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REAL TIME STRAIN ELASTOGRAPHY OF BREAST: PICTORIAL ESSAY OF OUR INITIAL EXPERIENCE.

Radiodiagnosis

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ABSTRACT

- Ultrasonic elastography (real-time elastography, sonoelastography) is a new ultrasound technique and one of the various imaging modalities in the last few years which are being used for characterizing soft tissue lesions of breast, thyroid, and lymph nodes. Musculoskeletal pathology was one of the early applications of sonoelastography, but the method is not yet standardized. Other new areas of applications include Liver, Prostate, obstetrics and gynaecology. We are presenting a pictorial essay of elastography cases of breast seen in our institution.

KEYWORDS

Elastography, Sonoelastography, Real-Time Tissue Elastography, Elasticity Imaging

Introduction:-Ultrasonic elastography (Sonoelastography) was originally described by Ophir et al which measures tissue deformation as a response to an external force, assuming the fact that deformation is lower in rigid tissues, compared with the elastic, soft tissues. [1] Its principle is based on tissue deformability on the application of the pressure. A tissue or lesion can behave in different ways, when external pressure is applied on it. Soft tissues will deform much more when pressure is applied and hard tissues will deform less. This information is represented on the monitor as a spectrum of colour scale: blue represents hard areas, red representing soft areas and green representing firm areas with intermediate consistency/stiffness. The tissue contrast seen on sonoelastography is due to difference in tissue stiffness. [2] Mainly two types of elastography techniques are used in clinical practice today strain elastography and other one is shear wave elastography.

Itoh et al introduced Tsukuba scoring method for strain pattern scoring of breast masses. According to this system, score 1 refers to completely green colour-coded masses that have a soft and loose structure. Score 2 is given to those masses coded in blue and green mosaic and emphasizes heterogeneously distributed soft -rigid internal structure. Score 3 masses have blue in the centre and green in the periphery indicating that the mass is harder in its central part and softer on the outside. Score 4 masses are completely blue that shows the whole structure is hard and tight. A score of 5 means to blue encoding of an area that is larger than the size of the mass, covering the mass and its surrounding tissue, caused by desmoplastic reaction. In addition, cystic lesions show a specific "BGR" pattern of blue, green and red colour coding. Score 1 and 2 are considered benign, score 3 indicates indeterminate origin while score4 and 5 are mostly malignant[3]

Elastography in Breast Pathology:-

A: - Benign breast masses

Fibroadenoma: - Fibroadenoma is seen on USG as well encapsulated wider than taller homogenous lesion showing predominantly green colour on elastography (score 1) or mainly green with mosaic blue colour (score 2) and low strain ratio measurement. (Figure 1).

Fibroadenosis: - is seen on USG as thickend heterogenous breast parenchyma showing mainly red and green (soft colours) on elastography scale. (Figure 2).

Simple breast cysts: - are seen on USG as anechoic lesions with posterior acoustic enhancement and clear fluid.On elastography typical BGR appearance is seen. (Figure 3)

Galactocoele: - is seen in postpartum patients as complex cystic mass with internal fluid levels, debris and classical BGR appearance on elastography (Figure 4)

Ductal ectasia: - is seen on USG as multiple dilated intramammary ducts containing particulate debris material within and showing BGR appearance on elastography (Figure 5).

Mastitis: - is seen on USG as heterogenous mass like lesion with increased vascularity on doppler.On elastography central soft colours are seen with peripheral stiff tissue on elastography. (Figure 6)

Granolomatous mastitis: - is seen on USG as hypoechoic hard breast mass with internal debris without increased vascularity on Doppler and BGR appearance on elastography with reactive axillary lymphadenopathy. (Figure 7). Diagnosis confirmed on pathological examination.

Nodular gynaecomastia:- is seen in a young male patient as a retro-areolar soft tissue mass which is hypoechoic on USG and shows soft colours on elastographic scale (red and green) (Figure 8).

Lipoma of the chest wall: - is seen as well-defined encapsulated hyperechoic subcutaneous lesion, showing predominantly soft colours on elastography scale with low strain ratio.Confirrmed on mammography. (Figure 9a and b).

Axillary lipoma: - is seen as well-defined hyperechoic lesion with multiple hypoechoic areas within. On elastography, stiff tissue areas are seen the region of fat necrosis while normal fat show soft colours. (Figure 10)

Fibroadenolipoma of breast: - appears on USG as encapsulated wider than taller compressible mass with fat within the lesion, showing soft colours on elastographic scale and low strain ratio. (Figure 11).

