4623 MRI Breasts and Chest Wall

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Chest Anatomy

- Mediastinum
- Vascular Structures
- Lungs, Heart
- Hilum (entering point)
- Diaphragm
- Pleura (parietal, visceral)
- Pectoralis Minor Muscle
Chest Anatomy

- Mediastinum

- Abnormalities are described by location
  - Superior, Anterior, Middle, Posterior or Multiple (invasive neoplasms)
• Muscles and bones. Easy to differentiate on CT.
• Pectoralis Minor part of chest wall, Pectoralis Major is not.
Chest Anatomy

- Mediastinum
- Heart
- Lung
- Liver
- Aorta
- Spleen
Questions we need to answer.

Pulse Sequences typically used for imaging of the Chest wall.

1. T1 FSE (TSE)
2. T2 Fat sat FSE (TSE)
3. Stir (FSE)
4. 3D SPGR (Spoiled Gradient Recall)
Positioning can be either supine or prone. Usually dictated by where pathology is and where artifacts will arise.

Positioning is also dictated by the coil used, patient habitus and patient comfort.
Routine imaging sequences (T1 and T2 Fat sat and Stir) should be used in 2 planes (Axial and Coronal) (Sag ?)

Pre and Post Fat sat 3D SPGR

Cover anatomy and look for pathology.
Check Phase direction, heart motion may interfere with pathology.
Fancy Imaging Techniques

You can use Breath Hold Imaging techniques for Pre and Post Fat sat sequences.
Parallel Imaging if coil is compatible.

1. 3D SPGR (Fame)(Flash)(Lava)(Vibe)(Flash)
These are all the same, can be ran during breath hold in under 30 seconds. Have hybrid Fat sat which looks like Stir.
Methods of reducing respiratory motion.

1. Respiratory Gating
2. Cardiac Gating
3. Prone or “Pathology down” Positioning
4. Breath Hold Imaging
Phase direction Rt-Lt.

What direction is Frequency?
Do you see the pathology?

Pre 3D SPGR
Do you see the pathology?

Paraspinal Cystic Lesion
T1 dark fluid, T2 bright fluid

Paraspinal Cystic Lesion
Pleural Fluid

Serous fluid produced by the intercostal arteries, during normal parietal circulation and reabsorbed by the lymphatic system.

Normal to see some fluid in chest imaging. Especially T2 sequences.

Effusion

- More fluid is produced than is reabsorbed.
3D SPGR
Pre contrast
3D SPGR w/ contrast
Advantages and Disadvantages of MRI for Pleural Effusion.

- MRI is very sensitive to fluid.
- T1 hypointense  dark
- T2 hyperintense  bright
- CT, all non-contrast fluid is hypointense or iso intense to muscle.
- Chest wall shifts during breathing, hard to measure effusion.
**Pleural effusion** — An abnormal accumulation of fluid in the pleura, a fibrous membrane that lines the inside of the chest cavity and protects the lungs.

Over two-thirds of all mesothelioma cases begin in the pleura region. Pleural mesothelioma spreads through the chest cavity, occasionally developing in the lungs as well. The disease most commonly causes **pleural effusion**, an excess build-up of fluid inside the chest cavity.
Pleural Effusion (Again)

MRI is very good at seeing Pleural Effusion. Unfortunately, MRI may be too sensitive. Fluid levels are hard to quantify because of patient positioning (Prone / Supine). We see a lot of “Benign” fluid in chest during normal CT and MRI Imaging. Lungs and surrounding tissue are “Wet” T2 Fatsat and Stir “sensitive” to water.
Pleural Plaques. Mesothelioma

Advantages / Disadvantages of visualizing with MRI.

Mesothelioma is an uncommon disease that causes malignant cancer cells to form within the lining of the chest, abdomen, or around the heart. Its primary cause is believed to be exposure to asbestos.

Approximately 80% of all mesothelioma patients have a history of asbestos exposure.
Mesothelioma gone bad
CT versus MRI Imaging

CT was the “Gold Standard”.
Great resolution. No Breathing Artifacts.
Can see calcifications well.

MRI has better tissue differentiation.
Better at Interstitial Fibrosis and Atelectasis.
Better at Pleural Effusion and Edema.
Better at visualizing “invasion” into other tissues and body cavities.
Benign or Malignant Plaque? (compared to muscle) MRI

**Benign** = Hypointense or Isointense on T1 and Hypointense on T2 Fatsat.

**Malignant** = (Inhomogeneous) Hypointense or Isointense on T1 and Hyperintense on T2 Fatsat.
Adipose Tissue Tumors- Just “Fat”. Can be small or large. MRI Fatsat or CT Hounsfield numbers(-50, -100) to DX. Lipoma

Vascular Tumors- Cavernous Hemangioma
Peripheral nerve tumors.

