hot-Cells in Clean Room: Perth
Perth Equipment Selection: Radiopharmaceutical

For Production
- Two hot-cells
- One IBA 18F-FDG synthesis module
- One GE 18F-FDG synthesis module
- One robot dose dispenser

*These located within GMP environment*

For R&D
- Four hot-cells
- One development 18F-FCh synthesis module
- One development 18F-FMISO/FLT synthesis module
QC Equipment; FDG Product Validation

- Gamma Spectrometer
- Thin Layer Chromatography
- High Pressure Liquid Chromatography
- Double distilled water plant for HPLC
- Dose Calibrators
- Gas chromatograph (not needed for FDG)

All QC equipment is contained in a QC Room situated within the GMP Clean Room environment.
PET/Cyclotron
PET

- Positron
- Emission
- Tomography

Positron Emitters
- = “positive electron”
- decay ---> annihilation photons
- 2 x 511 keV photons
FDG PET

Mesothelioma - Coronal Reconstruction
PET

History

- E. Lawrence 1929 Berkeley
  - produced first cyclotron
- PET theory 1950’s
- Positron tomography 1953 MGH
Limitations of Anatomic Imaging

- Benign or Malignant ??
- Assess whole body
- Residual post-Rx mass- Scar or Tumor??
- Assess/predict response to therapy

Lymphoma - Residual Mass
Limitations of Anatomic Imaging

Dx: Fibrotic scar - no evidence of residual lymphoma
Increased Sensitivity of PET

Prostate ca - Tc-99m MDP Bone Scan

Prostate ca - [F-18] PET Bone Scan
Positron Emission Tomography

- Biochemical/Molecular Changes
- Physiological Changes
- Anatomical Changes

- PET
- MR Spectroscopy
- Nuclear Medicine
- Functional MRI
- Functional CT
- MRI/multislice CT
Radionuclide Therapy

• Administer radioisotope for treatment – usually cancer
  – E.g. Iodine-131 for thyroid cancer (and overactive thyroid diseases)
• Benefits
  – Higher radiation dose deposited directly to target tissue (10-100x greater than external beam)
  – Decreased toxicity to adjacent tissue – short pathway
  – Selective targeting possible – e.g. anti-CD20, SSTR
  – Dosimetry possible
  – Can combine with chemotherapy or potentially other radionuclides
  – Various isotopes, energy and method of administration
  – “Cross-fire” and “Bystander” effects
TYPES OF RADIATION AND PENETRATION

- α particles
- β particles
- x-ray
- γ-ray
- neutron

Penetration levels:
- Paper
- Aluminum plate
- Lead
- Concrete
Radionuclide Therapy
## Choice of Radionuclide

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>$T_{1/2}$</th>
<th>Emission</th>
<th>Mean Path Length</th>
</tr>
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<tbody>
<tr>
<td>I-125</td>
<td>60.0d</td>
<td>auger</td>
<td>10nm</td>
</tr>
<tr>
<td>At-211</td>
<td>7.2h</td>
<td>alpha</td>
<td>65nm</td>
</tr>
<tr>
<td>Lu-177</td>
<td>6.7d</td>
<td>beta/gamma</td>
<td>0.7mm</td>
</tr>
<tr>
<td>Cu-67</td>
<td>2.58d</td>
<td>beta/gamma</td>
<td>0.7mm</td>
</tr>
<tr>
<td>I-131</td>
<td>8.04d</td>
<td>beta/gamma</td>
<td>0.9mm*</td>
</tr>
<tr>
<td>Sm-153</td>
<td>1.95d</td>
<td>beta/gamma</td>
<td>1.2mm</td>
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<tr>
<td>Re-186</td>
<td>3.8d</td>
<td>beta/gamma</td>
<td>1.8mm</td>
</tr>
<tr>
<td>P-32</td>
<td>14.3d</td>
<td>beta</td>
<td>2.9mm</td>
</tr>
<tr>
<td>Re-188</td>
<td>17h</td>
<td>beta/gamma</td>
<td>3.5mm</td>
</tr>
<tr>
<td>In-114m</td>
<td>50d</td>
<td>beta/gamma</td>
<td>3.6mm</td>
</tr>
<tr>
<td>Y-90</td>
<td>2.67</td>
<td>beta</td>
<td>3.9mm*</td>
</tr>
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Cross-fire Effect:
- Penetrating radiation minimises the problem of limited access in bulky or poorly vascularized tumours