Fibrosis of breast tissue: - can occur at the site of previous surgery which is seen predominantly as stiff tissue (blue colour on elastography) (Figure 12).

Intraductal Papilloma: - is seen as soft tissue mass in dilated duct showing soft colours on elastography. (red and green) (Figure 13)

B:-Malignant breast masses

Carcinoma breast: - Seen on USG as spiculated hypoechoic taller than wider masses with calcification showing predominantly blue

colour on elastography scale (Score of 4 and 5 on elastography scale) and high strain ratio (Figure 14).

Elasticity imaging/B mode ratio: - of greater than 1 is seen in these lesions due to desmoplastic reaction. (Figure 15).

Breast carcinomas undergoing cystic degeneration are seen showing blue colour in the peripheral solid portion of the neoplasm and centrally red and green colour in cystic areas. (Figure 16).

Male breast carcinoma is also seen as spiculated hypoechoic retroareolar mass showing stiff tissue. i.e. blue on elastography scale with high strain ratio. (Figure 17)

Axillary Lymph node metastasis: - in case of carcinoma breast is seen on USG as eccentric cortical thickening, hypoechogenicity, loss of fatty hilum, rounded shape of lymph node and cortex to hilar ratio greater than 2. On elastography, high strain ratio and stiff colour (blue) is identified. The cortex which is usually of soft colours (green) is seen replaced by the stiff tissue (blue colour). (Figure 18, 19) [4-12]

Metastasis to liver: - is seen on USG as multiple nodules scattered in liver parenchyma which appear stiff in colour (blue) (Figure 20).

Metastatic subcutaneous nodules: - can also be seen which appear on elastography as stiff nodules of blue colour in subcutaneous plane of breast tissue (Figure 21).

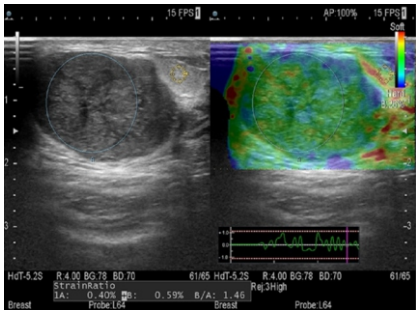

FIG 1] A well defined encapsulated wider than taller homogenous breast lesion showing mostly green (soft tissue) and mosaic blue color on elastography with strain ratio of 1.46 and score of 2 on elastography scale suggestive of Fibroadenoma.

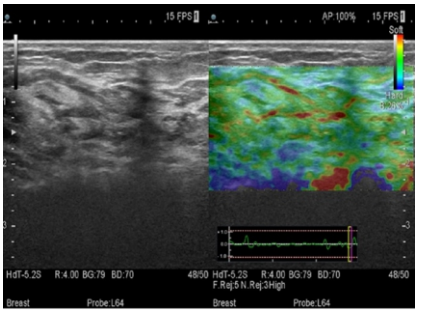

FIG 2] USG breast shows thickened heterogenous breast parenchyma with prominent fibrous tissue and elastography showing predominantly soft (red & green) tissue in breast s/o Fibroadenosis.

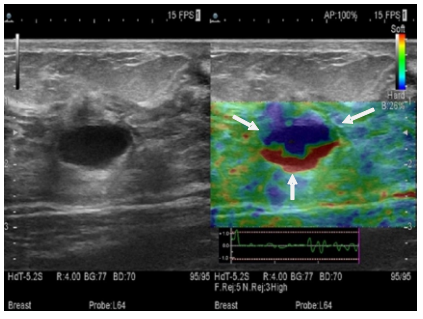

FIG 3] A clear cystic lesion with posterior acoustic enhancement in breast showing BGR (Blue-Green-Red) appearance on elastography in a case of simple cyst of breast.