Schwannomas, Neurofibromas, arise from Shwann cells, nerve sheath tumors.
Cavernous Hemangiomas

Very rare in the chest. Typically manifest at birth or before age 30. Seen as poorly marginated mass with signal intensity similar to muscle on T1. Hyperintense on T2 because of vascularity.
Neurofibromas in Chest
Benign Chest Wall Lesions

Paraspinal Schwannoma
Chest wall Schwannoma (CT)

On MRI images Schwannomas are isointense to hyperintense on T1, and hyperintense on T2.
Osteochondromas. Most common. Usually occurs near the end of bones.

“Cartilage Cap” Tumors, 10% become malignant.

Endochondroma. Metaphyseal-diaphyseal region of the bone.

Chondroblastoma. Arises from epiphysis. Most of these benign bone tumors show up in young people.
Osteochondroma

Arising from cartilage cap of rib
Giant Cell Tumor

Benign chest wall Tumor. Arise from subchondral region of chest wall. Usually solitary. Hypointense on T1, Hyperintense on T2,
Aneurysmal Bone Cyst

Bone cyst which arises from the clavicle. Destroys the bone. Fluid filled, Bright on T2.
Benign chest wall tumors are a diverse group of lesions with vascular, neural, osseous, cartilaginous, or lipomatous origins.

Lipoma, dark on CT. Bright on T1 and T2 WHY?
Malignant Chest Wall Lesions

Sarcomas. Cancers that arise from connective tissue. These are different than most cancers of the chest (Breast) because they form from the mesoderm (middle layer/forms bone, cartilage) and not the epithelium (surface lining of structures).
Sarcoma Lingo

Osteo = Bone

Chondro = Cartilage

Leiomyo = Smooth Muscle

Sarcoma = Flesh
Malignant Chest Wall Lesions

*Askin’s Tumor.* Very rare Primitive Neuroectodermal Tumor (PNET) of the chest wall. Almost identical to Ewing’s sarcoma. Is made of soft tissue.

“Thoracopulmonary PNET”

Visualized better on MRI than CT for extent of lesion.
Malignant Chest Wall Lesions

Pancoast Tumors.

Pulmonary sulcus tumor or superior sulcus tumor, is a tumor of the pulmonary apex. Type of lung cancer defined by its location at the right or left apex of the lung.
Malignant Chest Wall Lesions

Bronchogenic Carcinoma

Typical Lung Cancer. Uncontrolled cell growth in the tissues of the lung. Derived from epithelial cells. Responsible Over one million deaths per year.
Lungs are not easily imaged
No tissue, mostly air.
Won’t hold still. Heart motion
Giant Chest Tumor, T1 or T2?

Teratoma
Breast MRI   BMRI
Anatomy Breast Ducts

- Lactiferous sinus
- Duct orifices
- Lobe (segment): Duct orifice, multiple ducts and TDLUs
- Main duct
Parenchyma. Breast Ducts
BREAST CANCER ANATOMY

Carcinoma sites in Breast

- Lymph Nodes
- Lobule
- Duct
- Lobe
- Alveoli in Lobule
Stromal tissue=
Breast anatomy consists of the Parenchyma (ductal system), Stroma (supportive framework), Fat, Areola, Nipple, Pectoralis Major, Suspensory Ligaments, Lymph Nodes.
Patient Positioning
Patient is always prone so that gravity brings the breast into the coil. Also eliminates chest wall motion.
Tech must manually position breast so they can be imaged with consistancy.
Patient Preparation

It's better to spend 30 minutes preparing the patient than having the patient ruin the exam.

- Explain procedure in MRI suite
- Answer any and all questions
- Dress patient properly
- Start IV while interviewing patient
- Female tech positions patient
- Make comfortable
Patient preparation

- IV can be 18g to 24 g
- Hep cap, so we can hook up to power injector
- Ear plugs or Head phones (better)
- Explain the exact timing of your sequences
- Before injection personally communicate with pt.
- You get one shot at dynamic breast sequence
MRI Breast Protocol

- 3 Plane localizer
- Calibration scan (for parallel imaging)
- Ax T1 non Fat sat (bilateral breasts)
- Ax T2 Fat sat Lt. Breast (?) Sag
- Ax T2 Fat sat Rt. Breast (?) Sag
- Ax Pre “Vibrant” Bilateral
- Ax (5 Phase) Vibrant Dynamic
- Coronal Stir (both Breasts and Chest wall)
- Opt. Water Sat STIR (Silicone Implants)
VIBRANT

3D SPGR – 3D Gradient Echo (Flash, Vibe, Fame)

Has many names depending on manufacturer. In Breast imaging, sequence has been modified for Parallel Imaging and Selective Coil imaging.