Bystander Effect:
- Apoptotic cells have a damaging effect on adjacent cells
- Possibly from cytokine release or loss of homeostatic supportive mechanisms
Theranostics

The merging of drug therapy and diagnostics to advance personalized medicine
Theranostics

• First used by PharmaNetics president and CEO John Funkhouser
  – Developing diagnostic tests directly linked to the application of a specific therapies.
  – PharmaNetics - point of care coagulation tests supporting coagulation therapies

• September 25, 1998 - key day
  – FDA granted simultaneous approval for Genentech’s Herceptin® for the treatment of Stage IV breast cancer and Dako’s HercepTest® for diagnosis of Her2 overexpression
Theranostics in Nuclear Medicine

• Not a new paradigm
• Dr S Seidlin (1895-1955) Montefiore Hospital New York City 1943
  – Radioactive iodine (I-131) for metastatic thyroid cancer
• Tracer dose followed by therapeutic dose
  – Low dose I-131 or I-123 still used
Thyroid Cancer

Ablative Dose Image

1 year later
Gallium-68 PET Radiotracers

Germanium: Gallium-68 Generators
PERSONALISED MEDICINE, THERANOSTICS & RADIOPEPTIDE THERAPY (RPT)

Theranostics

Therapy → Diagnostics

Ga$^{68}$

Lu$^{177}$

Targeted therapy

Molecular receptor
Gallium-68 Products

- Gallium Citrate
- Gallium MAA
- Gallium DTPA
- Gallium Octreotate
- Gallium PSMA
- Gallium Pentixafor
- Gallium Herceptin
- Gallium Exendin
- Gallium Satareotide
- Etc.
The Target

SSTR1-5:

A G-coupled 7 Transmembrane receptor

Sheridan et al. Integrative and Comparative Biology 2000; 40(2):269-86
Ga-68/Lu-177 octreotate
Targeted Radionuclide Therapy: Ga-68 octreotate PET-CT

Primary NET lesion  Secondary liver mets
Targeted Radionuclide Therapy

13 JAN 2010

$^{68}\text{Ga OCTREOTATE}$

3 FEB 2010

$^{177}\text{Lu OCTREOTATE}$

Courtesy: Prof Harvey Turner
The times they are a changin’! ..... 

• Pre-2014 in Australia:
  – Rising PSA post definitive therapy for prostate cancer
    • CT and bone scan (+/- pelvic MRI)
  – High risk primary prostate cancer
    • CT, bone scan (if PSA >10) (+/- pelvic MRI)
    – Choline available at some sites – considered “useful”
  – Rising PSA - Choline as good and possibly mildly better than CT + bone scan
• 2009/2010:
  – First publications of Ga-68 PSMA in prostate cancer
Ga-68 PSMA

- July 2014:
  - “A date which will live in infamy….”
  - Wesley Hospital Brisbane performed their first clinical Ga-68 PSMA PET CT for prostate cancer in Australia (16th July 2014)
  - Peter MacCallum also performed their first clinical Ga-68 PSMA PET CT in July 2014
Perth Ga-68 PSMA

• 24<sup>th</sup> May 2015:
  – Oceanic Molecular PET CT Centre at Ramsay Hollywood Hospital performed
  – 1<sup>st</sup> Ga-68 PSMA PET CT in WA
  – 4<sup>th</sup> site in Australia to offer this form of PET imaging for prostate cancer

• 4<sup>th</sup> May 2018:
  – Oceanic Molecular has performed approx. 800 Ga-68 PSMA PET CT studies
  – 5 sites in Perth offering Ga-68 PSMA PET CT – 20-25 studies/week in Perth
  – Now: >40 sites in Australia offering Ga-68 PSMA PET CT
  – Fastest growing imaging test in Australia; no Medicare funding
  – Some sites doing 20+ scans per week; $600-$1200 per scan
Why the explosion?