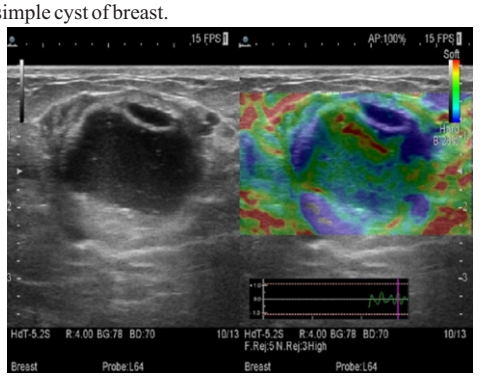

FIG 4] A complex cystic mass seen in breast with internal echoes and layering of debris in a lactating woman. On elastography BGR (Blue-Green-Red) appearance is seen suggesting a Galactocoele confirmed on pathology.

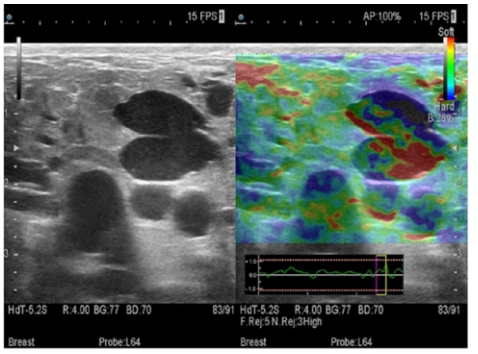

FIG 5] Dilated mammary ducts seen in breast and particulate material within. On elastography BGR appearance of cystic lesion seen suggestive of ductal ectasia in breast tissue in a patient presenting with breast discharge.

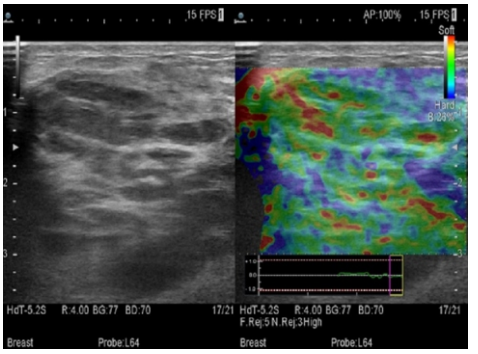

FIG 6] Patient with severe breast tenderness and fever USG breast showing diffusely heterogenous mass lesion. Inflammed breast tissue, increased vascularity on Doppler and mostly red, green color identified centrally and stiff tissue peripherally on elastography scale suggestive of Mastitis.

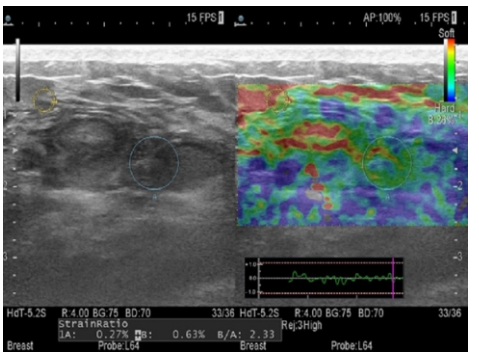

FIG 7] Patient presented with a hard lump in right breast without acute signs of inflammation. On USG multiple hypoechoic lesions with internal echoes and debris were seen with reactive axillary lymphadenopathy. On elastography scale soft colours were seen centrally with peripheral stiff tissue. Diagnosis of infective lesion was considered. Granolomatous mastitis was confirmed on FNAC.

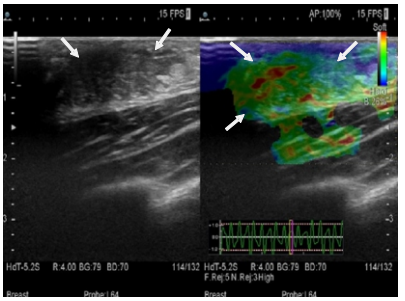

FIG 8] Hypoechoic retro-areolar lesion in a male patient suggestive of nodular type of gynaecomastia. On elastography soft tissue (red and green) seen indicating a benign process

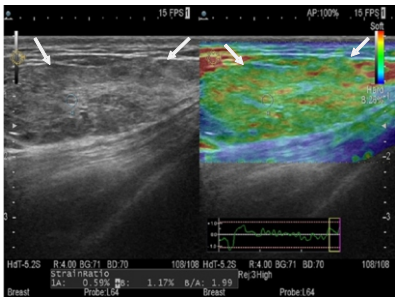

FIG 9a] USG shows a well encapsulated hyperechoic mass with internal hyperechoic strands in inner upper quadrant of right breast in subcutaneous plane s/o lipoma. Elastography confirms soft tissue within (red and green).Strain ratio was 1.99 indicating a benign lesion.

