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Original Research Article

EVALUATION OF THE USEFULNESS OF SHEAR WAVE ELASTOGRAPHY IN THE DIAGNOSTIC PROCESS FOR NONCANCEROUS SOFT TISSUE MASSES

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Abstract: *Current study was carried out to assess efficacy of SWE as an adjunct to sonography in investigating superficial benign lesions. The retrospective study was conducted in the Radiology department of Nishtar Medical Hospital from July 2021 to July 2022. The study included 45 patients with 49 lesions. Doppler and grayscale ultrasound and SWE was performed. Conventional ultrasonic features like depth (mm), size (mm), margin (ill defined or well defined), vascularity (present or absent) and echogenicity (isoechoic, anechoic, hyperechoic or hypoechoic) were investigated. Median shear modulus and ultrasonic features were documented. Mean shear modulus for epidermoid, ganglion and lipomatous cyst was 23.6kPa, 5.9kPa and 9.1kPa respectively. Difference between lipomatous tumors, ganglion cysts and epidermoid cysts were significant (P=0.018). Median shear modulus of epidermoid cyst was higher than ganglion cysts and lipomatous tumors. Shear wave elastography is a valuable modality for diagnosis of superficial benign soft tissue masses through direct quantitative analysis.*

Keywords: Shear wave elastography, Epidermal cysts, Ganglion cysts, Imaging techniques

Introduction

Ultrasonography is cost effective, widely available and allows real time examination. It is also less time consuming as compared to magnetic resonance imaging (MRI) (Jacobson et al., 2016; Ryu et al., 2015). Ultrasonography provides higher resolution for visualizing superficial musculoskeletal lesions. Recent development in ultrasound elastography provides useful information about intrinsic properties of tissues and contribute in diagnosis (Snoj et al., 2020; Taljanovic et al., 2017). Shear wave elastography (SWE) helps in quantifying tissue elasticity (Ryu and Jeong, 2017). It has high clinical significance for musculoskeletal radiography (e Lima et al., 2018). Different studies have been conducted on usefulness of sonoelastography in detection of superficial soft tissue lesions (Pass et al., 2017; Pass et al., 2016; Taljanovic et al., 2017). Recent research shows that malignant lesions have variable elasticity due to tissue characteristics and cellular differentiation. Therefore, there is need for more studies for identifying tools to differentiate between malignant and benign soft tissue tumor. Soft tissue tumors are mostly benign, thus the possibility of clinician encountering benign soft tissue tumor is high. Therefore, SWE is useful for acquiring additional information without spending much time. The aim of this study is to assess the efficacy of SWE as an adjunct to sonography in investigating superficial benign lesions.

Methodology

The retrospective study was conducted in the Radiology department of Nishtar Medical Hospital from July 2021 to July 2022. 85 patients and 101 benign soft tissue lesions were analyzed, 40 patients were not followed up. Therefore, the study included 45 patients with 49 lesions. Medical records of the patients, histopathology and ultrasonic exams were investigated. Patients aged between 18 and 80 years were included in the study. Those with any chronic illness were excluded. There were 20 females and 25 males. Written informed consent of the patients was taken. The Ethical Board of the hospital approved the study.

For each lesion, Doppler and grayscale ultrasound and SWE was performed. A single radiologist performed all examinations for consistency. Dual mode imaging was used for color coded electrograms and grayscale images. On chromatic scale, a higher shear modulus was indicated by red. 2- or 3-mm regions of interest were marked on the lesions. Images were reviewed by experienced radiologists who did not have prior information of the final diagnosis. Conventional ultrasonic features like depth (mm), size (mm), margin (ill defined or well defined), vascularity (present or absent) and echogenicity (isoechoic, anechoic, hyperechoic, or hypoechoic) were investigated. Median shear modulus and ultrasonic features were documented.

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Data was analyzed through SPSS version 18.0. Nonparametric tests were conducted on values of median shear modulus. On the basis of final diagnosis lesions were classified as lipomatous tumors, ganglion cysts , epidermoid cysts or miscellaneous. The Kruskal-Wallis test was used for the comparison of median shear moduli of lipomatous tumors, ganglion cysts and epidermoid cysts. Mann-Whitney U test was used for the comparison of distinct groups. P value <0.05 was considered statistically significant.

Results

In 30 lesions surgical excision and 7 lesions fine needle aspiration was done for histopathologic diagnosis. In 8 lesions diagnosis was based on clinical assessment and results of sonography. Of 45 lesions, 5 were epidermoid cysts, 17 were lipomatous tumors , 13 were ganglion cysts, and 10 were miscellaneous lesions. Of 17 lipomatous tumors, 16 were lipomas and 1 angiolipoma.

