C13
Imaging Modalities Used to Detect Breast Cancer

Elizabeth Wende Breast Care. (2023, November 13). *Your first mammogram? what you should know: EWBC.* https://www.ewbc.com/posts/your-first-mammogram-what-you-should-know//

Breast 3T MRI. Breast Diagnostic Specialists. (n.d.). https://breastdiagnosticspecialists.com.au/breast-3t-mri/

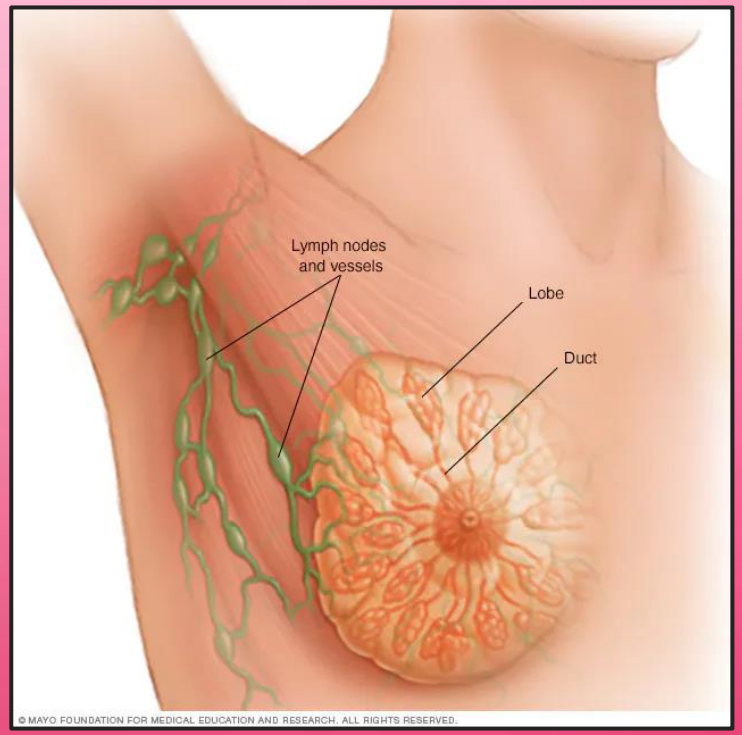
Abus Breast Imaging Ultrasound Products & Solutions. ge monogram primary white RGB. (n.d.). https://www.gehealthcare.com/products/ultrasound/breast-ultrasound

Objectives

- Understand how diagnostic imaging can help screen for cancer
- Explain which imaging modalities are used in the process of diagnosis
- Identify where breast cancer is formed
- Discuss the benefits of early cancer detection
- Know each component of the breast
- Determine the sequence of imaging used for the breast

What is Breast Cancer?

- Breast cancer occurs when cells grow abnormally and divide quickly to accumulate, forming a lump or a mass.
- Cancerous breast cells metastasize, spreading to lymph nodes and other parts of the body.
- “There is a 13% chance that women will develop breast cancer in their life, that is an average of 1 out of 8 people” (American Cancer Society, 2023, p.1).

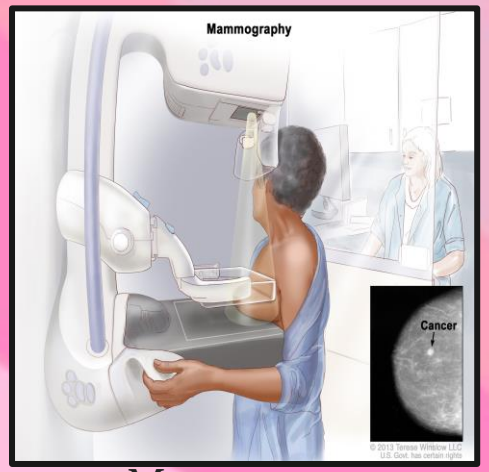


"Breast Cancer." *Mayo Clinic*, www.mayoclinic.org/diseases-conditions/breast-cancer/symptoms-causes/syc-20352470.

The Different Modalities Used to Scan Breasts

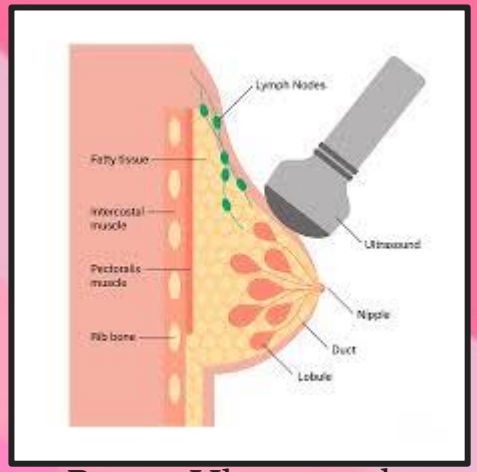
- In order to detect breast cancer, most women over the age of 40 are recommended to undergo annual imaging; with more frequent imaging for high-risk patients.

