Ultrasound in Breast diseases a vital modality

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Epidemiology of breast cancer

- Leading cause of death after lung cancer
- 210,000 new cases of breast cancer/year
- 35,000 new cases of DCIS/year
- 40,000 deaths due to breast cancer/year
- 1,500 of male breast cancers/year
Epidemiology

- Life time risk in a female is 14% (1 in every 7)
- 2-8 new cancer per 1,000 mammogram
Anatomy of Breast

- Breast is a modified sweat gland along the mammary ridge
- Mammary ridge extends from base of forearm bud to the medial end of the hind arm bud
- Majority of the mammary ridge disappears. Breast develops from mid third of the upper mammary ridge extending into axilla
- Accessary breast develops along the mammary ridge
Sweat Gland
Mammary ridge

28 Days

Mammary ridge

Remnant of Mammary ridge

6 weeks
Mammary ridge

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Axillary breast
Accessory breast
Accessory nipple
Anatomy

- Primitive ectodermal bud near upper arm
- Epithelial cell form here grow and penetrate dermis
- At birth there is network of ducts around the nipple
- There may be milky discharge from the neonate’s nipple due to maternal hormones
- Lobule and glands mainly develop around puberty
Anatomy

- Thelarche precedes Menarche
- Breast buds enlarge to form palpable disc
- Growth may be asymmetric initially
- With time it becomes symmetric
- In 3% it remains asymmetric
Asymmetric breast bud
Breast cancer in preadolescent

- Very rare
- They are very indolent and less aggressive
- Grow eccentrically
- Biopsy should be performed if the sonographic findings are pathognomonic
- Unnecessary biopsy of breast bud can affect breast development
Breast cancer
Breast Anatomy: Terminal development

- Ductal element elongates, divide and extend deeper into the subcutaneous tissue
- Adipose and connective tissue increases in volume
- Terminal ducts at the variable end of branching form glandular acini
- Stem cells at the terminal duct end are responsible for this change
- This is the site for rapid cell growth and DNA replication and common site for breast cancer
Breast Anatomy

- 7-20 lobes with the duct system
- Ducts converge under areola in a spoke wheel fashion
Most cancer appear at the terminal duct as it enter and along it course with in the lobule

Increase cell proliferation can cause faulty DNA replication or Mutation the root cause for cancer.
Breast development

- Preperty
  - Onset of puberty
  - End of puberty
- Lactation
Axillary lymph nodes
Risk Factors

- **Age**
  - 0.2% of breast cancers before 30 years
  - Incidence start to increase after 35 years
  - PPV of mammogram is 15% at 40 years
  - PPV of mammogram is 50% at 80 years

- **Female sex**
  - >99% of breast cancers in females
Risk factors

- Duration of hormone exposure
  - Increased cell proliferation and DNA alteration
- Early menarche or late menopause
  - 4% increase for every year before 16 years
  - 3% increase for every year after 45 years
Risk Factors: Family History

- First degree relative before menopause: x4
- More than one first degree relative: x6
- First degree relative with bilateral cancer: x9

- 60% of females with cancer have no family history
- Screening to start 10 year earlier than the age of relative at the time of cancer
Risk factors: Genetic susceptibility

BRACA 1: at 17q21
BRACA 2: 13Q
Susceptibility for Breast, Ovary, stomach and Pancreatic cancer
At 40 years: 37%
At 65 years: 55%
Life time risk: 82%
Recent data shows overall risk of 50%
Risk factors: Age at first term pregnancy

- Pregnancy increases the differentiation of terminal bud into TDLU
- Pregnancy at 30 year double the risk of cancer than pregnancy at 18 year
- Pregnancy and lactation suspends ovulation and decreases risk of ovarian cancer
Risk factors: Prior breast cancer

- Risk increases 1% every year up to a maximum of 15%.
- “The Daughter is usually like Mother”
Risk factors: High risk breast lesions

- ADH, ALH, Radial scar and Papillomatosis.
- High risk breast lesions: x 5 times.
- Choices are Lumpectomy/excision biopsy.
- Regular follow up.
No increase risk

- Adenosis
- Cystic changes
- Apocrine metaplasia
- Duct Ectasia
- Squamous metaplasia
- Fibrosis
- Mastitis
- PASH
Risk Factors: Radiation

- Radiation damage the DNA by producing free radicals.
- Exposure of 200 rads double the risk.
- Younger the age of exposure increases the risk.
- Screening should start after 8 years of exposure.
Risk factors: HRT, OCC

- OCC: Low risk if used before first pregnancy
- HRT: x 1.3 to 1.9 times if uses for many years
- CVS and bone health overweighs the risk of breast cancer
- Increases the growth of initiated clones rather than truly increasing the initiation of cancer
Risk factors: Obesity

- Increase risk in postmenopausal females.
- Fat convert androgens into estrogen causing increase proliferation.
Risk Factors: Alcohol consumption

- Alcohol increases the risk x 1.4-1.7 times.
- Alcohol increases the estrogen levels
Risk Factors: Breast Density

- Maximum breast density at 30 years
- 0.1 to 0.2% decrease from 30-45 years.
- 1-2% decrease from 45-65 years
- Plateau after 65 years
- Initial study (Wolfe) estimated a risk of x 37 times than fatty breast: flawed and biased
- Other study (Boyd) found risk of x 3 times
- National screening study of Canada: 9.7%
Breast Density Law

- Breast density notification is currently put into effect in 24 states including Michigan from July
- A breast density notification law requires that physicians notify women who have undergone mammography and were found to have dense breast tissue with increase risk of malignancy
- The intent of such a law was to give women the necessary information to decide on further action if they had dense breast tissue
Breast Ultrasound