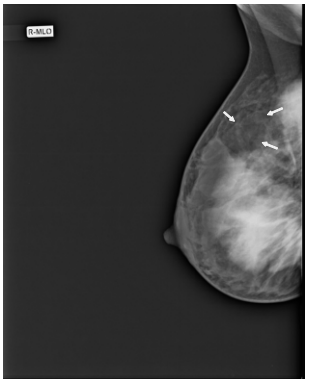

FIG 9b] Mammography confirms a lucent lesion in breast in subcutaneous plane.

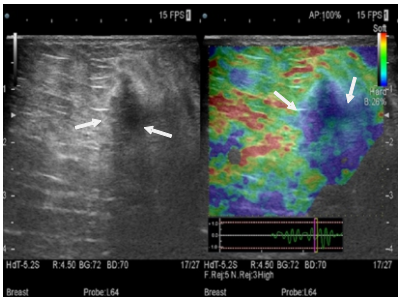

FIG 10] Patient presented with a large right axillary mass. On USG a large lipoma was identified with multiple hypoechoic areas of fat necrosis. Elastography revealed mostly stiff areas in the region of fat necrosis (blue) while normal fat was soft (red and green) on elastography scale.

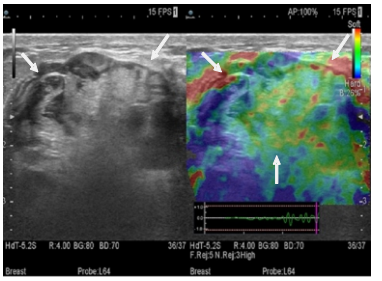

FIG 11] USG shows a heterogenous encapsulated wider than taller compressible mass in right breast with evidence of hyperechoic fat within mass indicating fibroadenolipoma (hamartoma) which is soft(red and green) on elastography color scale.

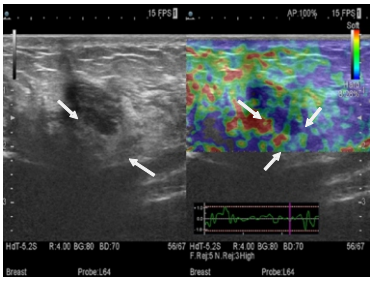

FIG12] A palpable hypoechoic lesion seen in breast at the site of previous surgery indicated fibrous tissue seen as mostly stiff tissue (blue) on elastogram.

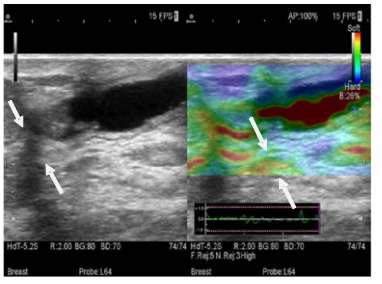

FIG 13] USG shows a dilated mammary duct with soft tissue lesion within in a patient presented with nipple discharge. On elastography soft colours were seen in the lesion indicating possibility of intraductal papilloma confirmed later on. Dilated duct showing BGR pattern on elastography.

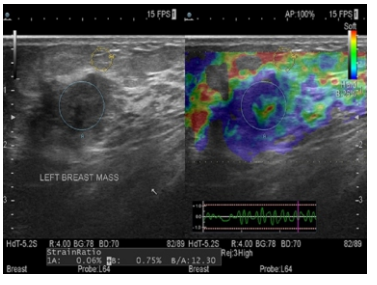

FIG 14] Spiculated hypoechoic mass in left breast showing strain ratio of 12.30 indicating possible malignancy. On elastographic color scale it is showing mostly stiff tissue with blue color. Biopsy report was ductal carcinoma.

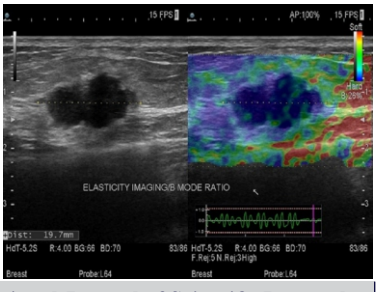

FIG 15] Carcinoma breast with Elasticity imaging/B mode ratio of 1.2 indicating a high grade of malignancy