- The most common imaging modality is called a mammogram, which captures a picture of the breast in its entirety. In addition to a mammogram, ultrasound, magnetic resonance imaging (MRI), computed tomography (CT) are all very common modalities that can be used to detect early onset of breast cancer.



Mammogram

Professional, C. C. medical. (n.d.). *Mammogram: What it is, types, purpose & results*. Cleveland Clinic. https://my.clevelandclinic.org/health/diagnostics/4877-mammogram



Breast Ultrasound

Breast ultrasound - stock image - M406/0253 - science photo library. (n.d.). https://www.sciencephoto.com/media/271264/view/breast-ultrasound

Breast CT

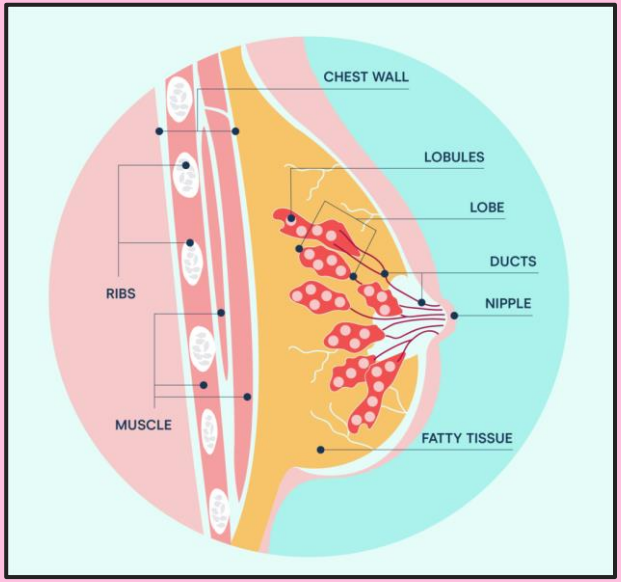
Library, P.-I. P. (n.d.). *Breast cancer CT scan - stock image - C014/6256*. Science Photo Library. https://www.sciencephoto.com/media/481471/view/breast-cancer-ct-scan

Breast MRI

Mayo Foundation for Medical Education and Research. (2023, September 22). *Breast mri*. Mayo Clinic. https://www.mayoclinic.org/tests-procedures/breast-mri/about/pac-20384809

Breast Anatomy

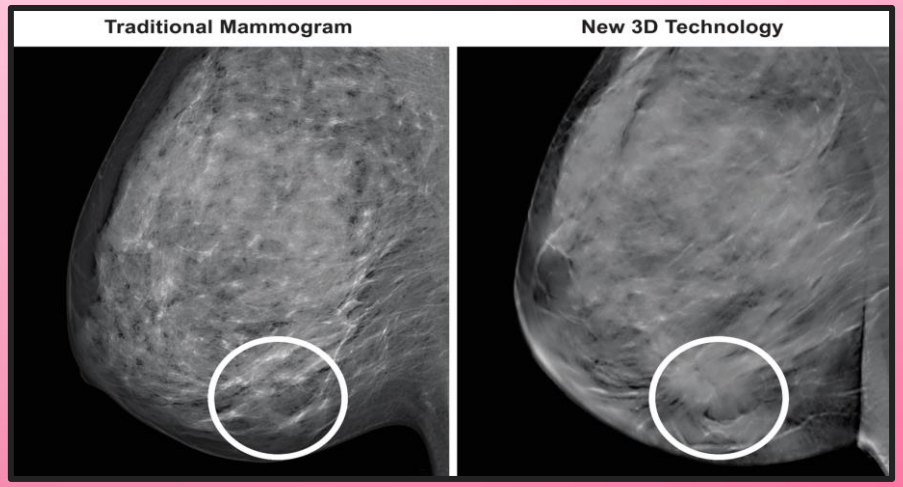
- The breast consists of lobes, lobules, bulbs, areola, nipple, adipose, and lymph nodes.
- The breast contains around 20-30 axillary lymph nodes which can often be used as a sign of cancer when they become enlarged or dense.
- The terminating duct is a common spot for breast cancer that can be seen on imaging.
- The nipple is used in most imaging for alignment and positioning due to its central location.



