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ORIGINAL ARTICLE

The Added Diagnostic Value of Shear Wave Elastography to Differentiate between Benign and Malignant Musculoskeletal Soft Tissue Tumors

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ABSTRACT

Background: It is highly challenging for radiologists to differentiate benign from malignant soft tissue tumors using imaging features alone. For superficial benign soft tissue masses, the shear wave elastography (SWE) could provide a direct quantitative analysis that could help with differential diagnosis. The present work aimed for evaluation the diagnostic value of ultrasound (US) as well as the shear wave elastography to differentiate benign from malignant soft tissue tumors.

Methods: We conducted this prospective cross-sectional study on 30 cases who were clinically suspected to have superficial soft tissue masses in Radio-diagnosis Department, Faculty of Medicine, Zagazig University. All cases were subjected to entire history taking with clinical assessment. In addition to radiological assessment including US, Doppler US, and SWE and compared with histopathological findings.

Results: There was no significant difference between histopathological and shear wave velocity (P=0.4). There was significant difference between histopathological finding and age and sex (p=0.03 and 0.008 respectively).There was significant difference between histopathological and ultrasonographic findings as regard size, cystic component, invasion, definition of margin, echogenicity and vascularity types (p= 0.02, 0.03, 0.02, 0.001, 0.03 and 0.001 respectively) with a sensitivity of (88.9%), specificity of (90.5%) and accuracy of (90%). While the diagnostic variety in differentiation between benign and malignant masses increased when we combin results of elastography and ultrasound with sensitivity of (100%), specificity of (87.8%) and accuracy of (93.3%) in discrimination of benign from malignant lesions.

Conclusion: Despite the fact that ultrasound characteristics can differentiate benign from malignant tumors of soft tissues, but the combined use of Shear Wave Elastography and ultrasound together can increase the diagnostic validity and considered a first-line diagnostic tool.

Keywords: Shear Wave Elastography; Ultrasound; Musculoskeletal; Soft Tissue Tumors

INTRODUCTION

Tumors of the soft tissues comprised up of a collection of lesions that are mainly constituted of mesenchymal cells. These lesions include adipose tissue, peripheral nerves, tendons, blood vessels, fibrous tissue, as well as muscles (including ligaments and fascia) [1, 2]. Soft tissues of the extremities, head, neck, trunk, retroperitoneum, as well as mediastinum are all potential sites for these lesions [3].

The histologic subgroups of soft tissue tumors include benign, intermediate, as well as malignant varieties [4, 5]. It is highly challenging for radiologists to differentiate benign from malignant soft tissue tumors using imaging features alone [6]. The prevalence of benign tumors is higher than that

of malignant tumors; there is a documented 0.3 percent incidence of soft tissue tumors, with over 90% of those tumors being benign [7]. Nevertheless, malignant tumors are more common among children [1].

As a result, individuals with benign soft tissue tumors may end up undergoing unneeded tests, while patients with malignant tumors may have to wait longer for a correct diagnosis. Furthermore, foreign bodies, fluid collections, fat necrosis, epidermal inclusion cysts, and other non-neoplastic lesions can all give a perception of soft tissue tumors [8].

Elastography is the set of techniques by which tissue stiffness is estimated as a physical property termed the Young's modulus (E). The Young's modulus is a proportionality constant that relates applied force per unit area or stress, and the resultant relative change in tissue dimension, or strain. The nature of the external mechanical stimulus defines these methods. In strain-based elastography, force is applied by the application of probe pressure or through endogenous mechanical force (e.g. carotid pulsation). In shear-wave based elastography, a tissue shear-wave is induced by the imaging system. In both approaches, the response of tissue to these mechanical stimuli is used to estimate tissue mechanical properties. Strain imaging uses the direct relationship $E=\sigma/\varepsilon$ (Hooke's Law) in which σ represents externally applied stress, and ε represents strain. Young's modulus is usually not computed with clinical strain imaging systems, as the applied force on the tissue of interest is usually not known. Shear wave imaging systems compute Young's modulus using the relationship $E=3\ \rho cs2$ in which ρ represents tissue density, and cs represents shear wave speed. Most of the vendors provide automatic calculation systems and ultrasound operator can convert kPa to m/s and m/s to kPa [9].

The goal of elastography, an imaging technique based on ultrasound (US), is to distinguish between tissues by measuring the stiffness [9, 10]. Shear wave elastography (SWE), Strain elastography (SE) are the two mainstays of standard elastography [11, 12].

Tissue stiffness is determined in SE by applying a physical compression to the studied tissue and then comparing the strain of the analyzed tissue to that of a neighboring reference tissue [11]. This technique relies on the operator and is semi-quantitative method [11].

