Working in a Multi-Modality Operating Suite

Angela R. Kanan BSN, RN, CNOR, CRN
AMIGO Suite
Brigham & Women's Hospital
Boston, Massachusetts
Discuss

- Setting up a Hybrid Operating Room or Suite
- Training Staff
- Safety Training
- Discuss some procedures
No Financial Disclosures
Grant Funding from the NIH
Planning

- Grants from National Institute of Health
- Buy in from Hospital Administration/Finance
Advanced Multi-Modality Image Guided Operating Suite (AMIGO)

- OR with Interventional Angiography System
  - ionizing radiation
- OR with 3T MRI Scanner
  - ever present magnetic field
- OR with PET/CT scanner.
  - Radioactive sources (PET)
  - ionizing radiation (CT)
Why use image guidance???

- Visualize area of interest (aoi)
- Visualize marker, probes needles in aoi
- Soft tissue discrimination
- See adjacent critical structures
- Visualize tumor margins
- Cross sectional imaging
- Monitor thermal effect
Planning / Construction

- State Department of Health
- JCAHO Guidelines
- Architects - Construction Meetings
- Project Manager
- Guidelines for Design and Construction of Hospital and Health Care Facilities
- AORN Guidelines
- MR Safety Guidelines
Planning Meetings

- Administration
- Radiology
- Nursing
- Anesthesiology
- Information systems
- Biomedical Engineering
Staff Training

- Nurses
- Radiology technologists
- Anesthesiologists
- Radiologists
- Surgeons
- Ancillary staff
Radiology Divisions

- Angiography
- MRI
- Nuclear Medicine PET/CT
- Ultrasound
Layout

- OR with MRI
- OR with Angio/X-ray and Ultrasound
- OR with PET/CT
MRI Moves into Main OR on Ceiling Rails
Staff training

- **Operating Room Environment**
  - Sterile environment with air exchange
  - Bovie, Bipolar, Cusa, Scopes,

- **Radiology Environment**
  - MR scanner
  - CT scanner
  - X-ray C-ARM
Nursing Orientation

- Spend time working in various radiology environments or spend time in the operating room
- Limit the number of staff being oriented to hybrid OR until the core team member becomes the experts
- Specific training should include live lectures and videos pertaining to the various aspects of radiology and safety
- Training should be repeated each year (on-line)
OR nurse vs IR nurse

* OR nurse
  - Circulator/scrub
  - Open surgeries & minimally invasive procedures
  - Anesthesia always present

* IR nurse
  - Angio/CT/MRI/Nuc Med
  - Minimally invasive procedures
  - Moderate sedation/ACLS trained
  - Anesthesia sometimes present

X-train Nurses
MRI & Radiology Safety Education

- Hospital Radiation Safety Officer should oversee education and compliance of safety in the Hybrid Operating Rooms.

- OR and Radiology staff must work together to establish policies and provide education.

- Radiology staff are the experts in safety with the specific image modality in which they are trained. (MRI, CT, Angio, X-ray, Nuclear Medicine)
Radiation Safety

- Educate Staff on Radiation Safety
- ALARA - As Low As Reasonably Achievable
- Reduce Exposure-Time, Distance, Shielding
- Wear Dosimetry badges
- Wear lead aprons with thyroid shield
Lead Apron, Thyroid Shield, Dosimetry Badge

- 2 piece apron distributes weight of apron better
- Thyroid shield worn with thyroid dosimetry badge attached
- 2nd dosimetry badge worn at waist level inside lead apron
- Aprons x-rayed each year to check for cracks or holes
Dosimetry: measurement of the absorbed dose delivered by ionizing radiation.
Contrast Media

- Enhances visualization of area of interest.
- Patient with contrast allergies should be pre-medicated.
- Contrast Reaction Kits should be available in each Hybrid OR.
- X-Ray Contrast is different than MRI contrast
Emergency Situations

- Perform A MOCK CODE
- Contrast Reaction Kits
- Code Buttons on the wall in each OR
- Designated area for a code in MRI room
Safety

- Radiation
- MRI
- PET
Radiation Safety

- Yearly lecture on Radiation Safety
- Dosimetry badges
- Wrap around lead aprons
- ALARA
MRI

