Tips and Tricks for Improving PET Imaging

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Lecture Outline

- Technologist Checklist
- Imaging Techniques + Reconstruction
- Obese Patients
- Pediatric Patients
- Technical Artifacts
- Radiotherapy (RT) planning
- New PET Technologies
✓ Technologist Checklist
✓ Read patient’s history
✓ Prepare scanner room for imaging
✓ Radiation Exposure (ALARA)
✓ Patient compliance
✓ Special needs Patients
✓ Check patient’s BMI
✓ Patient’s positioning
Read patient’s history

- Type of cancer/diagnosis.
- Staging? Initial, restaging, or monitoring response to therapy.
- Type of imaging protocol needed (ROI):
  - Vertex to mid-thigh (VMT) - General PET/CT protocol.
  - Full Whole Body (FWB) - melanoma, sarcoma, FUO, subcutaneous lymphoma etc.
  - Arm position (Up/Down)

https://www.verywell.com/prescription-history-may-affect-health-insurance-costs-2615274
- Fix Head holder for Head & Neck and brain protocols.
- FWB imaging need bed extension.

- Be more efficient with time to lower radiation exposure.
- 511 keV vs 140 keV.

✔ Patient compliance

- Claustrophobic?
  Develop a relationship with the patient.
- Techniques to avoid anesthesia.
- Did the patient void before scanning?
✔ Special needs patients

- Bedridden? Patient can tolerate imaging positioning?
- Conscious? Unconscious?
- Mental / psychological patients
- limited mobility?
- Check patient’s:
weight + height + dose
(images will be effected)

**weight (kg)** = BMI
**height(m)**

[Chart showing BMI categories]

http://artoftall.com/body-mass-index-tall-people/
Patient positioning

• Body is straight + knee support.
• check that all metal objects are removed.
• Foley catheter urine bag is out of the FOV.
• Clean colostomy bag + pampers.
• VMT = arms up relaxed on arm rest.
• FWB = arms down + feet away from each other.

https://www.researchgate.net/publication/8447817_Positron_emission_tomographycomputed_tomography-imaging_protocols_artifacts_and_pitfalls

http://jnm.snjmjournals.org/content/48/1_suppl/45S/F1.large.jpg
Imaging Techniques + Reconstructions
PET/CT Acquisition

• Scout view to outline the patient's body and ROI.
• CT Acquisition
• PET Acquisition
PET/CT Gantry

Dual-modality imaging range
CT Acquisition (Local)

- Select the area desired to be imaged on the scout view.
- Check the slice thickness of images and reconstruction area.
- Auto mA and Smart mA is a new imaging option depends on the patient’s body density.
- Imaging protocols depends on the patient’s BMI:

<table>
<thead>
<tr>
<th>BMI</th>
<th>kV</th>
<th>Auto mA Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;33</td>
<td>120</td>
<td>50 - 100</td>
</tr>
<tr>
<td>33 - 40</td>
<td>120</td>
<td>50 - 150</td>
</tr>
<tr>
<td>40&lt;</td>
<td>140</td>
<td>50 - 200</td>
</tr>
<tr>
<td>50&lt;</td>
<td>140</td>
<td>50 - 250</td>
</tr>
</tbody>
</table>
PET Acquisition (Local)

- The selected area on the CT view should be the same as the PET selection for accurate image registration.
- Check the patient’s dose and time of administration.
- Check the selected imaging area for reconstructions.
- Imaging protocols depend on the patient’s BMI:

<table>
<thead>
<tr>
<th>BMI</th>
<th>MIN/BED</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;33</td>
<td>2</td>
</tr>
<tr>
<td>33 - 40</td>
<td>2.5</td>
</tr>
<tr>
<td>40&lt;</td>
<td>3</td>
</tr>
<tr>
<td>50&lt;</td>
<td>4</td>
</tr>
</tbody>
</table>
CT Parameters can be adjusted to create new reconstructed images:

- mA
- kV
- Slice Thickness
- Recon type (standard, bone plus)
- Reconstruct a specific region with thinner slice thickness.
PET Parameters can be adjusted to create new reconstructed images:

- Time/bed, less than acquired.
- Recon option (Non-AC)
- Recon type
  - subsets
  - Iterations
  - Filter cutoff
- Recon method (TOF)
- Quantitation method (Q Clear)
PET Images + Reconstruction

AC
Attenuated Corrected

NAC
Non-Attenuated Corrected (Raw Data)
Time of Flight (TOF) Reconstruction method on Obese patients
A bone lesion in the rib was detected with the New Reconstruction method (e.g. Qclear)
Reconstruct Raw data for research purposes

Reconstruct Images:
- Time/bed (can go lower but not higher)
- TOF on or off
- Change Q. clear values
Q. clear Reconstructions
Obese Patients
Obese Patients

- Consider scanner bed tolerance  (227kg max)
- Will the patient fit in the scanner? (70cm diameter bore)
- Need restraints to minimize patient motion.

impact of obesity on imaging:
- Access to veins - extravasation?
- Patient needs assistance to move?
- Positioning for acquisition.

Imaging protocol depends on the patient’s BMI.

Image resolution improved with a higher dose and longer time of acquisition.

BMI = 59
Weight = 190Kg
TOF and New Reconstruction method in Obese patients

Right Peri-Cardial

• Lesions are detected when all reconstruction methods are on.
Pediatric Patients
Pediatric Patients

- 0 – 18 years (toddler most difficult)
- Need restraints to minimize patient motion.
- Some pediatric patients are cooperative.
- Develop a relationship with the patient.
- Usually need anesthesia (0-6 years old).
- Liquid chloral hydrate syrup is not allowed for sedation as it contains glucose.

Pediatric Imaging Protocols (Local)

- Age and weight dependent (up to 55kg)
- If patient’s weight is more than 55kg use adult protocol.
- Pediatric CT parameters depends on the patient’s weight:

<table>
<thead>
<tr>
<th>Weight (Kg)</th>
<th>kV</th>
<th>Auto mA Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 11.4</td>
<td>120</td>
<td>20 - 25</td>
</tr>
<tr>
<td>11.5 - 22.4</td>
<td>120</td>
<td>25 - 40</td>
</tr>
<tr>
<td>22.5 - 55</td>
<td>120</td>
<td>25 - 50</td>
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</tbody>
</table>
Pediatric Patient Imaging
Technical Artifacts
Dose Extravasation

Arm Infiltration

Hand Infiltration
Catheter urine bag placed between feet.

Full bladder

Patient has Cervical Cancer
Patient Moved arms during Acquisition

Head Movement
Radiotherapy (RT) Planning
Radiotherapy (RT) Laser Simulation
Radiotherapy (RT) Laser Simulation

Head & Neck RT Planning

Fused PET/CT image
Colorectal RT Planning
New PET Technologies

• New Digital PET/CT Cameras.
• Motion free acquisition
  - Correct motion in chest and abdomen area
  - To increase detectability of lesions
Thank You
**References**

- University of Zurich (QCLEAR IMAGES)
- [https://www.verywell.com/prescription-history-may-affect-health-insurance-costs-2615274](https://www.verywell.com/prescription-history-may-affect-health-insurance-costs-2615274)