Alternatively, SWE involves applying an acoustic radiation force impulse to the tissue under examination, which results in horizontal displacements on the part of the tissue known as "shear waves." Shear wave velocity, measured in meters per second (m/s), is a measure of tissue stiffness. [12]. Consequently, SWE collects quantitative information regarding tissue stiffness and is less operator-dependent than SE [12]. So, the present work aimed for evaluation of the diagnostic value of ultrasound as well as shear wave elastography to differentiate benign from malignant soft tissue tumors.

METHODS

We conducted this prospective cross-sectional study on 30 cases that were clinically suspected to have superficial soft tissue masses in Radio-diagnosis Department, Faculty of Medicine, Zagazig University. Informed consent has been taken from all individuals in this investigation. This study was approved by Zagazig University Ethical committee regulations. The research was conducted under the World Medical Association's Code of Ethics (Helsinki Declaration) for human research. we obtained the approval from the Institutional Review Board (IRB#9770/6-9-2022).

Cases with the following characteristics were included; patients presented with soft tissue masses detected by clinical and ultrasound examination from any age or sex.

Cases with the following characteristics were excluded: Patients who have been submitted to intervention treatment or biopsy before SWE examination, lost during follow up, or unavailable pathological analysis of their soft tissue mass.

All casese were subjected to entire history taking, and clinical assessment. Imaging Modalities included:

***Ultrasonography*:** Using a Toshiba Aplio 500 ultrasound system with a 5-18 MHz linear array transducer, B-mode ultrasound examinations were performed. Adequate acoustic coupling gel was used to minimize operator-induced compression artifacts. Lesion assessment included characterization of location, shape, three-dimensional size, echogenicity (as opposed to nearby skeletal muscle), texture (heterogeneous versus homogeneous), existence of cystic components, and margin definitions (either well versus ill-defined), with documentation of any evidence of surrounding tissue invasion.

Doppler examination: Doppler ultrasound examinations were performed. Color Doppler imaging classified lesions according to vascularity: Type 1 (avascular), Type 2 (hypovascular with single-pole feeding vessel), Type 3 (hypervascular with multiple peripheral vessels), and Type 4 (hypervascular with multiple peripheral and central feeding vessels).

Shear wave Elastography: Participants were positioned comfortably to minimize active (contraction) and passive (stretching) influences on shear wave elastography (SWE) measurements. Using a linear array transducer, SWE was done on necrosis-free, the most solid, and, if present, the hypervascular region of the lesion. The equipment software shows the elastograms in a dual mode on top of the grayscale images. The electronic rectangle box was activated to obtain a color elastogram ranging from blue to red, which was configured from the least to the most stiffness in our equipment, and the other elastogram represented the propagation of shear waves. Next, Five circular regions of interest (ROI), each measuring 2 × 2 mm, were chosen at random inside the lesion. Each SWE examination was repeated twice to assess intra-observer variability. then The equipment automatically provided the velocity for each ROI by m/s. Mean shear wave velocity (SWV) values were used for statistical analysis.

Gold standard: Histopathologic diagnoses were established via core needle biopsy or surgical excision. All imaging findings were correlated with histopathologic results.

Statistical Analysis:

Statistical analysis, we utilized SPSS version 23. Whenever necessary, we compare groups using chi-square or Fisher's exact tests, and we provide qualitative data as percentages and counts. Methods for presenting numerical data include means and standard deviations. While comparing two groups, we utilized independent samples t-tests for data that was normally distributed and Mann-Whitney U tests for data that was non-normal. We utilized Kruskal-Walli's test for more than two groups. To assess the reliability of continuous variables as predictors, ROC curve analysis was employed. $P < 0.05$ was used to determine statistical significance.

RESULTS

We included 30 patients with musculoskeletal soft tissue tumors who ranged in age from 12 to 70 years (mean ± SD: 40.9 ± 16.2 years). The cohort consisted of 30% males and 70% females. 20% of participants were younger than 30 years, and 50% were older than 50 years (Table 1).

Table (2) showed that (70%) of the lesions were diagnosed as benign by histopathology, while (30%) of the lesions were diagnosed as malignant lesions. A statistically significant difference was revealed between histopathological findings with age as mean of age was higher among patients with malignant masses (P=0.03) and sex as most of the patients with malignant masses (66.7%) were males, while most of the patients with benign masses (85.7%) were females (P=0.008).