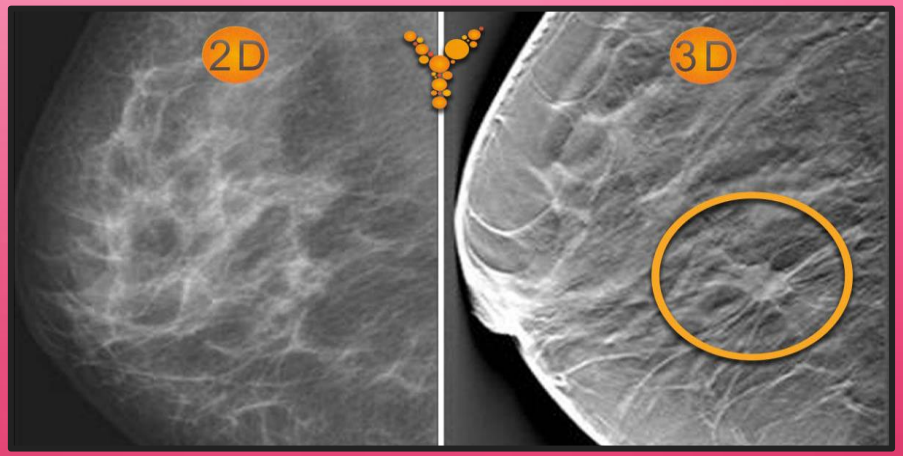
"BREAST CANCER ANATOMY and HOW BREAST CANCER STARTS." *National Breast Cancer Foundation*, 2024, nbcf.org.au/about-breast-cancer/diagnosis/breast-cancer-anatomy/.

Mammography

- The mammogram uses low energy x-rays to penetrate the breast tissue to detect calcifications, masses, cysts, and mammary lymph nodes where cancer cells can hide.
- Mammography is the most common, and well known modality used for breast imaging, which is encouraged in women at the age of forty. The breasts are compressed for about 20-30 seconds in order to spread and flatten the tissue to get a clear view and reduce the amount of radiation needed to make an image.
- These images are important because they are “capable of detecting breast cancer cells up to three years before it can be physically felt” (CDC, p.6).



“3D Mammography (TM).” *The Breast Center a MANA Clinic*, 2024, mana.md/clinics/the-breast-center/3d-mammography/.

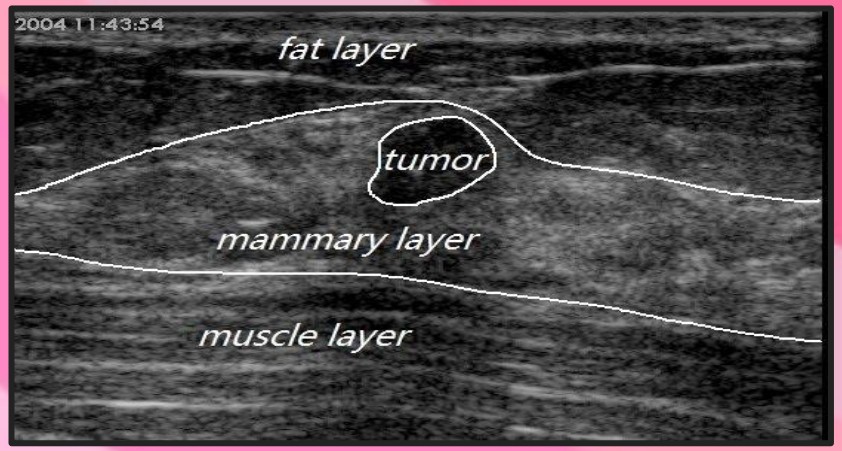


“3D Mammography or Tomosynthesis.” *ΥΓΕΙΑ ΙΑΤΡΙΚΗ Ανώνυμη* , ygeia-iatriki-apeikonisi.gr/en/examination/3d-mammography-tomosynthesis/. Accessed 2024.