Doppler and grayscale ultrasound were used for visual assessment of all lesions (Table I). 58.8% (10) lipomatous tumors were found in trunk and all 13 ganglion cysts were found in upper or lower extremities. Lipomatous tumors had the greatest mean depth of 4.19mm. 84.4% (38) lesions had circumscribed margin. 60% epidermoid cysts (3) were hypoechoic, 69% ganglion cysts (9) were anechoic. Vascularity was not present in ganglion cyst or epidermoid cyst, while 23.5% lipomatous tumors (4) and 80% miscellaneous lesion (8) had internal vascularity.

Findings of SWE overlapped to an extent. Median shear modulus for epidermoid cyst, ganglion cyst and lipomatous tumor were 24.5 kPa,5.9kPa and 9.1kPa respectively (Table II). Difference between lipomatous tumors, ganglion cysts and epidermoid cysts were significant (P=0.018). Median shear modulus of epidermoid cyst was higher than ganglion cysts (0.015)and lipomatous tumors (0.048). However, the difference between lipomatous tumor and ganglion cyst was not significant.

Table I Features of Conventional Ultrasonography

Ultrasonographic Features	Epidermoid cyst n=5	Ganglion cyst n=13	Lipomatous tumor n=17	Miscellaneous lesion n=10
Location				
Upper extremity	3(60%)	10(76.9%)	4(23.5%)	5(50%)
Lower extremity	1(20%)	3(23.0%)	1(5.8%)	2(20%)
Trunk	1(20%)	0	10(58.8%)	2(20%)
Neck	0	0	2(11.7%)	1(10%)
Depth (mm)				
Mean ±SD	2.91±1.05	3.21±0.84	4.19±3.15	4.56±4.24
Margin				
Well defined	4(80%)	12(92.3%)	14(82.3%)	8(80%)
Ill defined	1(20%)	1(7.6%)	3(17.6%)	2(20%)
Echogenicity				
Hypoechoic	3(60%)	2(15.3%)	10(58.8%)	7(70%)
Hyperechoic	1(20%)	1(6.9%)	3(17.6)	3(30%)
Isoechoic	0	1(6.9%)	3(17.6)	0
Anechoic	1(20%)	9(69.2%)	1(5.8%)	0
Vascularity				
Absent	5(100%)	13(100%)	13(76.4%)	2(20%)
Present	0	0	4(23.5%)	8(80%)

Table II Median shear modulus

Diagnosis	N	Median shear modulus *
Epidermoid cyst	5	24.5±14.6
Ganglion cyst	13	5.9±5.1
Lipomatous tumor		
Lipoma	13	9.1±5.2
Angiopapiloma	4	-
Miscellaneous lesions		
Arteriovenous malformation	1	0,4.1
Panniculitis	1	13.3,21.2

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Cavernous hemangioma	2	31.0
Thrombosed pseudoaneurysm	2	21.1
Schwannoma	2	5.6
Vascular lymphoma	2	23.2

**Unit of median shear modulus is kPa*

Discussion

Differentiating between benign and malignant lesions is difficult using conventional ultrasonography, thus biopsy is required for diagnosis and treatment planning (Pass et al., 2017). Moreover, the echogenicity of lipoma is based upon water component and purity and amount of fatty tissue. Physical principles used in SWE are different from strain elastography (Chatelin et al., 2022). Interaction of conventional ultrasound waves with tissues results in production of shear waves.

The majority of cystic tumors have elasticity, it either suggests artifacts in shear wave signals or a semisolid cystic wall. In current study shear modulus of epidermoid cysts was higher as compared to other cystic lesions. Vibration frequency and elastography contrast are inversely related, shear viscosity is significant for evaluation of liver elasticity. However, in most elastography techniques impact of viscosity on shear modulus is overlooked (Wiseman et al., 2019). Elasticities of epidermoid and ganglion cysts is addressed in only few studies (Harmon et al., 2019).

A study showed that strain ratio in ganglion cysts was higher (2.77±0.49) as compared to epidermoid cysts (0.16±0.22) (Baloji et al., 2020). In a current study, there was a ruptured epidermoid cyst whose shear modulus was lower as compared to other epidermoid cysts. Although the difference between lipomatous tumor and ganglion cyst was not statistically significant, these lesions could be distinguished through conventional ultrasonography. It implies elasticity of cystic and solid lesions may be similar. Research on musculoskeletal tumors show that malignant tumors have low shear velocities (Abd Ellah et al., 2020; Catalano et al., 2020). Another study showed that among neck masses neurogenic tumors, metastatic tumors and dermoid cysts have high stiffness, while cystic tumors, venous malformations and lipoma have low stiffness (Bhatia et al., 2010).

The limitation of this study is that only benign tumors are targeted. As in our hospital there are insufficient malignant cases, there is a need for multi-centered study. Moreover, as population size was small different types of soft tumors could not be evaluated and significant cutoff values differentiating between epidermoid and ganglion cyst could not be determined.

Conclusion

Shear wave elastography is a valuable modality for diagnosing benign soft tissue masses through direct quantitative analysis.

Conflict of interest

The authors declared absence of conflict of interest.

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