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Original research



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Is there a correlation between the severity of Idiopathic Granulomatous Mastitis and pre-treatment Shear-Wave Elastography Findings? Original research

AIM: The aim of this study was to analyze the correlation between the severity of idiopathic Granulomatous Mastitis (IGM) and the pre-treatment Shear-Wave Elastography (SWE) findings.

MATERIAL AND METHODS: A total of 39 patients diagnosed with granulomatous mastitis were included in the study between the dates of December 2014 and February 2017. The patients were divided into two groups. Group 1 was treated using a conservative protocol and steroids. Group 2 was treated surgically. Pre-treatment SWE findings of both groups were compared.

RESULTS: The mean ages of the patients in group 1 and 2 were 38.44 ± 9.6 and 36.05 ± 7.44 years, respectively. There were not any significant differences between the groups with regard to frequency of BI-RADS categories and Virtual touch tissue imaging (VTI) patterns. The mean Shear-Wave Speed (SWS) were 1.98 ± 1.02 m/sec and 2.82 ± 1.66 m/sec in group 1 and 2 respectively. The difference was not significant ($p \geq 0.05$). The BI-RADS categories and VTI patterns did not show significant difference when the recurrent and non-recurrent patients were compared.

CONCLUSION: There may not be a correlation with the pre-treatment SWE findings and severity of the IGM.

KEY WORDS: Breast, Elasticity Imaging Techniques, Granulomatous mastitis, Ultrasonography

Introduction

Idiopathic granulomatous mastitis (IGM) is chronic, non-caseous, inflammatory breast disease characterized by granuloma and abscess formation and generally affecting young women of reproductive age. It can mimic breast carcinoma both clinically and radiologically¹⁻³. Previously reported mammographic appearances include focal or diffuse asymmetric density, ill-defined mass, multiple masses or being normal^{4,5}.

It doesn't show calcification at mammography. When considering that IGM affects younger population, Ultrasound (US) becomes the initial imaging modality to assess it. US appearances include mass lesions, tubular hypoechoic lesions with or without connecting, indistinctly bordered heterogenous lesions⁴⁻⁶.

Magnetic resonance imaging (MRI) is another modality that provides lesion characterization and assessment of the extension of the disease. MRI findings are peripheral ring shaped enhancing lesions or intensive homogeneously enhancing lesions^{6,7}. Diffusion-weighted MRI showed commonly none-mass like lesions with restricted diffusion⁸.

None of these imaging modalities show specific imaging findings to differentiate IGM from breast carcinoma.

Elastography is a new Ultrasound (US)-based complementary imaging technique that improves diagnostic performance of B-mode US^{9,10}. Currently, there are two

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US elastography techniques; strain elastography (SE) and shear wave elastography (SWE) ¹¹. SE uses manual compression produced by operator pressing the transducer and provides qualitative and semiquantitative analysis of the lesions. SWE is one of the dynamic elastography techniques which use shear waves generated by acoustic radiation force. Acoustic radiation force impulse (ARFI) imaging is a new technique enabling quantitative analysis of tissue elasticity by Virtual Touch Tissue Imaging (VTI, Siemens) and quantitatively by Virtual Touch Tissue Quantification (VTQ, Siemens) without compression. ARFI elastography is more objective than the SE ^{9,12}. Both SE and SWE of IGM were described previously ^{13,14}. They suggested that SE helps showing the benign natures of IGM.

There is not a standard treatment protocol for IGM in the literature. Currently, treatment options for IGM include antibiotic therapy, oral corticosteroid treatment, surgical excision, and abscess drainage. When deciding the optimal treatment modality for the patient, the severity and extend of the disease become important. So far, there has not been a published study assessing the severity of the disease.

In our clinical practice, patients with severe disease or serious abscess were treated with antibiotics followed by surgical treatment to correct the abscess or fistulas. However patients without severe infections or serious abscess were treated with steroid treatment and/or antibiotics.

The aim of this study is to analyze the correlation between the severity of IGM and the pre-treatment SWE findings.

Materials and Methods

PATIENTS

The Baskent University Institutional Review Board (IRB) approved this retrospective study (project number: KA14/304). The IRB waived the need for informed consent. We performed a retrospective search of our tertiary breast cancer center databases for the dates of December 2014 to February 2017 for patients fulfilling the fol-

lowing criteria: (1) histopathologically-confirmed granulomatous mastitis (2) having pre-treatment SWE images. This search identified 41 patients. Of those, one patient having unsatisfactory SWE images and the second patient having lobular carcinoma accompanying the granulomatous mastitis at the surgical resection specimen were excluded from the study. Thus, 39 patients were included in the study.

