RADIOLOGICAL SOCIETY OF NORTH AMERICA
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Molecular Imaging Education Directory of Knowledge

This directory is a curriculum outline of molecular imaging topics across multiple modalities, including contrast and radiopharmaceutical design, imaging tools and functions, regulatory requirements, study design and potential sources of funding. It is intended for clinicians, researchers, program directors and students interested in developing a MI curriculum or simply learning more about the field.

Imaging Tools

1. X-Ray
2. CT
   a. Dual-energy / Multispectral CT
   b. General CT
3. MR
   a. Nuclear Spin
   b. Basic T1, T2, T2*, DWI etc. Sequences
   c. Spectroscopy
   d. Hyperpolarization
   e. Nanoparticles, SPIO
   f. Diffusion
   g. General MR Resources
4. Ultrasound
   a. Principals of Image Formation, A, B, M Scans, Real Time Systems, Doppler, Duplex, Color Doppler
5. Optical
   a. Photoacoustic / Thermoacoustic
   b. Optical Coherency Tomography
   c. Raman Spectroscopy
6. Gamma Camera / SPECT
7. PET
8. Hybrid
   a. Fusion
      i. Anatomic / Anatomic
      ii. Functional / Anatomic
   b. PET / CT
   c. PET / MR
   d. SPECT / CT

Contrast Agent Design

1. CT
2. MR
3. Hyperpolarization
4. Microbubbles
5. Nanoparticles
6. Designing a Study for a New Contrast Agent
7. Considerations for Selecting an Appropriate Probe

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Imaging Agent Design

1. General Principles
    a. Imaging Component
    b. Targeting Component (as needed)
2. Radiopharmaceutical Design
    a. Gamma-camera / SPECT
    b. PET
    c. Q/C
    d. Designing a Study for a New Radiopharmaceutical
3. Optical
4. MR
5. CT
6. Ultrasound

Imaging Functions

1. Defining Disease Signatures such as Cancer
    a. Measuring Tumor Response Beyond RECIST
        i. Early: Before Size Change
        ii. Late: At Expected Time of Size Change
        iii. Durability
    b. Disease Signatures – General Resources
2. Radiogenomics
3. Gene Manipulation – Reporter Genes
4. Imaging with Amino Acids
5. Antigens – Targeting with Antibodies or their fragments, peptides
6. Signaling Pathways / Unique Pathology in Different Diseases
7. Imaging Hormonal Status, e.g. Androgen and Estrogen
8. Imaging Tumor Hypoxia
9. Imaging Cell Death – Mitotic, Apoptotic, Autophagy, Necrosis
10. Interrogating the Vasculature
    a. Dynamic Contrast Enhanced (DCE) Imaging
        i. DCE-CT
        ii. DCE-MR, DSC-MR
        iii. DCE-General
11. Theranostics

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Clinical Translation

1. Regulatory Requirements
2. Investigational New Drug (IND) Applications
3. Differences Between
   a. Radiopharmaceuticals
   b. Contrast Agents for CT, MR, and Ultrasound
   c. Biologics such as Reporter Genes
      i. Vectors
      ii. Cells
4. Study Design
5. Potential Sources of Funding

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