- Prostate Cancer
  - Approx. 20,000 cases diagnosed annually in Australia
  - Most common cancer diagnosis in Australia (more than breast, lung and melanoma)
  - 1/3 will show biochemical relapse (PSA) within 10 years
  - More men die per year from prostate cancer (>3000) in Australia than women die from breast cancer
  - No major advance in therapeutic options in last 20 yrs
    - Surgery/brachytherapy/radiotherapy
    - ADT/pelvic irradiation
    - 2nd line ADT/Docetaxol/2nd line chemo
    - Radium (palliation)
Prostate cancer imaging with PSMA-ligands

- PSMA: prostate-specific membrane antigen
- Cell surface protein with overexpression in prostate cancer
- Transmembrane localization including large extracellular part
- Promising target for prostate cancer specific imaging and therapy
- Recently: development of various PSMA-ligands for PET imaging
- e.g. $^{68}$Ga-PSMA: Glu-NH-CO-NH-Lys-(Ahx)-$[^{68}$Ga(HBED-CC)] (only for $^{68}$Ga) and PSMA I&T (TUM/Scintomics), suitable for $^{M^3+}$ labeling ($^{68,67}$Ga, $^{177}$Lu, $^{90}$Y, $^{111}$In...)
[\textsuperscript{68}Ga]PSMA-Ligand PET

Afshar-Oromieh A, \textit{EJNMMI} 2012; \textit{EJNMMI} 2013
Example: local recurrence

81y patient, s/p prostatecomy (18 years ago), PSA-value 5.5 ng/ml
Mr BN

83y patient, s/p prostatectomy, PSA-value 11 ng/ml. F-choline Jan 2015

Ga-PSMA

F-choline
Mr BN

Ga-PSMA

F-choline
Mr BN

Ga-PSMA

F-choline
Ga-PSMA vs F-choline

- 38 patients. 34 (89%) radical prostatectomy and 4 (11%) had undergone radiation treatment. Twelve (32%) had undergone salvage radiation treatment after primary radical prostatectomy.
- Mean PSA level was 1.74 ± 2.54 ng/mL.
- Scan results were positive in 26 patients (68%) and negative with both tracers in 12 patients (32%).
- Of 26 positive scans, 14 (54%) positive with 68Ga-PSMA alone, 11 (42%) with both 18F-fluoromethylcholine and 68Ga-PSMA, and only 1 (4%) with 18F-fluoromethylcholine alone.
- PSA below 0.5 ng/mL, detection rate 50% for 68Ga-PSMA versus 12.5% for 18F-fluoromethylcholine.
- PSA 0.5–2.0 ng/mL, detection rate 69% for 68Ga-PSMA versus 31% for 18F-fluoromethylcholine.
- PSA above 2.0, the detection rate was 86% for 68Ga-PSMA versus 57% for 18F-fluoromethylcholine.
- On lesion-based analysis, 68Ga-PSMA detected more lesions than 18F-fluoromethylcholine (59 vs. 29, P < 0.001).
- 63% (24/38 patients) management impact, with 54% (13/24 patients) being due to 68Ga-PSMA imaging alone.
- Histologic follow-up available for 9 of 38 patients (24%), and 9 of 9 68Ga-PSMA-positive lesions were consistent with prostate cancer (68Ga-PSMA was true-positive). The lesion positive on 18F-fluoromethylcholine imaging and negative on 68Ga-PSMA imaging was shown at biopsy to be a false-positive 18F-fluoromethylcholine finding (68Ga-PSMA was true-negative).

Conclusion: In patients with biochemical failure and a low PSA level, 68Ga-PSMA demonstrated a significantly higher detection rate than 18F-fluoromethylcholine and a high overall impact on management.

Morigi et al J Nucl Med August 1, 2015 vol. 56 no. 8 1185-1190
Ga-68 PSMA PET CT

• 2 major indications:
  – Traditional - Rising PSA following definitive therapy for prostate cancer
  – More recent - Staging of primary prostate cancer
[\textsuperscript{68}Ga]PSMA-Ligand PET in recurrent prostate cancer

Detection rate with [\textsuperscript{68}Ga]PSMA-Ligand:

- 73 patients; PSA: median 3.04 ng/ml (range 0.2 – 1000 ng /ml)
- Mixed PET/CT and PET/MR imaging
Comparison of $^{68}$Ga-PSMA PET/CT and PET/MR

**Courtesy:** Eiber M (NuklMed) and T.Maurer (Urology) at Technische Universität München

- No statistical significant difference in detection rate between PET/CT and PET/MR
- Diagnostic efficacy mainly driven by uptake in PET ($\varnothing$ morphol. imag.)
- In PSA<1 ng/ml: increase in definite lesion detection from 28.6% to 48.2%
Detection rate with [68Ga]PSMA-Ligand:

- 102 pts; Age range 45-84 years.
  PSA range 0.04-100 ng/ml,
  67/102 positive scans
- 15/67 (22%) recurrence confined to prostatic bed; lowest positive scan 0.17 ng/ml

Detection Rates According to PSA Levels (%)

- <0.5: 25 (Gallium PSMA PET), 5 (Diagnostic CT)  
P= 0.0017
- 0.5-1.5: 67 (Gallium PSMA PET), 41 (Diagnostic CT)  
P= 0.056
- >1.5: 92 (Gallium PSMA PET), 63 (Diagnostic CT)  
P<0.0001
PMSA-ligand imaging for radioguided surgery

Collaboration: Eiber M, Schwaiger M (Nucl.Med), T.Maurer, J Gschwend (Urology) and Weineisen M, Schottelius M, Wester HJ, Pharmaceutical Radiochemistry, Technische Universität München

75y patient, radical prostatectomy (2010), pT2c pNO cM0, PSA: 0.46 ng/ml (03/14)

$^{68}$Ga-PSMA-HBED PET/MR: single PET-positive lymph node metastasis

Individual therapy decision: Secondary radioguided lymphadenectomy
Radioguided Surgery PET Probe
Collaboration: Eiber M, Schwaiger M (Dept. Nucl. Med), T. Maurer, J Gschwend (Urology) and Weineisen M, Schottelius M, Wester HJ (Pharmaceutical Radiochemistry) Technische Universität München
Collaboration: Eiber M, Schwaiger M (Dept. Nucl.Med), T.Maurer, J Gschwend (Urology) and Weineisen M, Schottelius M, Wester HJ, (Pharmaceutical Radiochemistry), Technische Universität München
PSMA-IHC (in 8mm Lymphnote)

Collaboration: Eiber M, Schwaiger M (Nucl.Med), T. Maurer, J Gschwend (Urology) and Weineisen M, Schottelius M, Wester HJ, Pharmaceutical Radiochemistry, Technische Universität München
Ga-68 PSMA PET CT

- Rising PSA following definitive therapy for prostate cancer and negative CT +/- bone scan:
  - Data similar to European counterparts with I&T PSMA compound
    - Very high sensitivity if PSA >1.5 (~90%)
    - Limited value if PSA <0.5 (~25%) and likely no value if PSA <0.2
    - 1/5th had recurrence in prostate bed; mostly pelvic or abdominal nodes
    - Often nodal disease just out of field of treatment from pelvic radiotherapy
- FSH/SCGH - HBED vs I&T compound - HBED better signal to noise for small volume disease? Clinically significant
Ga-68 PSMA PET CT in Primary Staging

Results:
- PSMA-avid disease outside of the prostate gland (distant) detected:
  - Gleason 7 or below: 18.2% (4/22)
  - Gleason 8: 31.6% (6/19 - all PSA 10 or more)
  - Gleason 9 and above: 47.8% (11/23)
  - PSA less than 5: 9% (1/11)
  - PSA 5-10: 25% (6/24)
  - PSA less than 10: 20% (7/35);
  - PSA over 10: 45.7% (16/35)
- 11 patients had both a PSA over 10 and Gleason 9 or more:
  - 7 of these (63.6%) had distant PSMA-avid disease. Of these 7 positive subjects: 5 to lymph nodes, 1 to skeleton and 1 to skeleton + lymph nodes.
Mr B

- CT pelvis – localised disease. Bone scan ? Fracture 9th rib
Mr B

Se:3
l: 54.7
Im: 272

DFOV 54.2 cm
STND/SS50 No Filter

3.3
KV 140
mA 121
Rot 0.50s/HE 55.0mm/rot
3.8mm 1.375 1/3.3sp
Til: 0.0

Se:12 / 3
l: 54.7
Im: 272

DFOV 54.2 cm
S.84
Mr B
Ga-68 PSMA PET CT in Primary Staging

Conclusions:

• $^{68}$Ga-PSMA PET CT appears to have the potential for improving staging of primary prostate cancer.