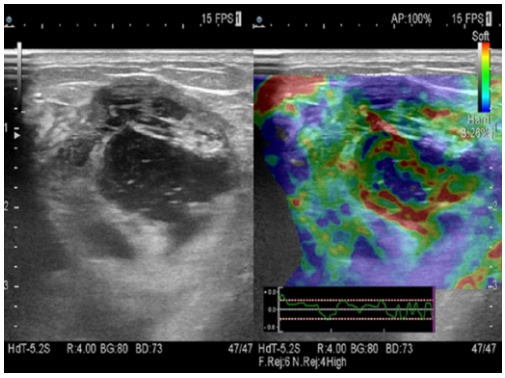

FIG16] A complex cystic breast mass showing thick internal septa and stiff tissue in peripheral part (Blue of elastography) and soft colours in central necrotic part. FNAC indicated infiltrating intraductal carcinoma.

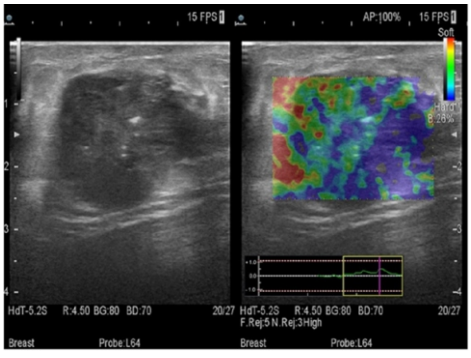

FIG17] Male breast cancer seen as spiculated hypoechoic mass with internal calcification and stiff tissue on elastography(blue) and strain ratio of 15.17 indicating malignancy.

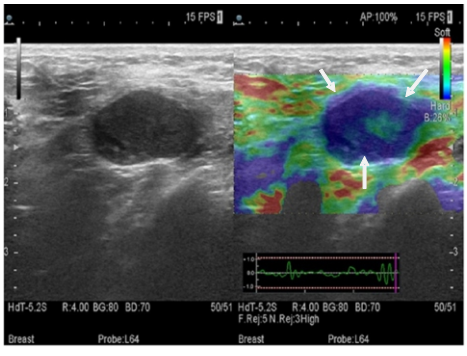

FIG 18] Case of ductal carcinoma breast showing type 6 [Bedi classification] lymph node i.e. hypoechoic without fatty hilum showing almost entire stiff (blue) color on elastography suggestive of its metastatic nature. Central green colour indicates necrosis. Here L/T ratio (Longitudinal/transverse diameter ratio) is 1.7 due to roundish shape of lymph node.

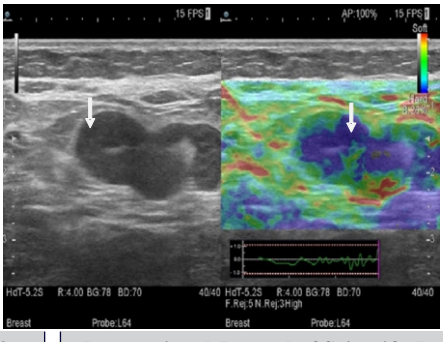

FIG 19] Metastatic lymph node showing cortical deposits. There is eccentric cortical thickening and replacement of green cortical tissue by blue (stiff) tissue indicating metastasis on sonoelastography.

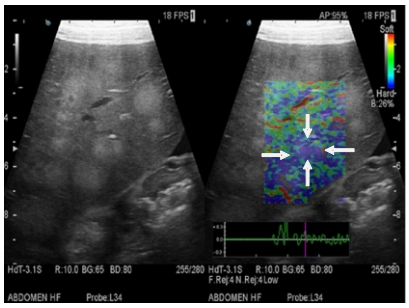

FIG 20] Known patient of breast cancer showing liver metastasis as stiff (blue) color in metastasis. Normal liver is soft on elastography with green and red color on elastography scale.

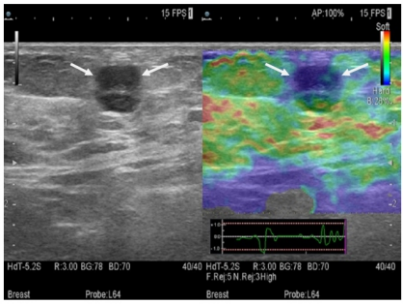

FIG 21] Carcinoma breast case showing subcutaneous nodule in axilla s/o of metastatic deposit showing stiff tissue (blue). Multiple metastatic axillary lymph nodes were also present in this case.

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