Table (3) showed a statistically significant difference between benign and malignant lesion regarding ultrasonographic findings as regard size, cystic component, invasion, morphology, echogenicity and vascularity types; as most of the malignant lesions (88.9%) sized > 5 cm, and most of benign lesions (61.9%) sized<5cm. As regard cystic component most of the malignant lesions (66.7%) showed cystic component in comparison to (23.8%) of the benign lesions. As regard invasion, (33.3%) of the malignant lesions showed invasion, while none of the benign lesions (0%) showed invasion (P=0.02).

As regard morphology, (66.7%) of the malignant lesions had ill-defined morphology, while none of the benign lesions (0%) had ill-defined morphology (P<0.001). Also, mean of depth of invasion was higher among malignant lesions (P=0.02). Also, all the malignant lesions (100%) showed hypo-echoic echogenicity in comparison to (61.9%) of the benign lesions (P=0.03). As regard vascularity types; most of the benign lesions (52.4%) were type Ⅰ, while most of the malignant lesions (55.6%) were type Ⅲ (P<0.001). While no significant difference was found between histopathological and shear wave velocity (P>0.05) (Table 3).

Table (4) showed non-significant difference between histopathological and shear wave velocity (P>0.05).

Table (5) showed that ultrasound had a specificity of 90.5%, sensitivity of 88.9%, as well as accuracy of 90%, with positive and negative predictive values of 80% and 95%, respectively in differentiation benign from malignant soft tissue tumors, while Elastography alone showed a specificity of 88.89%, sensitivity of 80.95%, as well as accuracy of 83.3%. The added value of elastography and ultrasound combined had specificity of (87.8%), sensitivity of (100%), as well as accuracy of (93.3%).

Table (1): Demographic and anthropometric measurements data among studied patients

Variable		**All patients (n=30)**
Age (years)	Mean ± SD	40.9 ± 16.2
	Range	(12 – 70)
Age groups (N. %)	10 - 30	6 (20%)
	31 – 50	9 (30%)
	51 – 70	15 (50%)
Sex (N. %)	Male	9 (30%)
	Female	21 (70%)

Table (2): Histopathological findings, and Comparison of histopathological findings and demographic data among studied patients

Diagnosis (N. %)	**All patients (n=30)**
Benign	21 (70%)
Fibromatosis	2
Desmoid type of fibromatosis	2
Lipoma	5
Ganglion	5
Hematoma	2
Vascular malformation	1
Epidermoid cyst	1
Connective tissue element	1
Neurofibromatosis	2
Malignant	9 (30%)
Liposarcoma	1
Metastatic papillary carcinoma	1
Metastatic follicular carcinoma	1
Undifferantiated Sarcoma	1
Pleomorphic sarcoma	2
Synovial sarcoma	1
Spindle cell sarcoma	1
Giant cell tumor	1

Variable		**Benign (n=21)**	**Malignant (n=9)**	**P Value**
Age (years)	Mean ± SD	36.8 ± 16.3	50.6 ± 11.8	**0.03**[1]
	Range	(12 – 70)	(30 – 66)	
Age groups (N. %)	10 – 30	6 (28.6%)	0 (0%)	0.11[2]
	31 – 50	7 (33.3%)	2 (22.2%)	
	51 – 70	8 (38.1%)	7 (77.8%)	
Sex (N. %)	Male	3 (14.3%)	6 (66.7%)	**0.008**[2]
	Female	18 (85.7%)	3 (33.3%)	

Table (3): Comparison of histopathological with ultrasonographic findings and shear wave elastography findings among studied patients