• In high risk patients (Gleason 9+ and PSA>10) PSMA avid disease was found distant to the prostate in 64% of this group. This may have significant impact in patient management.
Ga-68 PSMA PET CT in Primary Staging

• Further work:
  – $^{68}$Ga-PSMA PET CT in primary staging - change of management study (PRO-PSMA TRIAL)
  – Radiotherapy planning in primary prostate cancer study
  – $^{68}$Ga-PSMA PET CT fused with MRI for on table MRI guided targeted biopsy
Ga-68 PSMA PET CT in Primary Staging
Ga-68 PSMA PET in DXRT Planning

**Fig. 1** Overview of the impact of PSMA staging results on radiotherapy (RX). In *light grey* cases treatment was carried out as initially planned based on conventional staging information, and in *dark grey* cases radiotherapeutic management was changed in dose or target volume.
Ga-68 PSMA PET in DXRT Planning
Outpatient Radiopeptide Centre

Prof Harvey Turner – Fremantle Hospital 2012
Lu-177 PSMA in Ga-68 PSMA Avid Metastatic PCa

Lu-177 PSMA whole body scan 92 h post-therapy: excellent uptake in the bone mets.
Illustrative Video

https://www.youtube.com/watch?v=GRRmX5eTa8s
Lu-177 PSMA in Treatment

$^{177}$Lu-PSMA has been used safely in metastatic prostate cancer patients (>1000 worldwide – mostly Germany) with promising results.

• **Aims:**
  1. Assess safety of $^{177}$Lu-PSMA in a private hospital outpatient setting
  2. Assess response on imaging and PSA criteria
  3. Assess combination radiosensitizing chemotherapy with $^{177}$Lu-PSMA in selected patients

• **Methods:**
  – 20 patients referred to Theranostics Australia Ramsay Hollywood Private Hospital for $^{177}$Lu-PSMA due to progressive disease or difficult to manage local recurrence. All had $^{68}$Ga PSMA PET CT.
  – All patients gave informed consent, treated under TGA Special Access Scheme.
  – Received 2.5-7.5GBq $^{177}$Lu-PSMA ($^{177}$Lu from ANSTO or ITG). $^{177}$Lu-PSMA synthesized by radiochemist on Scintomics radiopharmaceutical production unit.
  – Patients followed clinically with haematology/biochemistry, Ga-68 PSMA scans and QOL assessment following treatment.
Lu-177 PSMA in Treatment

- **Results:** Mean age 69 years (range 53-87 years), all treated with 1-5 cycles of $^{177}$Lu-PSMA.
- 2/20 discontinued therapy after 1-2 cycles (medical reasons). 1 patient given 2 cycles of therapy, following initial two cycles in Germany. 4 patients were treated with concurrent Docetaxol.
- 19/20 no acute side-effects. 1/20 rash after cycles 2 and 3. 4/20 with mild xerostomia. 1/20 dry eyes. 8/20 reported lethargy. No significant change in renal/liver function noted. Minor changes in haematology in 16 patients. Significant changes in haematology noted in 5 patients (1 with advanced disease; 4 with concurrent chemotherapy). 1 patient combined treatment had G-CSF for neutropenia. 1 patient chemotherapy halted - flare of osteomyelitis.
- 17/20 : stabilization or regression of disease on PSA velocity and/or PSMA PET CT.
- Local control achieved in 5 pts with prostatic bed recurrence.
- Nodal & local disease appears to respond better than bone disease.
Lu-177 PSMA in Treatment

[\((177)\text{Lu}\)-PSMA-617 radionuclide treatment in patients with metastatic castration-resistant prostate cancer (LuPSMA trial): a single-centre, single-arm, phase 2 study.

Findings  Between Aug 26, 2015, and Dec 8, 2016, 43 men were screened to identify 30 patients eligible for treatment. 26 (87%) had received at least one line of previous chemotherapy (80% docetaxel and 47% cabazitaxel) and 25 (83%) received prior abiraterone acetate, enzalutamide, or both. The mean administered radioactivity was 7.5 GBq per cycle. 17 (57%) of 30 patients (95% CI 37–75) achieved a PSA decline of 50% or more. There were no treatment-related deaths. The most common toxic effects related to $^{177}$Lu-PSMA-617 were grade 1 dry mouth recorded in 26 (87%) patients, grade 1 and 2 transient nausea in 15 (50%), and G1–2 fatigue in 15 (50%). Grade 3 or 4 thrombocytopenia possibly attributed to $^{177}$Lu-PSMA-617 occurred in four (13%) patients. Objective response in nodal or visceral disease was reported in 14 (82%) of 17 patients with measurable disease. Clinically meaningful improvements in pain severity and interference scores were recorded at all timepoints. 11 (37%) patients experienced a ten point or more improvement in global health score by the second cycle of treatment.

