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Original Article

Comparison of Ultrasonography and Magnetic Resonance Imaging for Diagnosis of Soft Tissue Masses of the Hand and Wrist

[1]Güneş Orman, [2]Güray Yeşiladalı, [1]Ercan Olcay, [1]Mahmut Duymuş

ABSTRACT

The purpose of this study is to evaluate the preoperative features and predict the preoperative diagnosis of hand and wrist soft tissue masses by ultrasonography and magnetic resonance imaging and compare the results with the postoperative pathological results. 14 patients with the complaint of mass or pain in their hand and wrist were included. Before the operation we practised ultrasonography and magnetic resonance imaging to the patients. The preoperative diagnosis were compared with postoperative pathological diagnosis. 14 patients (female/male: 10/4) were included. The pathological results were glomus tumor in 2, giant cell tumor of tendon sheath in 4, ganglion cyst in 4, schwannoma in 2, lipoma in 1 and fibroma in 1. According to these pathological results ultrasonography was 64 % (9/14) successful and magnetic resonance imaging was 50% (7/14) successful to predict all of the masses. High resolution ultrasonography is well suited for screening soft tissue masses because of its safety, low cost and real-time dynamic imaging. Sonography enables a reliable diagnosis of the cystic or solid nature of soft tissue lesions, accurate estimation of the volume and even presume the pathologic diagnosis according to the lesions. Ultrasonography may usually be adequate solely for the evaluation of soft tissues masses of hand and wrist.

Key words: *Soft tissue mass, ultrasonography, MRI*

Ultrason ve Manyetik Rezonans Görüntülemenin El ve El bileği Kitlelerinin Tanısında Karşılaştırılması

ÖZET

Çalışmanın amacıel ve el bileğindeki yumuşak doku kitlelerinin ultrason ve manyetik rezonans görüntüleme ile preoperatif özellikleri ile preoperatif tanı tahminlerini değerlendirmek ve postoperatif patoloji sonuçları ile kıyaslamaktır. El ve el bileğinde kitle yakınmasıyla başvuran 14 hasta dahil edildi. Yapılan ultrasonografi ve manyetik rezonans görüntüleme tetkikleri sonuçları operasyon sonrası patoloji sonuçları ile karşılaştırıldı. Toplam 14 olgu çalışmaya dahil edildi (kadın/erkek: 10/4). 14 olgunun patoloji sonuçları glomus tümörü 2 olgu, tendon kılıfının dev hücreli tümörü 4 olgu, gangliyon kisti 4 olgu, schwannom 2 olgu, lipom 1 olgu ve fibrom 1 olgu olarak değerlendirildi. Buna göret üm kitlelerin operasyon öncesi doğru saptanabilme oranları ultrasonografide 14 olgunun 9'u ile %64, manyetik rezonans görüntülemede ise 14 olgunun 7'si ile %50 olarak bulunmuştur. Yüksek çözünürlüklü ultrasonografi, güvenilir, düşük maliyetli ve reel zamanlı dinamik görüntüleme imkanı tanıyan bir yöntem olması nedenleriyle yumuşak doku kitlelerinin değerlendirilmesinde uygundur. Ultrasonografi yumuşak doku kitlelerinin kistik, solid yapısını ortaya koyma imkanı tanır, hacim tahmini sağlar ve hatta patolojik tanıyı tahmin edebilir. Ultrasonografi el ve el bileği kitlelerinin değerlendirilmesinde çoğunlukla yeterli olabilir.

Anahtar kelimeler: *Yumuşak doku kitlesi, ultrasonografi, MRI*

[1]Kafkas University Faculty of Medicine [2]Dr Ersin Arslan State Hospital

Correspondence: *Güneş Orman,*
Kafkas University Faculty of Medicine

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INTRODUCTION

High-resolution ultrasonography is well suited for screening soft tissue masses because of its safety, low cost, and capacity for real-time dynamic imaging. Ultrasonography enables a reliable diagnosis of the cystic or solid nature of soft tissue lesions and accurate estimation of the volume, and can even facilitate pathologic diagnosis based on characteristics of the lesions. In general, magnetic resonance imaging (MRI) cannot differentiate between benign and malignant tumors, but in many circumstances, a specific diagnosis may be achieved by taking into account patient history, location of the lesion, and its signal characteristics. The purpose of this study was to evaluate the preoperative features of hand and wrist soft tissue masses by ultrasonography and MRI and to compare the results with the postoperative pathological results.

MATERIALS AND METHODS

Patients (n:14) with a complaint of mass or pain in the hand and wrist were included in the study, after obtaining informed consent. Before surgery, we performed ultrasonography and MRI of the masses. An ultrasound scanner (Toshiba Aplio XG®) equipped with 12-17 MHz lineer transducer was used to evaluate all the masses. Patients were seated facing the examiner with arm elong the shoulder and elbow flexed, the forearm lying on the knee, wrist in supination or pronation according to the place of masses. Doppler imaging was used on solid masses. MRI was performed using a Siemens 1.5T MAGNETOM Avanto®. A dedicated extremity coil was used, with a 15-18 cm field of view, with a matrix of 512 and slice thickness of 1.5–3 mm. The routine examination for a mass included axial T1-weighted and fat saturation, coronal or sagittal T1- and T2-weighted images. The preoperative diagnoses were compared with postoperative pathological diagnoses, and the results were statistically evaluated by using the chi-square frequency test.