Variable (N. %)		**Benign (n=21)**	**Malignant (n=9)**	**P Value**
Size	< 5 cm	13 (61.9%)	1 (11.1%)	**0.02[1]**
	> 5 cm	8 (38.1%)	8 (88.9%)	
Location	Distal LL	2 (9.5%)	2 (22.2%)	0.12[1]
	Distal UL	4 (19%)	3 (33.3%)	
	Proximal LL	2 (9.5%)	3 (33.3%)	
	Proximal UL	4 (19%)	0 (0%)	
	Trunk	9 (42.9%)	1 (11.1%)	
Cystic component	Absent	16 (76.2%)	3 (33.3%)	**0.3[2]**
	Present	5 (23.8%)	6(66.7%)	
Border	Angular	2 (9.5%)	0 (0%)	0.18[1]
	Indistinct	0 (0%)	2 (22.2%)	
	Lobulated	6 (28.6%)	1 (11.1%)	
	Smooth	13 (61.9%)	6 (66.7%)	
Shape	Irregular	4 (19%)	2 (22.2%)	0.82[1]
	Oval	16 (76.2%)	6 (66.7%)	
	Rounded	1 (4.8%)	1 (11.1%)	
Dimensions	Taller than wider	1 (4.8%)	1 (11.1%)	0.52[1]
	Wider than taller	20 (95.2%)	8 (88.9%)	
Invasion	Absent	21 (100%)	6 (66.7%)	**0.02[1]**
	Present	0 (0%)	3 (33.3%)	
Margin	Well-defined	21 (100%)	3 (33.3%)	**<0.001[1]**
	Ill-defined	0 (0%)	6 (66.7%)	
Texture	Homogenous	10 (47.6%)	4 (44.4%)	0.87[2]
	Heterogenous	11 (52.4%)	5 (55.6%)	
Echogenicity	Echogenic	8 (38.1%)	0 (0%)	**0.03[1]**
	Hypo-echoic	13 (61.9%)	9 (100%)	
Vascularity types	Type Ⅰ	11 (52.4%)	0 (0%)	**<0.001[1]**
	Type Ⅱ	2 (9.5%)	2 (22.2%)	
	Type Ⅲ	1 (4.8%)	5 (55.6%)	
	Type Ⅵ	7 (33.3%)	2 (22.2%)	
	Range	(1.5 – 4.7)	(2.1 – 5.1)	

*[1]Fisher exact test, [2]Chi-square test, [3]Mann-Whitney U test, Non-significant: P >0.05, Significant: P ≤0.05

Table (4): Comparison between histopathological and shear wave elastography findings among studied patients

Variable *(N. %)*		**Benign (n=21)**	**Malignant (n=9)**	**P Value**
Average velocity *(m/s)*	***Mean ± SD***	**3.15 ± 0.85**	**3.47 ± 1.17**	**0.4**
	Range	**(1.5 – 4.7)**	**(2.1 – 5.1)**	

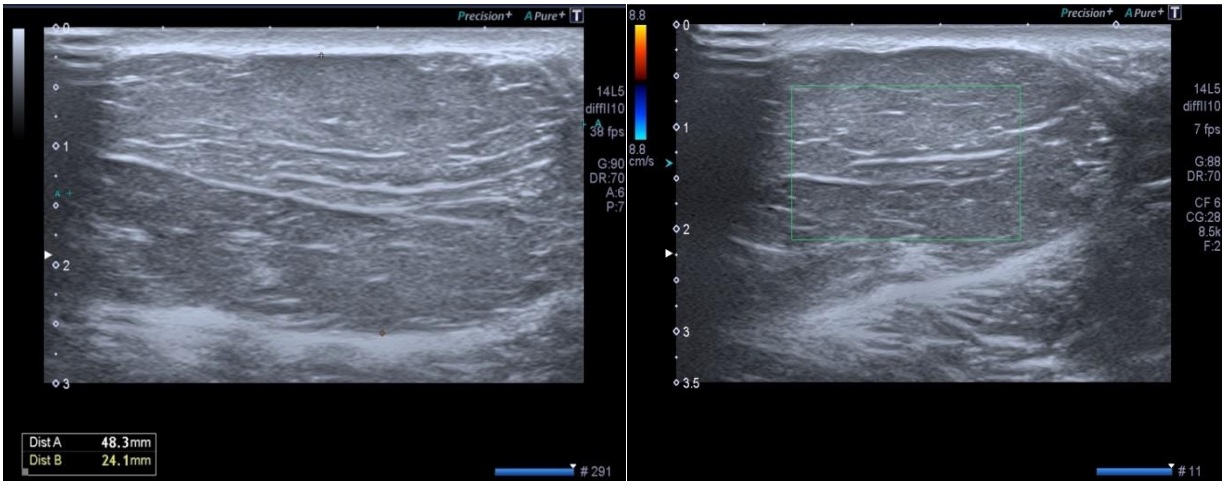
*Student's T test, Non-significant: P >0.05, Significant: P ≤0.05

Table (5) Diagnostic accuracy of Ultrasound among studied patients and Diagnostic accuracy of Elastography versus Ultrasound and Combined