The presenting symptoms include palpable breast mass, redness and swelling of the breast and/or nipple retraction and a sinus formation.

None of the patients had received any treatment except antibiotic therapy before US-guided core-needle biopsy. All the diagnosis was initially confirmed to be IGM through US-guided core needle biopsy, using a 14-gauge automated needle. At least 4 to 6 samples were taken for each patient. Polymerase chain reaction (PCR) DNA analyses for tuberculosis were negative for all patients. Diagnosis was confirmed by either ultrasound guided core-needle biopsy or surgical specimen. Initially the patients were divided into two groups based on the clinical findings at presentation. When the size of the mass and the ratio of the mass to the breast volume were taking into consideration, patients with focal disease without fistulas or serious abscess were assigned to the group1 (conservative group). Patients presenting with extensive disease, serious abscess or draining fistulas were assigned to the group 2 (surgery group).

All the patients in group 1 (conservative group) were initially treated by a conservative protocol and steroids. 5 patients initially in group 1, did not respond to steroid treatment and surgically treated, and thus these patients were transferred to group 2. All the patients in group 2 were treated surgically. Surgical pathology and core specimens were reviewed by one pathologist with 15 years of experience in breast pathology.

US AND SWE EXAMINATION

The US elastography evaluations were performed using a US system (Acuson S 2000, Siemens Medical Solutions, Mountain View, CA,USA) with a linear transducer that

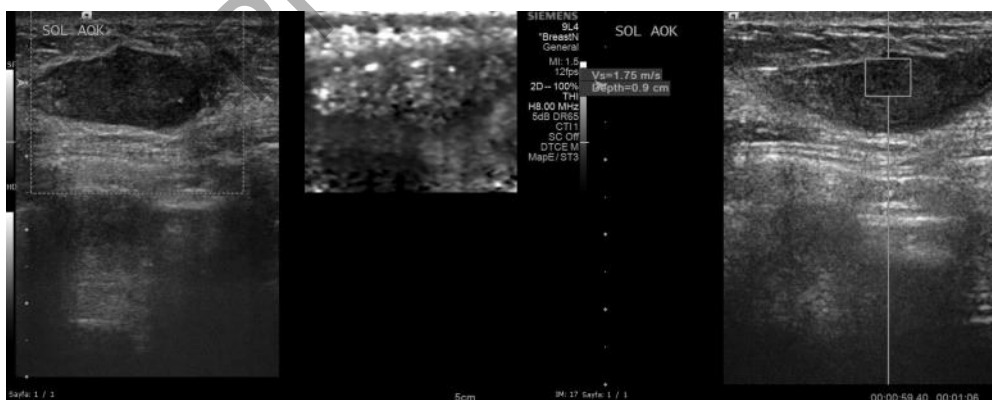


Fig. 1: A 35-year-old patient with granulomatous mastitis in the group 2 (surgery group). B-mode image (left) shows a tubular shaped hypoechoic lesion, and the lesion failed to be visually confirmed on VTI map (middle). The lesion was classified into pattern 1. VTQ (right) image showed that SWS was 1.75 m/s within the lesion.

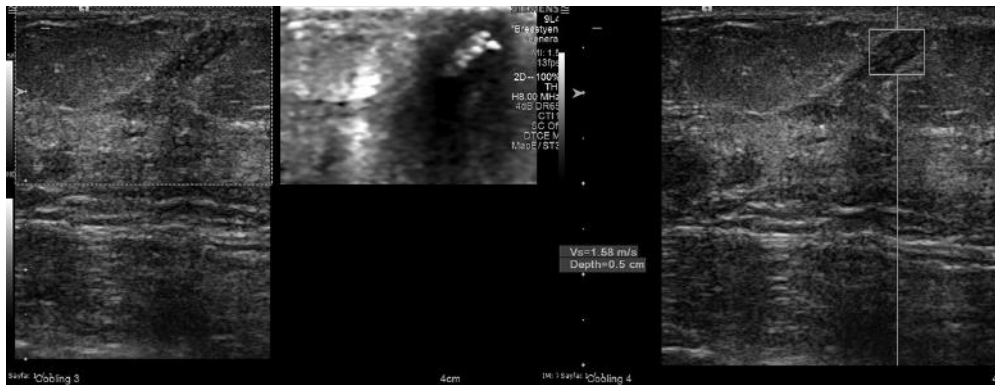


Fig. 2: A 32-year-old patient with granulomatous mastitis in the group1 (conservative group). B-mode image (left) shows a hypoechoic oval shaped lesion and the lesion was bright on VTI image (middle). The lesion was classified into pattern 2. VTQ (right) image showed that SWS was 1.58 m/s within the lesion.

