ABC’s of Molecular Imaging

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Objectives

- Define Molecular Imaging
- Review the different Molecular Imaging Modalities
- Review patient preparations for the most common imaging studies
- Areas in the CC where Molecular Imaging is performed

What is Molecular Imaging

Molecular Imaging….as defined by the Society of Nuclear Medicine is “The visualization, characterization, and measurement of biological processes at the molecular and cellular levels in humans and other living systems.”

What is Molecular Imaging?

- It originated from the field of radiopharmacology
- Developed to help better understand the molecular pathways inside organisms in a noninvasive manner.
- Allows physiological processes to be evaluated over time

Goals of Molecular Imaging

- Early detection of cancer
- Predict outcomes
- Enable the identification of therapeutic agents
- Monitor responses in targeted therapies
- Accelerate new drug development

Types

- Optical Imaging
- Single Photon Emission Computed Tomography (SPECT)
- Positron Emission Tomography (PET)
- Magnetic Resonance Imaging (MRI)
Optical Imaging

- Uses fluorescent molecules that target cancer cells which fluoresce or "light up" when scanned with a UV light
- Useful during endoscopy and surgery to detect smaller tumors that are not visible by the naked eye.
- Not good for whole body imaging b/c of poor penetration of light.

“It’s what the surgeon doesn’t see that kills the patient”

SPECT

- SPECT stands for Single Photon Emission Computed Tomography
- Uses tracers and a scanner to acquire data
- Uses a computer to construct images in a 2D or 3D mode.
- It gives information about blood flow and chemical reactions (metabolism) in the body.
- A SPECT scan is done the determine where tumor is located in the body
- SPECT is less expensive and more available than PET

PET

- Stands for Positron Emission Tomography
- Uses radiotracers and scanner to obtain images
- Obtains images of chemical changes (metabolism) that take place in tissue.
- They play a vital role in determining if a mass is cancerous.
- They can help in evaluating and staging disease.
- PET has higher resolution and higher sensitivity than SPECT
**PET/CT Scanner**

**PET Scans Types**

- FDG
- NaF
- DCFBC
- FLT
- Cu 64 Plexifor

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**Case FDG PET/CT**

Sarcoma in the right thigh with lung metastases

Hypermetabolic activity in a large proximal right thigh soft tissue mass. Abnormal increase of FDG uptake is also seen in a left anterior paravertebral area (lung metastases).

**NaF PET Scan**

NaF prostate ca pt with mets in skull, ribs, spine and pelvis. D/D in major joints and R hip.

**FLT PET Scan**

**DCFBC**
MRI

- Magnetic Resonance Imaging
- Uses a high powered magnetic field, radio frequency pulses, and a computer to produce detailed images of organs, bone, and other internal body structures.
- MRI does not use ionizing radiation (x-rays, CT Scan)

3T MRI Scanner

MRI Prostate

PATIENT PREPARATIONS

FDG PET Scan Prep

- NPO for 6 hours before the appointment time (no chewing gum, mints, soft drinks or sugar-free or diet drinks)
- No exercise for 48 hrs prior to appointment
- Drink plenty of water
- No caffeine for 24 hours before the exam
- Medications should be taken with water only w/i 6 hours of the exam

FDG PET Scan Prep

- If the patient is claustrophobic, please ask MD to prescribe an anxiolytic for the scan.
- Diabetic patients
  - Insulin Dependent Diabetics
    - You may eat a small meal not less than 4 hours prior to your appointment to take your insulin.
  - Non-Insulin Dependent Diabetics
    - You may eat a light meal not less than 4 hours prior to your appointment to take oral medications.
- Blood Glucose will be checked prior to scan. If elevated, the scan may be deferred.
**NaF PET Scan Prep**

- No fasting required
- Drink plenty of fluids unless contraindicated
- Take prescribed medications on the day of your test unless instructed not to do so.
- If the patient is claustrophobic, please ask MD to prescribe an anxiolytic for the scan.

**MRI Patient Prep**

- Serum Creatinine and eGFR within of 30 days of MRI scan
- MRI Safety Questionnaire (pacemakers, clips, shrapnel, welding)
- Medication/Contrast Allergies
- If the patient is claustrophobic, please ask MD to prescribe an anxiolytic for the scan

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**Molecular Imaging Locations**

**Nuclear Medicine Department**

- Imaging Section in Radiology that performs diagnostic testing
- Staffed by Nuclear Medicine Radiologist, and Nuclear Medicine, Technologist, Patient Care Coordinator
- Located on the First Floor of the Clinical Center across from Radiology
- Tests Performed
  - Bone Scans
  - Dexe Scans
  - FDG PET
  - Cardiac Scan (Sestamibi)
  - Thyroid Scans
  - MUGA Scan
  - Bleeding Studies
  - Renograms
  - Lung Scans
  - Parathyroid Scans
  - MIBG Scan

**Research PET Department-CC**

- Department that does only Research PET Scans
- Staffed by physicians and imaging technologists
- Located on the 1st Floor of the Clinical Center in the back of the Nuclear Medicine Department
- Tests performed
  - PETs Scans (FDG, F-Dopa, Dopamine, Gallium 68 Dotatate etc..)
Molecular Imaging Clinic (NCI)

- Imaging Clinic with PET/CT & 3T MRI scanners
- Staffed by physicians, fellows, a research nurse, imaging technologists, Health Care Associate & scientists
- Located on the B3 Level of Clinical Center
- Tests performed
  - Prostate MRI
  - Research DCE MRI
  - PETs Scans (FDG, NaF & Proprietary agents-FES, DCFBC, Cu64)

NCI/Molecular Imaging Clinic

Scheduling
- Scheduled through the MIC clinic
- For non-FDG/NaF scans, need at least 1 weeks’ notice
- Non-FDG/NaF scans are performed after 12pm

Orders
- In general, MIP staff place CRIS orders for the scans

LIP in Attendance for Scan
- No log we have our own MD’s on staff and will call if questions or concerns

Research PET Department

Scheduling
- Scheduled through Jeff Green if the scan is planned at least one month in advance. 301-402-1960 or jgreen@cc.nih.gov
- Schedule with Jerry Jacobs if scan is needed within the month. 301-496-1090 or jiacobsi@cc.nih.gov
- A monthly schedule is posted at the below link. Staff should check that schedule to confirm a patient’s appointment
  http://intranet.cc.nih.gov/pet/scan_schedule/index.html

Orders
- Protocol Staff place CRIS orders by 12pm the day prior to the scheduled scan
  http://intranet.cc.nih.gov/pet/policies/cris_reports.html

Pregnancy Test
- Urine or Serum Pregnancy test performed the day before or the day of the scheduled scan
  http://intranet.cc.nih.gov/pet/policies/pet_studies_women.html
- "Blue Card" signed by both the patient and the LIP
- Urine/serum testing for LIP’s will be done by Dr. Corina Millo and is coordinated by Jerry Jacobson.

LIP in Attendance for Scan
- No
- Policy
  http://intranet.cc.nih.gov/pet/policies/phys_accomp.html
- Patient needs to arrive to PET dept. with iv in place

Consent Form
- Not needed. Consent forms are generally signed in the MIC or can be verified by staff in CRIS or with the referring team

Acknowledgements

- Dr. Peter Choyke
- Dr. Liza Lindenberg
- Dr. Baris Turkbey
- Dr. Hisataka Kobayashi
- Dagane Daar, MS, RT
- Gideon Kwarteng, BS, CNMT
- Phillip Eclarinal, CNMT

- Steve Adler, Ph.D.
- Karen Wong
- Mirna Martinez
- Juanita Weaver
- Anita Ton

Thank You