Interpretation  Our findings show that radionuclide treatment with $^{177}$Lu-PSMA-617 has high response rates, low toxic effects, and reduction of pain in men with metastatic castration-resistant prostate cancer who have progressed after conventional treatments. This evidence supports the need for randomised controlled trials to further assess efficacy compared with current standards of care.
Figure 3: (A) PSA response after 12 weeks* and (B) best PSA response from baseline.
Lu-177 PSMA in Treatment

- Now treated over 160 patients (over 600 doses administered); 90% endstage disease
- Responders 60-70% (30% good response; 30-40% stabilization)
- Myelotoxicity an issue if heavy pretreatment and extensive bone disease (Kesavan et al 2018)
- Previous radium treatment may affect myelotoxicity (bone marrow toxicity)
- No renal toxicity (Gallyamov et al 2018)
- No liver or lung toxicity
- Overall improvement in quality of life
- Nodal disease alone better PFS and OS compared with more extensive disease (Finn et al 2018)
- Side effects – tiredness, dry mouth (10% after 3-4 treatments), nausea (20%)
Lu-177 PSMA in Treatment

• Conclusions:
  – $^{177}$Lu-PSMA is well tolerated with minimal side-effects.
  – $^{177}$Lu-PSMA can be provided safely in an outpatient private hospital setting with improvements in most patients on PSA and molecular imaging criteria.
  – Improves PFS and OS in end stage disease; TheraP trial will assess if better than 2$^{nd}$ line chemotherapy.
Mr JD – 3 cycles: 17 GBq
Mr JD – 3 cycles: 17 GBq
Mr JD – 3 cycles: 17 GBq
Mr J – 3 cycles: 17 GBq
Important Dates

• First U.S. Multi-center Investigational Clinical Trial of 177 Lu PSMA-617 Targeted Radioligand Therapy in Metastatic Castration Resistant Prostate Cancer Receives FDA Clearance February 06, 2017 06:00 ET | Source: RadioMedix Inc.

• November 2017 - Endocyte Announces Exclusive Worldwide License of Phase 3 Ready PSMA-Targeted Radioligand Therapy for Development in Prostate Cancer

'Billion-dollar molecule' may extend life in men with prostate cancer

'It is a disruptive therapy and has the potential to change practice,' Professor Michael Hoffman says of a prostate cancer treatment that is being studied in Australia. Jesse Matlow
Actinium-225 PSMA

Lu-177 PSMA failure

Before

PSA 420

After

PSA <0.1
Actinium-225 PSMA

Lu-177 PSMA failure

before
PSA 3000

after
PSA <0.1
Clinical Trials

- LUPIN Trial – Dr Louise Emmett – St Vincent’s
- THERA-P Trial – Dr Louise Emmett – St Vincent’s; RNSH to commence
- Endocyte trial – overseas
- TARGET Trial – Dr Nat Lenzo – Perth and Sydney
- NIGHTCAP Trial – Dr Nat Lenzo – Perth and Sydney
- LuPSMA vs Docetaxol Trial – Dr Nat Lenzo – Perth and Sydney
- Lu-PSMA + immunotherapy – Prof Howard Gurney/ Dr Nat Lenzo - MUH
- ACT trial – South Africa/ Perth/Sydney – Prof Michael Sathekge/ Dr Nat Lenzo
Summary

- Long history of theranostics in nuclear medicine
- Molecular targets coupled with standardised production of diagnostic and therapeutic radiopharmaceuticals has expanded potential imaging and therapeutic options
- Ga-68 PSMA rapidly taking over as diagnostic test of choice in staging and restaging of prostate cancer
- Ga-68/Lu-177 PSMA very promising addition to management of prostate cancer
- Number of trials underway to further assess both Ga-68 and Lu-177 PSMA
Acknowledgements

- Professor Harvey Turner, Dr Phil Claringbold, Dr Murali Kesavan, Mr Phillip Calais
- Nuclear Medicine staff at Fremantle Hospital
- PET staff at Oceanic Molecular
- Prof Hans Wester Technical University of Munich; Scintomics
- Theranostics Australia team – Dr Joe Cardaci, Dr Danielle Meyrick, Dr Jerome Barley, Dr Sharon Yeo, Dr Magda Wajrak, Ms Sarah Ransom, Mrs Penny Fegan, Mr Ryan Palmiero
- Staff at MUH and Genesis Care
Fremantle Harbour