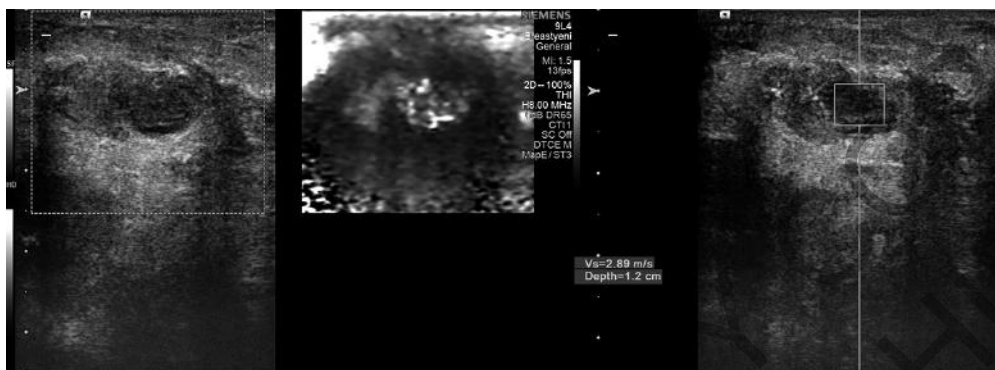


Fig. 3: A 29-year-old patient with granulomatous mastitis in the group 2 (surgery group). B-mode image (left) shows a hypoechoic heterogeneous lesion with lobulated margins. The lesion was containing both bright and dark areas and was classified into pattern 3 on VTI image (middle). VTQ (right) image showed that the SWS was 2.89 m/s within the lesion.

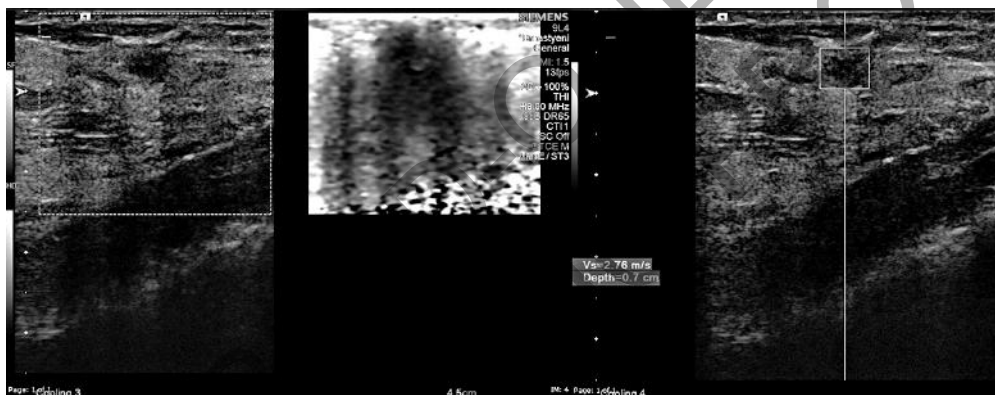


Fig. 4: A 24-year-old patient with granulomatous mastitis in the group1 (conservative group). B-mode image (left) shows a hypoechoic round shaped lesion with posterior acoustic enhancement. VTI image (middle) showed a dark area larger in size than the lesion on the B-mode image. The lesion was classified into pattern 4b. VTQ (right) image showed that the SWS was 2.76 m/s within the lesion.

enables scanning with a frequency ranging of 9–4 MHz. All of the B-mode US images and SWE images were performed by the same radiologist (HA). All patients were evaluated by both ARFI strain images called as Virtual Touch Tissue Imaging (VTI) and point shear wave elastography (p-SWE) named as Virtual Touch Tissue Quantification method (VTQ). VTI provides qualitative and VTQ provides quantitative assessment of the lesions. By VTQ a fixed ROI of 5x5 mm was used. The Shear Wave Speeds (SWS) of each lesion were measured 3 times within the lesion. Mean SWS values were calculated for each lesion. If the SWS exceeds the limits of the SWE system, the system displayed the SWS as non-numeric symbols (X.XX).