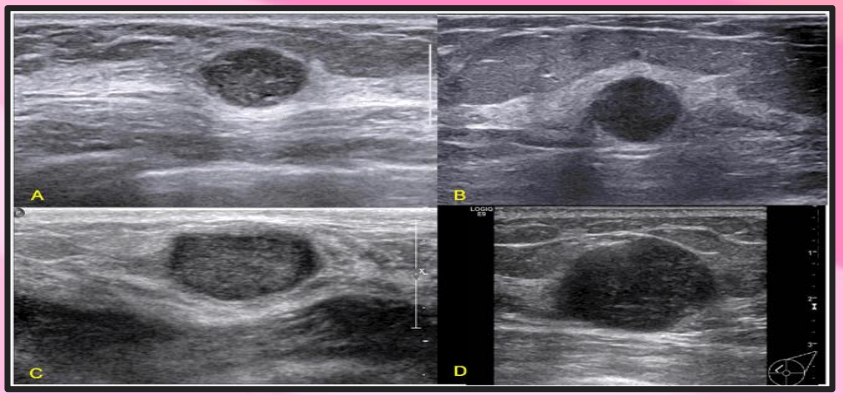
Breast Ultrasound

- Ultrasound works hand in hand with mammography to image and screen the breast for cancerous masses. After a mammogram is performed, if the radiologist detects any suspicious spots on the image, they will send the patient to undergo an ultrasound right away. The sonographer uses a small hand-held probe which “directs high-frequency sound waves at the internal body structures being examined. The reflected sounds, or echoes, are recorded to create an image that can be seen on a monitor”. (Better Health Channel, p.1).

- Ultrasound is able to detect a lump found by the radiologist and determine if the lump is fluid filled or if it has a solid density. Typically if it is a fluid filled cyst this means it is most likely not cancerous, and the patient is negative.



“A Saliency Model for Automated Tumor Detection in Breast Ultrasound Images.” *Research Gate*, www.researchgate.net/publication/277954546_A_Saliency_model_for_automated_tumor_detection_in_breast_ultrasound_images. Accessed 2024.

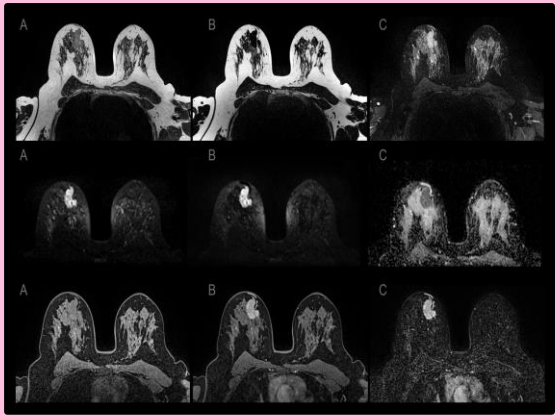


“Triple-Negative Invasive Breast Carcinoma: The Association between the Sonographic Appearances with Clinicopathological Feature.” *Scientific Reports*, www.nature.com/articles/s41598-018-27222-6. Accessed 2024.

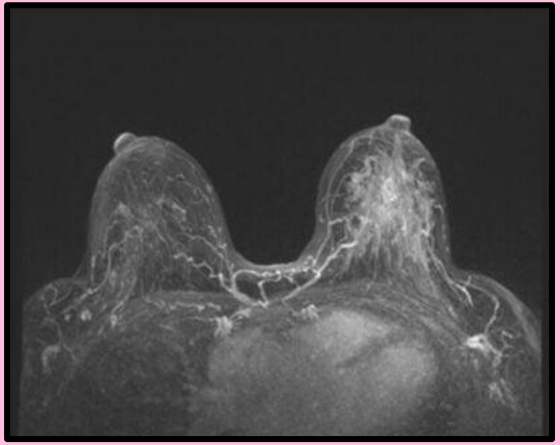
Breast MRI

- Magnetic resonance imaging (MRI) is a technique used to form pictures of the anatomy and physiological processes of the body. This non-invasive procedure does not use ionizing radiation and takes approximately 30-60 minutes when imaging the breast.

- The procedure uses a strong magnetic field to detect breast cancer by taking pictures of the inside of the breast and is the best option for women with significant genetic risk factors. Patients are injected with a dye called gadolinium through a vein to aid the radiologist in identifying the mass.



Womens imaging. Health Imaging. (n.d.). https://healthimaging.com/topics/medical-imaging/womens-imaging



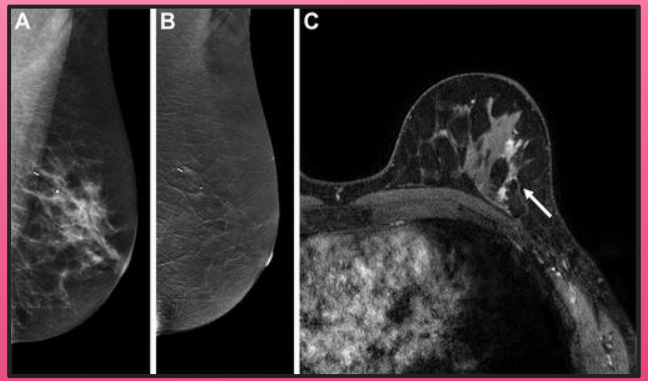
Novellino, W. (2023, July 26). Breast MRI for Cancer Risk: Benefits & types of screenings. MagView. https://magview.com/blog/breast-mri-high-risk-patients/

Breast MRI Continued...