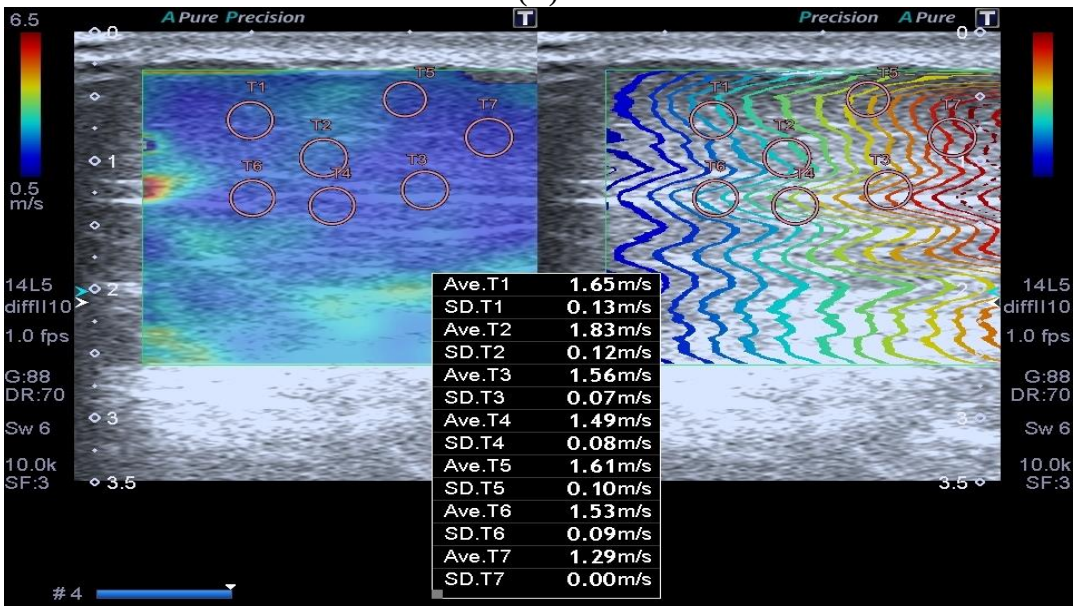
Diagnostic accuracy of Ultrasound				
		Histopathology (Gold standard)		**Total**
		Malignant	**Benign**	
Ultrasound	**Malignant**	**8**	**2**	**10**
	Benign	**1**	**19**	**20**
	Total	**9**	**21**	**30**

Sensitivity (%)	**Specificity (%)**	**PPV (%)**	**NPV (%)**	**Accuracy (%)**
88.9%	**90.5%**	**80%**	**95%**	**90%**

Diagnostic accuracy of Elastography versus Ultrasound and Combined			
Variables	**Sensitivity (%)**	**Specificity (%)**	**Accuracy (%)**
Elastography	80.95%	88.89%	83.3%
Ultrasound	88.9%	90.5%	90%
Elastography + Ultrasound	100%	87.8%	93.3%



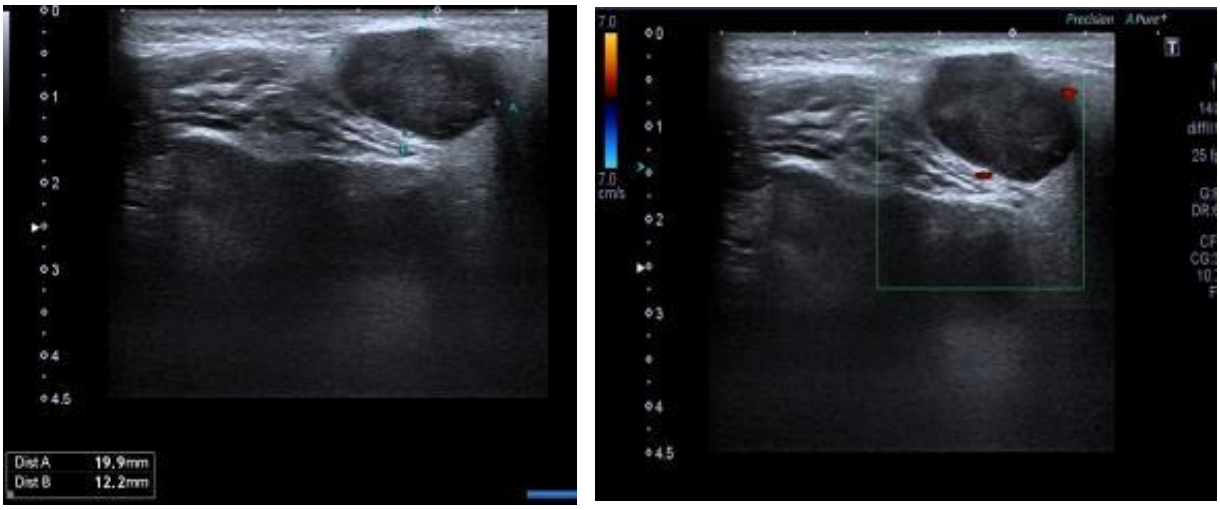
(A)