- Screening Questionnaire for all staff
- Yearly MR safety training video with quiz
- Terminology: gauss, Tesla, quench
- THE MAGNET is always on.
- Color-coding instruments
- Labeling equipment
MR Safety

- ACR Policy
- Staff screening/training
- Patient screening
- MR Zones
- Testing Instruments/Equipment
- Annual safety drills including emergency in the event a patient has a cardiac arrest while undergoing a scan
ALL MUST BE MR SAFE

- Instruments.
- Tables, chairs, foot stools
- IV poles,
- Anesthesia Machines
- Patient Monitors
On-line Training

- What is MRI?
- Basic MRI concept
- Reported MRI Accident
- Magnetic field
- Shielding
- Zones
- Safety concerns
- Projectiles/ Missile Effect
PET/ CT

• PET
  - Radioactive tracers
  - Half life varies depends on tracer
  - Dosimetry badges
  - Trash disposal

• CT
  - CT plus fluoroscopy
  - Lead aprons
  - Dosimetry badges
Procedures

- Brain and Pituitary Tumor resections
- Laser Therapy for brain tumor
- Breast Lumpectomies
- Lung surgery IVATS
- Cryotherapy & Microwave Ablation
- Biopsies- prostate and soft tissue
Brain Tumor Resection

Diagnostic Ax FLAIR

Low Grade tumor

Diagnostic Ax T1 post gad
Intra-op shows residual tumor

Ax FLAIR – intra op

Ax T2 Blade – intra op
Post Surgical resection

Axial FLAIR – post surg

Ax T2 Blade – post surg
Follow up

Ax T1 Post gad

Ax T2 BLADE
68 year-old woman with chronic headache, visual field deficit. Suspected pituitary macroadenoma

Diagnostic MRI Post Gad
Intra Op images showing residual tumor
Images post gad done next day on L1
Cryoablation

- Minimally invasive
- Freeze using argon and helium gases
- See ice ball on CT. better on MRI
- Warm compresses to skin
The Freezing Process

- Argon Gas
- Passes through cryo-probes
- Tip is cooled & forms iceball
- Iceball engulfs tumor
- Iceball destroys tissue
PET/CT-guided cryoablation
MRI-Monitored freezing

The iceball is visible during the MR scanning!
Microwave Ablation

- PET/CT or MR guided
- Heat
- MW generator
- Probe with tongs
Lung Surgery iVATS

- Visualize tumor on X-ray/fluoro
- Takes only tumor leaves normal tissue
  - Instead of lobectomy
Lung Wedge Resection Surgery

Bueno, Gill, Jagadeesan
MR Guided Prostate biopsies

- Elevated PSA with failed TRUS (Ultra Sound)
- No rectum so cannot have US guided bx
Breast Lumpectomies

- 20-40% of patients need redo surgery
- Surgically Remove tumor
- Do MRI to confirm tumor is gone
- Pt gets MR contrast
- Remove any residual tumor
Pre-procedure Supine DCE-MRI