- Breast MRIs are completed in tandem with mammograms and most often after a biopsy shows cancer. The image will show the extent of the cancer, if the second breast has an issue, or if there is a possible leak or tear of a breast implant. “Studies show that breast MRI is better than the other imaging methods in identifying residual tumors” (Iacob et al., n.d.).

- “MRI is much more sensitive than mammography. It can find invasive breast cancers sooner than mammograms, and it can rule out abnormalities that appear suspicious on a mammogram. Unfortunately, MRI is much too expensive for routine screening" (Breast Cancer Org, 2018).

“Breast MRI Parsippany, NJ.” *Memorial Radiology Associates*, www.memradiology.com/womens-health/breast-mri/. Accessed 2024.



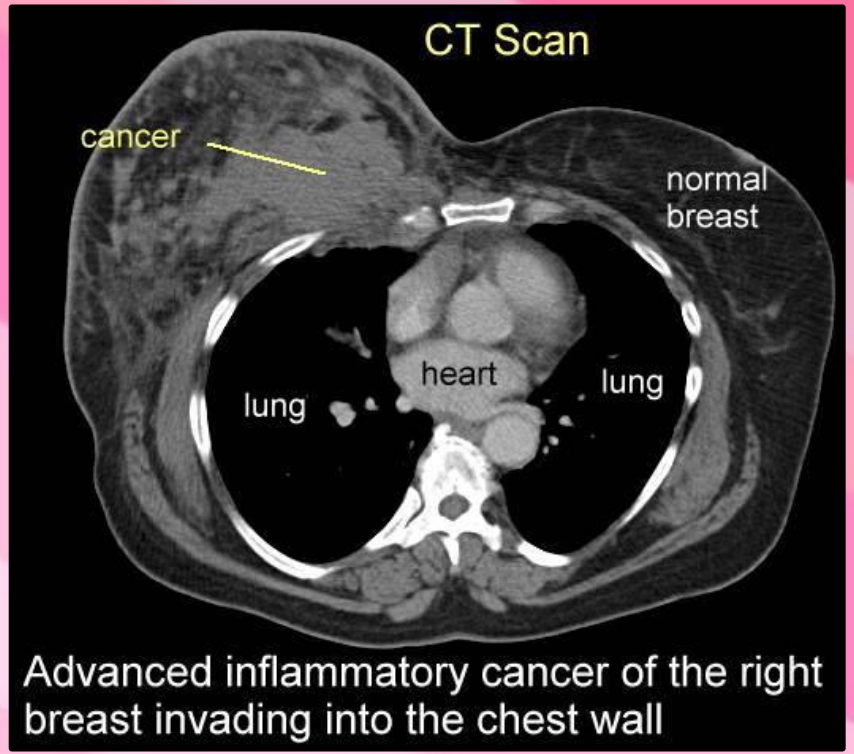
“Comparative Performance of Contrast-Enhanced Mammography, Abbreviated Breast MRI, and Standard Breast MRI for Breast Cancer Screening.” *RSNA Radiology*, pubs.rsna.org/doi/abs/10.1148/radiol.2305767?journalCode=radiology. Accessed 2024.

Breast CT

- Often a doctor may order a breast CT if the patient is claustrophobic and cannot undergo MRI imaging, allergic to gadolinium dye, has compromised renal function, or has a metal implant.

- During the outpatient breast CT scan, the patient lies face down on a table while the CT scanner rotates around the breast. The CT scan is different from an x-ray because it creates a series of clearer images taken from different angles.