- Has been used in breast imaging since 1970’s
- Primary method to differentiate cystic lesion from solid masses
- Can differentiate some benign from malignant masses
- Can detect some cancers occult on clinical and mammographic evaluations
- Not clear whether breast ultrasound screening saves life
Limitations

- Operator dependent: The technique should be reproducible.
- High false positive rates, normal tissue variability could mimic cancer.
- Cooper’s ligament can produce acoustic shadowing.
- A solid lesion could look cystic and vice versa based on settings.
Technical details

- Linear array with center frequency of 10 mhz
- Field should include the whole breast and pectoral muscle
- Focal zone at the center of lesion
- Do not zoom or minify the lesion
- Measure lesion in long axis, perpendicular to long axis orthogonal to long axis
- Include distance from the nipple
Take home points

- Cystic mass overlying the axilla is malignant unless proven otherwise
- Ovoid or kidney shaped mass in the medial aspect of breast can not be a lymph node unless proven on pathology
- Always see for flow in a cystic mass in elderly, cyst are uncommon in elderly
- Any cystic mass growing overtime in elderly should raise red flag
- Predominantly cystic mass with fuzzy walls
BI-RADS ASSESSMENT

- **Classification**
  - The latest version classifies lesions into six categories:
    - **BIRADS 0**: incomplete, further imaging or information is required, e.g. compression, magnification, special mammographic views, ultrasound. This is also used when requesting previous images not available at the time of reading
    - **BIRADS 1**: negative, symmetrical and no masses, architectural disturbances or suspicious calcifications present
    - **BIRADS II**: benign findings, interpreter may wish to describe a benign-appearing finding, e.g.
      - calcified fibroadenomas
      - multiple secretory calcifications
      - fat containing lesions such as
        - oil cysts
        - breast lipomas
        - fibroadenolipoma or mixed density hamartomas
        - galactoceles
      - simple breast cysts
BI-RADS ASSESSMENT

- **BIRADS III**: probably benign, short interval follow-up suggested. The accent is on the word benign
- **BIRADS IV**: suspicious abnormality
  - there is a mammographic appearance which is suspicious for malignancy
  - biopsy should be considered for such a lesion
  - these can be further divided as
    - **BIRADS IVa**: low level of suspicion for malignancy
    - **BIRADS IVb**: intermediate suspicion for malignancy
    - **BIRADS IVc**: moderate suspicion for malignancy
- **BIRADS V**: there is a mammographic appearance which is highly suggestive of malignancy, action should be taken
- **BIRADS VI**: known biopsy proven malignancy
Characteristics for high probability of benign mass

- Ovoid
- Sharply marginated
- Well circumscribed
- Homogenous
- Wider than tall
- Through transmission
- Markedly hyperechoic
Specificity

- Well circumscribed and marginated: 10% malignant.
- Wider than tall: 30% could be malignant.
- Through transmission: 36% could be malignant.
Examples of Benign masses: Breast cyst
Physiology of breast cyst with adenosis
Be Careful
Solid mass with cystic appearance
PALP
Lt Breast 3:00
R/A Anti-Radial
Galactocele
Breast abscess
Breast abscess with doppler
Phylloides tumor
Phyllloides tumor
High probability for Malignancy

- Irregular mass
- Spiculated or angular margins
- Marked hypo-echogenicity
- Taller than wide
- Presence of calcification
- Duct extension
Malignant masses
Breast Carcinoma with Doppler
Breast Carcinoma
Breast Implant
Breast Ultrasound
Snow storm appearance
Role of ultrasound in Breast implant
Ultrasound staging of the Breast CA: Features of benign lymph nodes

1. Kidney shaped
2. Less than 1 cm in short axis
3. Smooth rim like cortex less than 3 mm
4. Fatty hilum
5. Hilar flow
Features of malignancy

- Cortical thickness
- Cortical bulging
- Round shape
- Loss of fatty hilum
- Loss of hilar flow
Benign lymph node on US
Normal hilar flow
Metastatic node
Metastatic node
Ultrasound guided needle localization
BNL with USG
BNL with USG
Role of USG

- Secondary screening process
- Further characterization of mammographic or MR findings
- Diagnostic for implant rupture
- Diagnostic for cyst vs solid mass
- Benign vs malignant masses
- Follow up for probably benign masses
- First line for palpable masses under 30 years
- Follow up for assessment of treatment response in benign or malignant etiologies.
Role of USG

- Therapeutic aspiration of symptomatic cysts
- Therapeutic aspiration of breast abscess
- Ultrasound guided wire localization
- Ultrasound guided biopsies
- Ultrasound guided placement of fiducial markers for radiation
Case 1: Mass in the inferomedial left breast
Spots
CAD
USG
Case 2: 42 F with palpable findings
Mondor’s Disease
Case 3: Small mass at Rt 3’o clock
Intraductal papilloma
Specimen Radiograph
Case 4: 54 F with mass at left 2’o clock position
Invasive ductal carcinoma
Case: 5  50y male with palpable findings
Lipoma
Case 6: 45 year old with palpable at left 12’oclock
LEFT BREAST
AREA OF PALP
2-3:00
4-8 CMNP
RADIAL
Benign Fat Necrosis
Last piece of puzzle
History

- 50 year old female presented with palpable findings in the right breast at 10 o'clock position. Strong family history of breast cancer
Case 1: 50y female with palpable mass at right 10 o'clock position
Invasive lobular carcinoma
Case 2: Presented with right nipple discharge
Needle LOC
Case: 3

- 35 year old female with strong family history of breast cancer, presented with palpable findings in both breasts. Personal history of lymphoma post radiation to left chest wall 15 years ago, now in remission. Patient is currently breast feeding.
LT BREAST
AREA OF PALP
9:30-11:30
9CMNP
ANTIRADIAL

PT IS BREAST FEEDING

9fps 3.5cm
Thank you