First post-contrast DCE-MRI

3D volume-rendered view showing the tumor

20-40% reoperation

Golshan, Gombos, Jagadeesan
BCS procedural steps

Pre-procedural imaging

Surgery

Post-procedural imaging

Re-excision

Golshan, Gombos, Jagadeesan
Post-procedure Supine DCE-MRI

First post-contrast DCE-MRI showing the surgical cavity

3D volume-rendered view showing the surgical cavity

Golshan, Gombos, Jagadeesan
<table>
<thead>
<tr>
<th>Procedure Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Neurosurgery</strong></td>
<td>142</td>
</tr>
<tr>
<td>• 91 MR and Ultrasound Guided Brain Tumor Resections</td>
<td></td>
</tr>
<tr>
<td>• 22 MR Guided Transsphenoidal Resections for Pituitary Tumors</td>
<td></td>
</tr>
<tr>
<td>• 15 MR Guided Deep Brain Stimulation Electrodes Placements</td>
<td></td>
</tr>
<tr>
<td>• 9 MR Guided Laser Brain Tumor Ablations</td>
<td></td>
</tr>
<tr>
<td>• 4 MR Guided Skull Base Surgery</td>
<td></td>
</tr>
<tr>
<td>• 1 MR Guided Epilepsy Electrode Placement</td>
<td></td>
</tr>
<tr>
<td><strong>Thoracic Surgery, Biopsy, Ablation</strong></td>
<td>65</td>
</tr>
<tr>
<td>• 26 Video Assisted Thoracoscopic surgeries (iVats)</td>
<td></td>
</tr>
<tr>
<td>• 13 Breast Lumpectomies</td>
<td></td>
</tr>
<tr>
<td>• 8 PET/CT Guided Lung Biopsies</td>
<td></td>
</tr>
<tr>
<td>• 7 Cardiac EP Ablations</td>
<td></td>
</tr>
<tr>
<td>• 7 PET/CT Guided Microwave Ablations of Lung Tumors</td>
<td></td>
</tr>
<tr>
<td>• 3 PET/CT Guided Cryoablations of Lung or Rib Tumors</td>
<td></td>
</tr>
<tr>
<td>• 1 MR Guided Cryoablation of Metastatic Paraspinal Tumors</td>
<td></td>
</tr>
<tr>
<td><strong>Head &amp; Neck Surgery</strong></td>
<td>12</td>
</tr>
<tr>
<td>• 5 Parathyroidectomies/Hemithyroidectomies</td>
<td></td>
</tr>
<tr>
<td>• 3 PET/CT Guided Biopsy of Tongue/Mouth/Neck</td>
<td></td>
</tr>
<tr>
<td>• 2 MR Guided Biopsy of Tongue/Mouth/Neck</td>
<td></td>
</tr>
<tr>
<td>• 2 MR-guided Cryotherapy of Neck Tumors</td>
<td></td>
</tr>
<tr>
<td><strong>Skeletal Biopsy &amp; Ablation</strong></td>
<td>4</td>
</tr>
<tr>
<td>• 2 PET/CT Guided Biopsy of Spine Tumor</td>
<td></td>
</tr>
<tr>
<td>• 1 MR Guided Cryoablation of Spinal Tumor</td>
<td></td>
</tr>
<tr>
<td>• 1 MR Guided Biopsy of Femoral Tumor</td>
<td></td>
</tr>
<tr>
<td><strong>Pelvic Biopsy, Ablation, Brachytherapy</strong></td>
<td>294</td>
</tr>
<tr>
<td>• 192 MR Guided Prostate Biopsies</td>
<td></td>
</tr>
<tr>
<td>• 84 MR and Ultrasound Guided Gynecologic Cancer Brachytherapy</td>
<td></td>
</tr>
<tr>
<td>• 8 MR and Ultrasound Guided Prostate Brachytherapy</td>
<td></td>
</tr>
<tr>
<td>• 7 MR Guided Cryoablations of Prostate Tumors</td>
<td></td>
</tr>
<tr>
<td>• 1 MR Guided Biopsy of Penile Tumor</td>
<td></td>
</tr>
<tr>
<td>• 1 PET/CT Guided Penile Biopsy</td>
<td></td>
</tr>
<tr>
<td>• 1 PET/CT Guided Cryoablation of Pelvic Tumor</td>
<td></td>
</tr>
<tr>
<td><strong>Abdominal Tumor Ablation &amp; Bx</strong></td>
<td>229</td>
</tr>
<tr>
<td>• 146 MRI Guided Cryoablations of Liver or Kidney Tumors</td>
<td></td>
</tr>
<tr>
<td>• 31 MR Guided Biopsies of Liver or Kidney Tumors</td>
<td></td>
</tr>
<tr>
<td>• 29 PET/CT Guided Microwave Ablations of Liver or Kidney Tumors</td>
<td></td>
</tr>
<tr>
<td>• 23 PET/CT Guided Cryoablations of Liver or Kidney Tumors</td>
<td></td>
</tr>
</tbody>
</table>
With Greatest Admiration and Respect

Dr Ferenc Jolesz  1946-2014
THANK YOU
akanan@partners.org