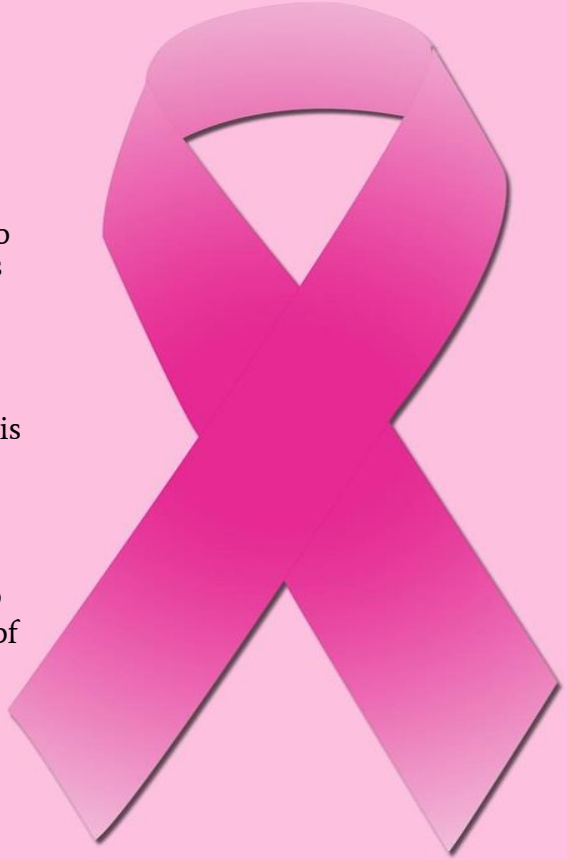
- The scan can show the radiologist the location of the tumor and the size and whether the cancer has spread to other parts of the body including the chest wall. This helps to determine whether a mastectomy may be an effective treatment option.

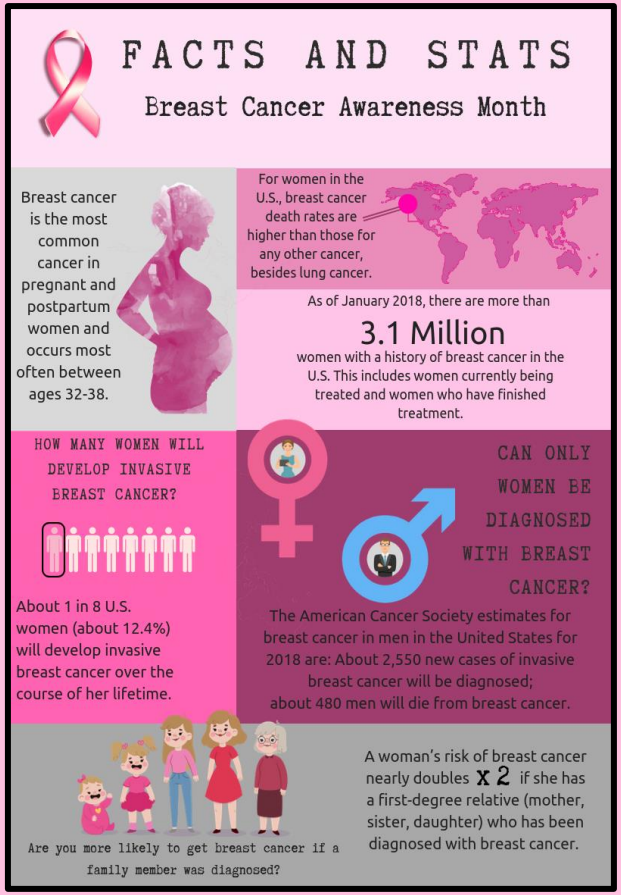


Breast cancer imaging. (n.d.). https://www.aboutcancer.com/breast_cancer_imaging_misc.htm

Why get Breast Imaging done?

- The advantage of using these modalities is to detect masses and tumors, reduce the risk of having to undergo chemotherapy, and allows women to know the health of their breasts.
- These relatively non-invasive procedures can also show metastasis and help medical providers determine the best course of treatment.
- Checking for breast cancer prior to experiencing signs and symptoms of the disease may mean life or death. Although screenings can't prevent breast cancer, it can help to detect cancer early, when it is easier to treat.





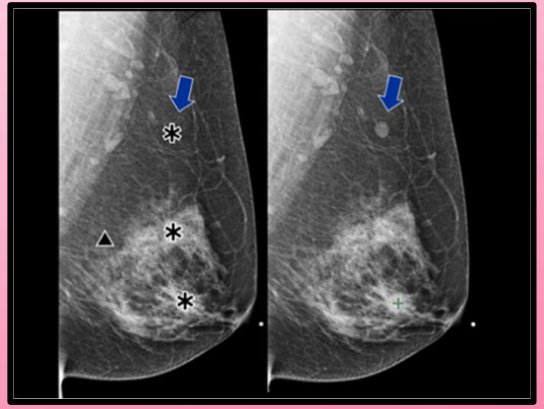
Breast cancer awareness. UNCAS Health District. (2023, November 20). https://uncashd.org/breast-cancer-awareness/