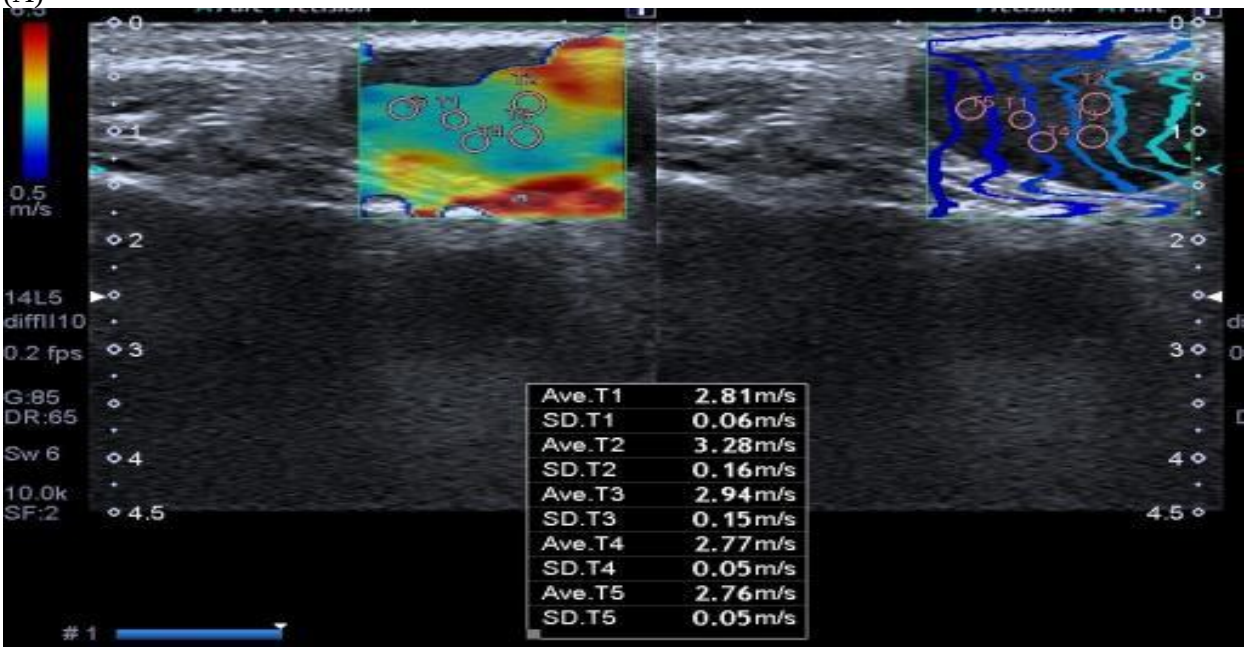
(B)

Fig. 1. Male patient 36 years old, complaining of painless swelling in right shoulder.(A) Well defined

smooth surface homogenous echogenic mass with internal linear echogenic lines , oval, wider than taller, no cystic component, no invasion of the deep structure, vascularity (type 1).(b)Shear wave velocity range from Vmax =1.83 m/s and Vmin=1.29 m/s Mean=1.56 m/s Histopathology: Lipoma



(A)



(B)

Fig. 2: 46years female complaining of swelling in upper right thigh (A)Well defined homogenous hypoechoic mass in the right thigh with type III vascularity.(B)Shear wave velocity range from Vmax =2.7m/s And Vmin=3.2m/s Mean= 2.9m/s. Histological findings: Pleomorphic sarcoma.

