NMED-2601: MOLECULAR AND FUSION IMAGING WITH PHARMACOLOGY

Cuyahoga Community College

Viewing: NMED-2601 : Molecular and Fusion Imaging with Pharmacology

Board of Trustees:
January 2024

Academic Term:
Fall 2024

Subject Code
NMED - Nuclear Medicine Technology

Course Number:
2601

Title:
Molecular and Fusion Imaging with Pharmacology

Catalog Description:
Examines the methodology of advanced molecular imaging and fusion imaging in the field of nuclear medicine and analyzes current trends and advances in the field. Focus is on patient preparation, pharmaceutical and contrast preparation, imaging protocols, radiation safety, and special considerations for fusion nuclear medicine studies with computed tomography and magnetic resonance imaging.

Credit Hour(s):
3

Lecture Hour(s):
3

Requisites

Prerequisite and Corequisite
NMED-1501 Radiation Physics and NMED-1701 Nuclear Medicine Instrumentation.

Outcomes

Course Outcome(s):
Differentiate between varying types of advanced molecular imaging and fusion imaging.

Objective(s):
1. Explain the historical background of advanced molecular imaging.
2. Define advanced molecular imaging.
3. Explain fusion imaging.
4. Discuss advantages and disadvantages to various types of fusion imaging.

Course Outcome(s):
Explain the methodology of various types and techniques of fusion imaging.

Objective(s):
1. Describe and discuss various imaging protocols for SPECT/CT, PET/CT, SPECT/MR, and PET/MR.
2. Describe quality control for fusion imaging equipment and instrumentation.
3. Examine special considerations for combining other imaging modalities with nuclear medicine.
4. Describe the necessary pharmaceutical preparation, patient preparation, and radiation safety measures that hybrid imaging requires.

Course Outcome(s):

Discuss current topics and advances in the fields of advanced molecular imaging and fusion imaging.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Discuss current research as it relates to molecular imaging and fusion imaging.
2. Examine current trends in molecular imaging.
3. Examine new and emerging fusion imaging instrumentation and techniques.

Methods of Evaluation:

1. Quizzes
2. Exams
3. Worksheets
4. Writing assignments
5. Case studies
6. Presentations

Course Content Outline:

1. Advanced Molecular and Fusion Imaging
    a. Defining molecular imaging
    b. Historical background
2. SPECT/CT system
    a. System characteristics
        i. Quality control
        ii. SPECT components
        iii. CT components
        iv. Spatial resolution
        v. Sensitivity
    b. Imaging protocols
        i. Neurologic
        ii. Cardiac
            1. CT angiography
            2. Imaging plaque
        iii. Cancer imaging: diagnose and staging
        iv. Miscellaneous uses
    c. Processing data
    d. Creating an image set
        i. Filter selection and tomographic reconstruction
        ii. Attenuation correction
    e. Analyzing the results
        i. Normal versus abnormal results
        ii. Case study review
    f. Special considerations
        i. Patient preparation
        ii. Contraindications and adverse reactions
        iii. Radiation safety considerations
        iv. Advantages and disadvantages
        v. Regulations on nuclear medicine technologists regarding hybrid CT
        vi. Uses in molecular imaging
        vii. New advances
3. Positron Emission Tomography/Computed Tomography (PET/CT)

a. PET/CT system characteristics
   i. Quality control
   ii. PET components
   iii. CT components
   iv. Spatial resolution
   v. Sensitivity
   vi. Positron Emission Tomography agents
   vii. Miscellaneous diagnostic agents
b. Imaging protocols
   i. Neurologic
      1. Dementia and neurologic disorders
      2. Stroke and perfusion imaging
      3. Seizure disorders
      4. Psychological and behavioral
   ii. Cardiac
      1. Myocardial perfusion
      2. Viability studies
      3. Molecular
   iii. Cancer imaging: diagnose and staging
   iv. Miscellaneous uses
c. Processing data
d. Creating an image set
   i. Filter selection and tomographic reconstruction
   ii. Attenuation correction
e. Analyzing the results
   i. Normal versus abnormal results
   ii. Case study review
f. Special considerations
   i. Patient preparation
   ii. Administering radioactive sugar and patient monitoring
   iii. Creating the ambiance for brain imaging injections
   iv. Contraindications and adverse reactions
   v. Radiation safety considerations
   vi. Advantages and disadvantages
   vii. Uses in molecular imaging
   viii. New advances
   ix.
   x. Pharmaceutical: Interventional and non-radioactive agents
      1. Administration by Nuclear Medicine Technologists
         a. Regulations
         b. Ethical implications
         c. Training
         d. Procedural considerations
   xi. For each pharmaceutical on the Nuclear Medicine Technology Certification Board Pharmacy List (NMTCB) and the American Radiologic Registry Technology (ARRT) Nuclear Medicine radionuclide list, the following elements will be examined interventional agents:
      1. Class of drug
      2. Alternate names
      3. Indications
      4. Mechanism of action
      5. Pharmacokinetics
      6. Dosage range
      7. Precautions and contraindications
      8. Adverse reactions
   xii. Contrast Media
      1. Alternate names
      2. Indications
      3. Pharmacokinetics
      4. Dose range including pediatric calculation