The lesions were classified like Tozaki et al.'s classification for VTI patterns. [10]

In this classification, the lesions on B-mode images that

failed to be visually confirmed on VTI map were classified as pattern 1 (Fig. 1). The visually confirmed bright lesions were classified into pattern 2 (Fig. 2). Lesions containing both bright and dark areas were classified into pattern 3 (Fig. 3). The correspondence of lesions on ARFI elastographic images to those on B-mode images was evaluated. Pattern 4 was subdivided into 4a (dark area corresponding in size to the lesion on the B-mode image) and 4b (dark area larger in size than the lesion on the B-mode image) (Fig. 4).

All of the lesions were retrospectively classified according to BI-RADS US assessment categories. Two radiologists evaluated all the images on consensus at a workstation (Synapse version 4.0, Fujifilm Medical Systems Inc., Connecticut, USA) for qualitative evaluation. Both radiologists determine the B-mode definition of the lesions and BI-RADS scoring.

STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS software (Version 16.0, SPSS Inc., Chicago, IL, USA). All numerical data are expressed as mean and median values (Minimum-Maximum). For each continuous variable, normality was checked by Kolmogorov Smirnov and Shapiro-Wilk tests and by histograms. Comparisons between groups were applied by using Mann Whitney U test for the data not normally distributed and student T test for the normally distributed data. The categorical variables between the groups were analyzed by using the Chi-squared test or Fisher's exact test. Values of $p < 0.05$ were considered statistically.

Results

There were 18 patients in group 1 (conservative group) and 21 patients in the group 2 (surgery group). The mean ages of the patients in group 1 and 2 were 38.44 ± 9.6 years, 36.05 ± 7.44 years respectively. All patients were female. In surgery group, the operation types were as follows; segmental mastectomy (n= 5, 27.8%), simple mastectomy (n= 5, 27.8%) and lumpectomy (n= 8, 44.4%).

In group 1, the rates of involvement of the right and left breast were 45% and 55% respectively. In group 2, right breast was involved in 6 patients (33.3%) and left breast was involved in 12 patients (66.7%). There was not statistical difference between the groups with regard to age and the affected side ($p \geq 0.05$).

In group 1, none of the patients had complication following steroid treatment.

In group 2, 3 patients (16.7%) had complications following surgery. One of these three patients had abscess (5.6%) and 2 patients had (11.1%) wound dehiscence.

In group 1, 4 patients showed recurrence (20%). In group 2, one patient had recurrence (5.6%) following surgery. In group 1, the mean recurrence time was 11 ± 9.29 months and average follow-up period was 9.05 ± 14.5 months. One patient showed recurrence at 13th months in group 2. In group 2 average follow-up periods was 10.28 ± 10.08 months.

At B-mode US, 6 of the 18 patients (33.3 %) had mass lesions and 12 of the 18 patients (66.7%) had tubular hypoechoic structures with or without connecting in the conservative group. In the surgery group, 9 of the patients (42.8%) had mass lesions and 12 of the patients (57.2%) had tubular hypoechoic structures with or without connecting.

4 patients in group 1 and one patient in group 2 had SWS displayed as X.XX. The mean SWS were 1.98 ± 1.02 m/sec and 2.82 ± 1.66 m/sec in group 1 and 2 respectively. The difference was not significant ($p \geq 0.05$).

The frequency of the VTI patterns were as follows in group 1; pattern 1 (n=3, 16.7 %), pattern 2 (n=5, 27.8 %), pat-

tern3 (n=6, 33.3 %), pattern 4b (n=4, 22.2 %). In group 2 the VTI patterns were as follows pattern 1 (n=2, 9.5 %), pattern 2 (n=3, 14.3 %), pattern 3 (n=9, 42.9 %), pattern 4a (n=1, 4.8 %), pattern 4b (n=6, 28.6 %).

The BI-RADS US scores of the lesions in group 1 were: BI-RADS 3 (27.8%), BI-RADS 4 (50%), BI-RADS 5 (22.2%). In group2 The BI-RADS US scores of the lesions were as follows; BI-RADS 3 (28.6%), BI-RADS 4 (47.6%), BI-RADS 5 (23.8%).