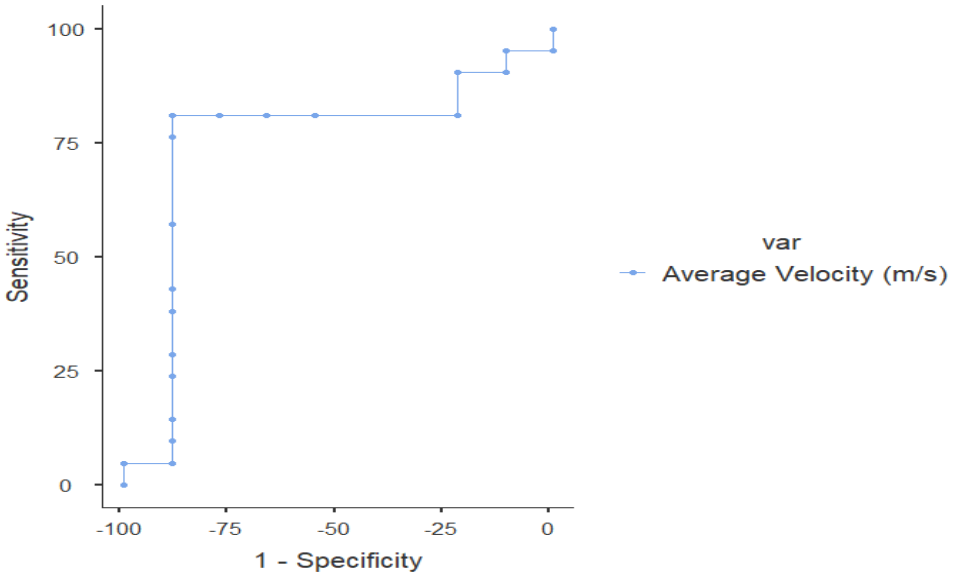


Fig 3: ROC curve analysis of average velocity in differentiating benign from malignant lesions.

DISCUSSION

Shear wave elastography is an emerging ultrasound technology that evaluates tissue biomechanical parameters by monitoring the propagation velocity of transducer-generated shear waves to infer tissue elasticity [13].

A small number of studies have attempted to investigate the value of SWE in musculoskeletal masses, the largest of these studies found no additional benefit of SWE over conventional US-based classification [13]. The main aim of this study was to determine the validity of SWE in the differentiation of malignant and benign soft tissue tumors.

We included 30 patients in this cross-sectional study with musculoskeletal soft tissue tumors. The participants ranged in age from 12 to 70 years, with a mean age of 40.9 ± 16.2 years. The cohort comprised 30% males and 70% females. Age distribution showed 20% under 30 years and 50% over 50 years.

The data presented here corroborate the findings of Ozturk et al. [21], who investigated the diagnostic utility of ultrasound and shear wave elastography in differentiating between benign and malignant soft tissue tumors. The study's participants were male (58.7% of the participants were male) and had an average age of 43.3 ± 20.5 years.

Our findings also are in line with those of Pass et al. [20], who examined 105 soft tissue lesions using US and SWE; both groups discovered that malignancy was more prevalent in older patients.

The present study revealed that 70% of the lesions were diagnosed as benign by histopathology, while 30% of the lesions were diagnosed as malignant lesions. Similarly, our findings were in line with Ozturk et al. [21] who reported that histopathological evaluations revealed 37 malignant (33.9%) and 72 benign (66.1%) lesions.

This study demonstrated a statistically significant association between age and histopathological findings (P = 0.03), with malignant masses exhibiting a higher mean age. A statistically significant association was also observed between histopathological findings and sex (P = 0.008), with a higher proportion of males (66.7%) presenting with malignant masses compared to females (85.7%) presenting with benign masses.

Similarly to Ozturk et al. [21], we found that patients with malignant lesions had a substantially older mean age (52.0 ± 20.7 years) compared to those with benign lesions (38.9 ± 19.0 years, p = 0.001). In addition, there was a substantially higher prevalence of malignant tumors in males (n = 28, 75.7% of the total) compared to females (n = 9, 24.3% of the total), and this disparity was statistically significant (p = 0.010) in both trials. This male predominance may be attributed to occupational exposure to potential mutagens in male-dominated professions [22].

Our results corroborated those of Winn et al. [23], who found that malignant lesions were noticeably bigger than benign ones, when it came to sonographic findings. Specifically, we found that 88.9% of the malignant lesions were larger than 5

cm, while 61.9% of the benign lesions were smaller than 5 cm. The fast-growing characteristic of cancer is explained by this finding.

As regards the cystic component, most of the malignant lesions (66.7%) showed a cystic component in comparison to (23.8%) of the benign lesions. Our results were in line with Ozturk et al. [21] who reported that cystic lesions were associated with an increased risk of cancer ($p = 0.011$). The central necrosis and bleeding caused by the tumors could be the reason.

As regards the margins of the lesion, (66.7%) of the malignant lesions had ill-defined margins, while none of the benign lesions (0%) had ill-defined margins ($P<0.001$). Our findings are consistent with those of Ozturk et al. [21], who observed a higher prevalence of ill-defined margins in malignant lesions ($n = 33$, 89.2%) compared to benign lesions ($n = 42$, 58.3%).

In the current study, among the most striking differences between benign and malignant lesions was the percentage of tumors that invaded their surrounding tissues; just 33.3% of malignant lesions exhibited this trait, whereas 0% of benign lesions did ($P=0.02$).

Consistent with Li et al. [24], our study also found a significant difference in depth between malignant and benign lesions, with malignant tumors more frequently located deep to the deep fascia (66.7%). These results can be explained by malignant tumors often invading surrounding tissues more aggressively than benign lesions. This invasive behavior leads to irregular and poorly defined edges as cancer cells spread into adjacent structures [24].