Risks to Breast Imaging

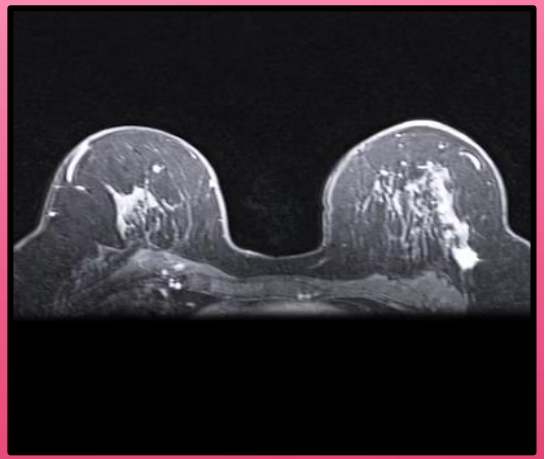
- The most common risk is if the imaging results are a false-positive. This occurs when the test results come back positive but the results are actually negative.

- For example, a breast MRI is very sensitive, detecting even the smallest cancerous changes, but may pick up other changes in the breast that are not cancerous, producing a false-positive result.

- Radiation caused by imaging
  - Mammogram: 3.0 - 5.0 mGy
  - Breast CT: 4.0 - 12.4 mGy



Mayo, R. C., Kent, D., Sen, L. C., Kapoor, M., Leung, J. W. T., & Watanabe, A. T. (2019, April 8). *Reduction of false-positive markings on mammograms: A retrospective comparison study using an artificial intelligence-based CAD - Journal of Imaging Informatics in Medicine*. SpringerLink. https://link.springer.com/article/10.1007/s10278-018-0168-6

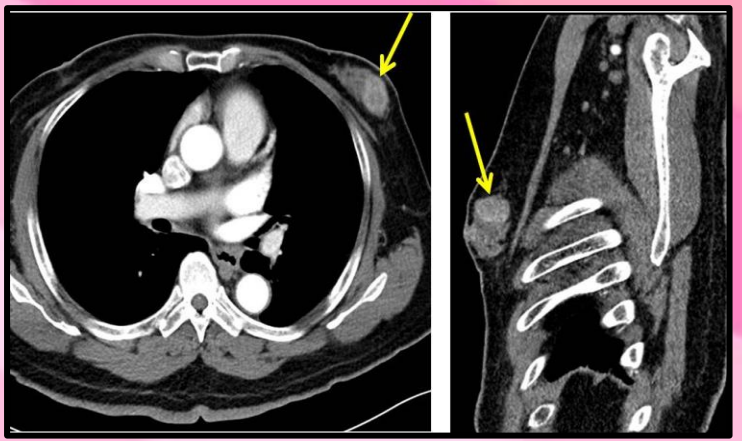


Yee, K. M. (2020, May 20). *Breast MRI's better cancer detection outweighs false-positive "harm."* AuntMinnie. https://www.auntminnie.com/clinical-news/mri/article/15625077/breast-mris-better-cancer-detection-outweighs-false-positive-harm

Breast Cancer in Men?

- Although it is rare, men can also get breast cancer, with the most common being invasive ductal carcinoma.
- “About 1 out of every 100 breast cancers diagnosed in the United States is found in a man” (CDC, n.d.).
- The treatment for both men and women are similar and depends on the size of the tumor and if there is metastasis. “Treatment may include surgery, chemotherapy, radiation therapy, hormone therapy, and targeted therapy” (CDC, n.d.).
- It is equally important for men to get screened for breast cancer especially if they have a history of cancer in their family.

Pathology of the male breast. The Radiology Assistant : Pathology of the Male Breast. (n.d.). https://radiologyassistant.nl/breast/male-breast/pathology-of-the-male-breast