There were not any significant differences between the groups with regard to frequency of BI-RADS categories and VTI patterns ($p \geq 0.05$).

Discussion

IGM is a rare inflammatory disease that is characterized pathologically by non-caseous chronic granulomas.^{1,2} The severity of the disease determines whether the patient receives surgical or conservative treatment. Surgical treatment involves lumpectomy, segmental mastectomy and simple mastectomy. The aim of this study is to investigate the correlation of the severity of disease and pre-treatment SWE findings. This is the first study in the literature assessing the severity of disease by SWE. US features of IGM include; connecting or non-connecting tubular hypoechoic lesions; irregular masses; hypoechoic linear tracks to skin (cutaneous sinuses); surrounding edema; dilated ducts and hypervascularity. In our clinical practice it commonly presents with dilated tubular structures filled with debris and hypervascular areas with or without connecting. Generally it is composed of both cystic and solid components sonographically. In IGM, granulomas occur around ducts and lobules of the breast. The epithelium of the ducts may be damaged on histology. Granulomas are also shown to be associated with duct ectasies and severe periductal mastitis.¹⁵⁻¹⁷ Most of the lesions in our study showed tubular structures similar to dilate ducts. The cystic areas may represent the microabscess formation or necrosis within the ducts. Previously low elasticity scores and strain ratios in IGM patients by SE were reported¹³.

Generally, SWS reflects the relative stiffness of the tissues. The stiffer the tissue is, the greater the SWS will be. The solid breast lesions show higher SWS when compared with cystic lesions. IGM showed lower SWS values when compared with malignant breast lesions. A cut off value of 4.07 m/s was suggested to differentiate IGM from breast carcinoma.¹⁸ In our study both groups showed lower SWS values than this cut- off value.

In the literature there are limited numbers of studies assessing VTI patterns of breast lesions¹⁹⁻²². We classified the lesions on the basis of VTI patterns. The VTI patterns of the surgically and conservatively treated groups did not show significance. Therefore, VTI patterns of IGM may not be related with the severity of the disease. Most of the patients in both groups were classified in pattern 1, 2

and 3 because IGM is a benign disease. Pattern 3 and 4 lesions have an increased risk of malignancy when compared with pattern 1 and 2 lesions^{10,23}. Previously reported pattern 1 and 2 lesions include benign lesions such as benign proliferative diseases, usual ductal hyperplasia, fibroadenoma and complicated cysts.

Previously reported studies showed that if the SWS of the lesion is expressed as X.XX, it means that the lesion is hard or heterogeneous¹⁸. Calcifications, stiff breast lesions, dense fibrous or desmoplastic tissues and low quality images can cause to obtain non-numeric SWS values^{24, 25}. In our study 5 patients showed X.XX value.

This study has some limitations; namely, its retrospective design and the small number of patients available for evaluation.

Conclusions

In conclusion, there may not be a correlation with the pre-treatment SWE findings and severity of the IGM.

Riassunto

Lo scopo di questo studio è stato quello di indagare la correlazione tra la gravità della mastite granulomatosa idiopatica (IGM) ed i rilievi della Shear Wave Elastography (SWE) eseguita prima del trattamento.

Lo studio ha riguardato 39 pazienti affette da mastite granulomatosa diagnosticata tra dicembre 2014 e febbraio 2017, suddivise in due gruppi. Le pazienti del gruppo 1 sono state trattate conservativamente con cortisone; in quelle del gruppo 2 il trattamento è stato chirurgico escissionale. In entrambi i gruppi sono stati confrontati i rilievi pre-trattamento della SWE.

L'età media delle pazienti erano 38.44 ± 9.6 and 36.05 ± 7.44 years rispettivamente del gruppo 1 e del gruppo 2. Non vi era nessuna differenza significativa tra i due gruppi per quanto riguarda le categorie della frequenza del BI-RAD e le caratteristiche VTI (Virtual Touch Tissue Imaging).

La velocità media della Shear Wave (SWS) era rispettivamente di 1.98 ± 1.02 m/sec e 2.82 ± 1.66 m/sec nel gruppo 1 e nel gruppo 2, con una differenza non significativa ($p \geq 0.05$).

Le categorie BI-RADS e caratteristiche VTI non hanno mostrato differenze significative nel confronti tra pazienti con recidiva e quelle non recidivate.

In conclusione non si rileva una correlazione tra i rilievi con SWE precedenti al trattamento e gravità della mastite granulomatosa idiopatica.

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