For other morphological features of the lesions, Also, all the malignant lesions (100%) showed hypo-echoic echogenicity in comparison to (61.9%) of the benign lesions ($P=0.03$). Our findings corroborate those of Li et al. [24], who reported a significant difference in echogenicity between malignant and benign lesions, with malignant tumors exhibiting a hypoechoic appearance in 100% of cases.

Regarding Doppler findings, a statistically significant difference in vascularity was observed between malignant and benign lesions ($P < 0.001$). Benign lesions predominantly exhibited type I vascularity (52.4%), while malignant lesions most frequently showed type III vascularity (55.6%). These results align with Ozturk et al. [21], who also reported significant differences in Doppler features between benign and malignant lesions ($p < 0.001$), with hypervascularity more common in malignant lesions (70.3%) and avascular/hypovascularity more frequent in benign lesions (75%).

Similarly, Winn et al. [23] investigated the use of ultrasound, shear wave elastography, and MRI to predict the benign or malignant nature and type of soft tissue masses. Their findings also indicated associations between malignancy and both lesion size and increased vascularity on Doppler imaging. These results may be due to malignant tumors typically growing rapidly and requiring a greater supply of nutrients and oxygen, leading to increased blood vessel formation (angiogenesis). While benign tumors generally grow more slowly and may not require extensive blood supply, leading to fewer blood vessels [23].

In contrast, there was no statistically significant variation in shear wave velocity (SWV) among the histological categories ($P > 0.05$) in this investigation. There was no statistically significant difference in the mean or maximum SWV between benign and malignant lesions, which is consistent with the results of Ozturk et al. [20] and Pass et al. [21]. Also, there was no discernible difference in SWV between benign and malignant lesions in the study of 206 soft tissue tumors conducted by Tavare et al. [25] that used US and SWE. Consistent with our findings, Winn et al. [23] also used US and SWE to analyze 148 soft tissue lesions; they also found no statistically significant difference in SWV between benign and malignant lesions.

These results can be explained by different types of tumors and their stages can exhibit varying degrees of stiffness. Some malignancies may not present a significantly altered stiffness compared to benign lesions, leading to overlap in SWV values. Also, soft tissue tumors can have varying cellular compositions, including a mix of malignant and benign components, inflammatory cells, or fibrous tissue. This variability can affect SWV measurements, leading to overlap between malignant and benign lesions.

With an accuracy rate of 90%, a specificity rate of 90.5%, a positive predictive value of 80%, and a negative predictive value of 95%, this study presented impressive results for ultrasonography, Hung et al. [26] reported that ultrasonography was 97.9% specific and had a sensitivity of 93.3% when they studied 823 soft tissue masses. Their results are consistent with our findings.

Our findings demonstrated that elastography had sensitivity of (80.9%), specificity of (81%) and accuracy of (83.3%), while ultrasound had sensitivity of (88.9%), specificity of (90.5%) and

accuracy of (90%), while added value of elastography and ultrasound increase sensitivity of (100%), specificity of (77.8%) and accuracy of (93.3%) in differentiation between benign and malignant soft tissue masses.

These findings are supported by studies demonstrating the complementary use of SWE with B-mode ultrasound to detect benign-appearing invasive breast cancers [27, 28].

Sravani et al. [29] reported a combined B-mode ultrasound and SWE approach yielded the highest sensitivity (100%) and negative predictive value (NPV) (100%), representing a significant increase in sensitivity from 90.6% with B-mode ultrasound alone. However, specificity decreased significantly from 90% to 72.2% with the combined approach. B-mode ultrasound and SWV (with a cutoff of 3.43 m/s) demonstrated the highest specificity (90%), while SWV alone showed the highest positive predictive value (PPV) of 90.7%.

This study has some limitations. First, limited numbers of patients were enrolled in the study, and studies with larger populations are needed to validate our findings. Second, histological results of little number of cases of lipomas were not available but these patients had at least 1 year follow up without mass growth or metastasis. Third, we can't cover all categories of soft tissue masse.

CONCLUSION

The present study demonstrated that lesions size, depth from skin, tumor margins and vascularity of the lesions can be used as independent factors for predicting malignancy. We concluded that despite the fact that ultrasound characteristics can differentiate benign from malignant tumors of soft tissues, but the combined use of Shear Wave Elastography and ultrasound together can increase the diagnostic validity and considered a first-line diagnostic tool.

Conflict of Interest or financial disclosure: No potential conflict of interest to be reported by the authors.

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