5. Adverse reactions and reporting
6. High-osmolality ionic agents
7. Low-osmolality ionic agents
8. Low-osmolality nonionic
9. Barium sulfate
10. Sodium amidotrisoate
11. Meglumine amidotrizoate
12. Other
13. Air

xiii. Record keeping
1. Proper charting and documentation
2. Legal ramifications of improper charting and documentation
3. Ownership and release of medical information

4. Single Photon Emission Tomography/Magnetic Resonance (SPECT/MR)
a. Physics Review
i. MR physics
b. SPECT/MR system
c. System characteristics
i. Quality control
ii. SPECT components
iii. MR components
iv. Spatial resolution
v. Sensitivity
d. Imaging protocols
i. Neurologic
1. Dementia and neurologic disorders
2. Stroke and perfusion imaging
3. Seizure disorders
4. Psychological and behavioral
ii. Cardiac
e. Cancer imaging: diagnose and staging
f. Infection and abscess imaging
g. Miscellaneous
h. Processing data
i. Creating an image set
i. Filter selection and tomographic reconstruction
ii. Attenuation correction
iii. Image processing techniques for MR
j. Analyzing the results
i. Normal versus abnormal results
ii. Case study review
k. Special considerations
i. MR safety and patient screening
ii. Patient preparation
iii. Contraindications and adverse reactions
iv. Radiation safety considerations
v. Advantages and disadvantages
vi. Regulations for nuclear medicine technologists regarding hybrid MR
vii. Functional MR
viii. MR spectroscopy
ix. Uses in molecular imaging
x. New advances

5. Positron Emission Tomography/Magnetic Resonance(PET/MR)
a. PET/MR system characteristics
i. Quality control
ii. PET components
iii. MR components

iv. Spatial resolution
v. Sensitivity

b. Imaging protocols
i. Neurologic
1. Dementia and neurologic disorders
2. Stroke and perfusion imaging
3. Seizure disorders
4. Psychological and behavioral
ii. Cardiac
1. Myocardial perfusion
2. Viability studies
3. Molecular
iii. Cancer imaging: diagnose and staging
iv. Infection and abscess imaging
v. Miscellaneous

c. Processing data

d. Creating an image set
i. Filter selection and tomographic reconstruction
ii. Attenuation correction

e. Analyzing the results
i. Normal versus abnormal results
ii. Case study review

f. Special considerations
i. MR safety and patient pre-screening
ii. Patient preparation
iii. Administering radioactive sugar and patient monitoring
iv. Creating the ambience for brain imaging injections
v. Contraindications and adverse reactions
vi. Radiation safety considerations
vii. Advantages and disadvantages
viii. Uses in molecular imaging
ix. New advances

6. Current Trends
a. Advanced molecular imaging
b. Hybrid/fusion imaging techniques
c. Emerging technologies
d. Newly approved drugs
e. Current research

Resources

Bolus, N., & Glasgow, K.W., (Eds.). (2018) *Review of Nuclear Medicine Technology (5th Ed.)*, Reston, VA: Society of Nuclear Medicine and Molecular Imaging.

Lee, K.H. (2015) *Basic Science of Nuclear Medicine: Bare Bone Essentials*, Reston, VA: Society of Nuclear Medicine and Molecular Imaging.

Mettler, F., & Guiberteau, M. (2019) Essentials of Nuclear Medicine and Molecular Imaging (7th ed.). Philadelphia, PA: Elsevier.

Saha, G. (2018) Fundamentals of Nuclear Pharmacy (7th ed.). Cham, Switzerland: Springer International Publishing.

Ziessman, H.A., O'Malley, J.P. & Thrall, J.H. (2014) *Nuclear Medicine: The Requisites (4th ed.)*, Philadelphia, PA: Elsevier.

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