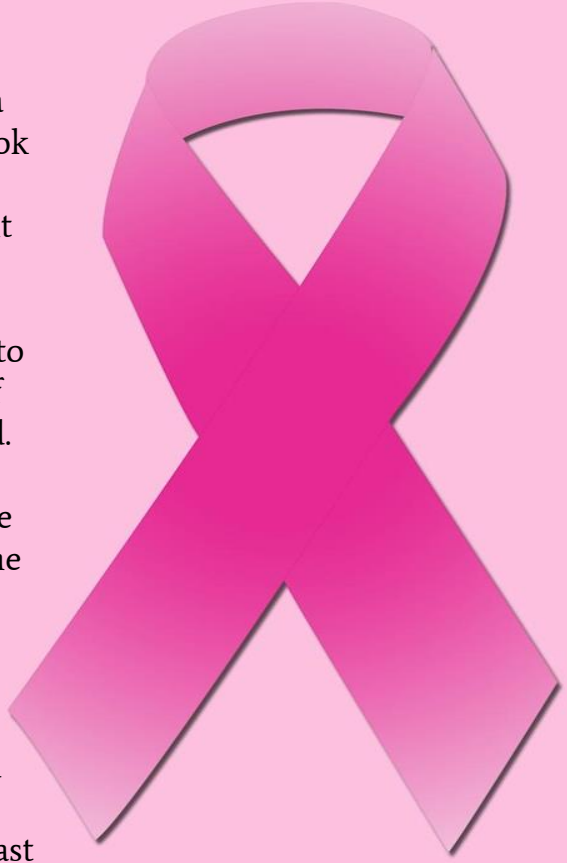


Radhianahassan. (n.d.). *Male breast carcinoma*. Radiology Cases. https://radiologycases.my/2020/07/08/male-breast-carcinoma/

Conclusion

- Healthcare providers recommend a mammogram as the first scan to look at suspicious areas, diagnose, determine how far the cancer might have spread, and if the treatment is working. Ultrasound is then used hand in hand with a mammogram to determine suspicious lobules and if these masses are fluid filled or solid. MRI, and CT scans are then collectively used in order to provide clearer imaging to further determine the best treatment option.

- This modern technology will help detect breast cancer early, when treatment may be less invasive, and hopefully decrease the number of women and men who die from breast cancer.



Handle with love by lottiefiles. LottieFiles. (n.d.). https://lottiefiles.com/animations/handle-with-love-Oof7UNtAJ1

References

Breast anatomy. UCLA Health. (n.d.).

https://www.uclahealth.org/departments/radiology/education/breast-imaging-teaching-resources/screening-mammogram/breast-anatomy

Breast Cancer & Lymph Node status. Susan G. Komen®. (2023, September 19). https://www.komen.org/breast-cancer/diagnosis/factors-that-affect-prognosis/lymph-node-status/#:~:text=If%20the%20lymph%20nodes%20feel,lymph%20nodes%20under%20a%20microscope.

Breast cancer statistics: How common is breast cancer?. Breast Cancer Statistics | How Common Is Breast Cancer? | American Cancer Society. (n.d.). https://www.cancer.org/cancer/types/breast-cancer/about/how-common-is-breast-cancer.html#:~:text=Overall%2C%20the%20average%20risk%20of,will%20never%20have%20the%20disease

Breast Ultrasound. Johns Hopkins Medicine. (2021, August 8). https://www.hopkinsmedicine.org/health/treatment-tests-and-therapies/breast-ultrasound#:~:text=A%20breast%20ultrasound%20is%20most,to%20screen%20for%20breast%20cancer.

Iacob R, Manolescu DL, Stoicescu ER, Fabian A, Malita D, Oancea C. Breast Cancer-How Can

Imaging Help? Healthcare (Basel). 2022 Jun 22;10(7):1159. doi:

10.3390/healthcare10071159. PMID: 35885686; PMCID: PMC9323053.

Centers for Disease Control and Prevention. (2023b, July 25). What is a mammogram?. Centers for Disease Control and Prevention. https://www.cdc.gov/cancer/breast/basic_info/mammograms.htm#:~:text=A%20mammogram%20is%20an%20X,before%20it%20can%20be%20felt.

Centers for Disease Control and Prevention. (2023c, July 25). What is breast cancer screening?. Centers for Disease Control and Prevention. https://www.cdc.gov/cancer/breast/basic_info/screening.htm

Department of Health & Human Services. (2002, April 10). Ultrasound scan. Better Health Channel. https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/ultrasound-scan

Mayo Foundation for Medical Education and Research. (2023, September 22). Breast MRI. Mayo Clinic. https://www.mayoclinic.org/tests-procedures/breast-mri/about/pac-20384809

Richards, T., Hunt, A., Courtney, S., & Umeh, H. (2007, March). Nipple discharge: A sign of breast cancer?. Annals of the Royal College of Surgeons of England. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1964556/

Types of Breast Imaging . Stanford Health Care (SHC) - Stanford Medical Center. (2017, September 12).

https://stanfordhealthcare.org/medical-tests/b/breast-imaging/types.html#:~:text=For%20women%20and%20men%20with,detailed%20pictures%20of%20the%20breast.