You can select which breast you want to image.

High resolution scanning in a short time.
VIBRANT

Near Isotropic Resolution.
Scan Time is **90** seconds per phase.
**40-60** slices (cover anatomy)
**2-3** mm slice thickness
Isotropic matrix= Frequency and Phase should be the same, should equal **1** mm
Example– 32 FOV Phase and Frequency
320 x 320 Matrix
Things to consider

Phase and Frequency Direction
Where's the artifact coming from and what will it obscure? What about Post Contrast?
Phase Wrap Around

Normal Sequences such as T1 and T2 FSE need to be careful of Phase Wrap.

With 3D SPGR and Parallel Imaging the “wrap” artifact shows up in the middle of picture.

But because of the Coil configuration and the special sequence developed we don’t get as bad of artifact as usual.
Should have Wrap, But....
INHOMOGENEITY
Must do Manual Pre Scan
T2 Fat sat, hard to have consistency with large FOV– Do breasts individually.
Single Breast using only half the coil. 4 element out of 8.
Silicone Implants

For silicone implant rupture we must run a “Water sat” Inversion Recovery sequence.

This is pretty close to a regular STIR, but we need to “Center” our Frequency on WATER.

Water  Fat 220 hz  Silicone  330 hz  90 hz
Silicone Implants
Silicone will dominate the signal. silicone will not be Black on T1. Silicone “will” be bright on STIR. Silicone Rupture Protocol is the same as Breast Cancer Protocol. All implants will “Mask” out on post processed images.
Post Processed 3D silicone implants
Water Sat STIR- notice the Fat.
STIR Coronal- silicone implants
Bright on T2
Saline Implants on T1 Vibrant Post

Notice how dark they are “Water”
Silicone Implants on T1 FSE.
Notice how they are not dark
Same Patient. Water Sat STIR Centered on Water, So water is nulled But Fat is too close to silicone.
Post silicone implant rupture with new “saline” implants. Water sat STIR
Same patient. Coronal STIR
Water bright, silicone not so much

Lymph Nodes
Same Patient, Notice Lymph Node
Breast Cancer

Breast cancer is the most frequent cancer for women in United States. 1 in 8 women will get some form of breast cancer. Quality of Care Model- Women should be screened with Mammography. Even so 10% to 30% of Breast Ca is missed
Reasons Breast CA is missed

• Poor technique and positioning
• Dense Breasts
• Error by Radiologist
Breast MRI

After screening Mammo,
When to have Breast MRI

- Screening Mammogram
- Diagnostic Mammogram
- Ultrasound
- MRI
How does Breast MRI find CA

Tumor mediated Angiogenesis

Most malignant Breast CA directs the vascularity towards the tumor. Thus MRI with dynamic contrast can see angiogenesis.
Post Processed. No Cancer
Angiogenesis
Kinetic Curve - Washout Malignant

Kinetic curve over 7 minute scan will show “flush in Flush out”
Plateau Kinetics-Benign

Location:
R, UO quadrant, central

CADstream

% Change

Rapid
Persistant- benign
Cyst vs. Lymph node on T2FS
Invasive Lobular- Check out the Lymph nodes.
Left side CA-Right side Parenchymal enhancement
Must be care of Menstrual Cycle
Must be day 7-14 from start.
Otherwise “Parenchymal enhancement.”
Types of Breast Cancer

- Ductal Ca in situ- Stays in ducts
- Lobular Ca in situ- In ducts lobular
- Invasive
- Mucinous
- Lymph node involvement
Lymph Nodes

Protect the body from invasion. We have a good idea if lymph nodes are involved if they are swollen. Also if they have a “Fatty Hilum” Need T1 non fat sat to see.
Lymph node involvement
Post Op- TRAM Flap and Radiation
TRAM Flap- Remove all ductal tissue but conserve breast Stroma. Reconstruct with Fat or Implant. Radiation causes parenchyma to “soften”
Dense Breasts.
Post Lumpectomy Scar T1
Normal Lymph node on subtracted image post contrast
Badness
Kinetics
QUESTIONS?