RESULTS

Of the 14 patients included in the study, 10 were women and 4 were men. The mean age was 38 9 ± 16.7 (mean ± SD) with an age range of 2–57 years. Pathological results were as follows: ganglion cyst in 4 cases (28.5%), giant cell tumor of the tendon sheath in 4 (28.5%), glomus tumor in 2 (14.2 %), schwannoma in 2 (14.2%), lipoma in 1 (7.1%), and fibroma in 1 (7.1%). According to these pathological results, the positive predictive value (PPV) of ultrasonography was 100% for ganglion cyst (4 cases), 75% for giant cell tumor of the tendon sheath (3 cases), 50% for glomus tumor (1 case), 0 for schwannoma, 100% for lipoma (1 case), and 0 for fibroma. The PPV of MRI was 100% for ganglion cyst (4 cases), 25% for giant cell tumor of the tendon sheath (1 case), 50% for glomus tumor, 50% for schwannoma (1 case), 0 for lipoma, and 0 for fibroma. In total, the PPV of ultrasound was 64% (9/14) and of MRI was 50% (7/14). Both methods were 100% successful in identifying the ganglion cysts (Table 1). However, according to our study, ultrasonography is statistically superior to MRI for the evaluation of soft tissue masses.

DISCUSSION

Our results showed that ultrasonography provides an advantage to evaluate soft tissue masses of hand and wrist with 64% to predict pathological results. Advancements

Table 1. *The cases predicted with Ultrasonography and Magnetic Resonance Imaging*

Pathological diagnose	*n*	*Rate (%)*	*US prediction n*	*US prediction (%)*	*MRI prediction n*	*MRI prediction (%)*
Glomus tumor	*2*	*14.2*	*1*	*50*	*1*	*50*
Giant Cell tumor of tendon sheath	*4*	*28.5*	*3*	*75*	*1*	*25*
Ganglion cyst	*4*	*28.5*	*4*	*100*	*4*	*100*
Schwannoma	*2*	*14.2*	*0*	*0*	*1*	*50*
Lipoma	*1*	*7.1*	*1*	*100*	*0*	*0*
Fibroma	*1*	*7.1*	*0*	*0*	*0*	*0*
TOTAL	*14*	*100*	*9*	*64*	*7*	*50*

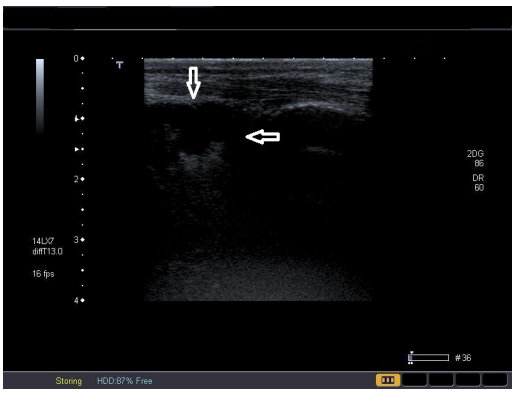

***Figure 1**. 35-year-old man with soft tissue swelling of the wrist, ultrasound image shows the anechoic lesion (arrows) of the wrist indicated that it is cystic mass. The pathological result is ganglion cyst.*

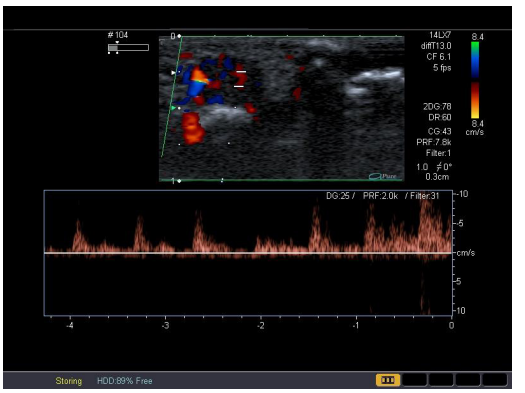

***Figure 3**. 28-year-old woman with an extremely painful solid tissue mass in the fourth finger pulpa. The lesion was very sensitive and painful during the ultrasound. The color Doppler imaging has shown the anechoic lesion with higly internal vascularity.*

in hardware and software have made ultrasonography a valuable non-invasive, accessible, cost-effective, inexpensive, and dynamic imaging technique for the evaluation of the musculoskeletal system (1-3). In particular, ultra high-frequency transducers (10–17 MHz) provide high image quality for superficial structures (1), and ultrasonography allows detection of foreign bodies and reliable identification of a variety of traumatic lesions affecting tendons, retinacula and annular pulleys, ligaments, vessels, and nerves (2, 3). Hand and wrist masses may be secondary to tumors, infection, inflammation, degeneration, or trauma (1). In patients with soft tissue masses in the hand and wrist area, ultrasonography is often able to assess the presence of a space-occupying

***Figure 2**. 47-year-old woman with soft tissue swelling and mild pain in third finger flexor aspect. A homogenous, hypoechoic, well-delineated solid mass adjacent to the tendons was seen in ultrasound. The pathological result was giant cell tumor of the tendon sheath.*

***Figure 4**. 33-year-old woman with soft tissue swelling in fourth finger flexor aspect. In non-contrast enhanced T1 weighted magnetic resonance image there is well-defined, hypointense lesion adjacent to the tendon.*

***Figure 5**. 33-year-old woman with soft tissue swelling in fourth finger flexor aspect. The same patient. After contrast material injection there is diffuse uniform enhancement has been noted.*

lesion and to characterize its nature (2). According to a Delphi-based consensus study by the European Society of Musculoskeletal Radiology, ultrasonographic evaluation of hand and wrist masses is the first-choice technique, and other approaches rarely provide more information (4). Our results are consistent with those findings.

Malignant neoplasms of the hand and wrist are uncommon, but soft-tissue masses located on the hand and wrist are a frequent clinical presentation. The majority of these are ganglia (5)], which are the most common soft tissue tumors and the most common cause of palpable lesions of the hand and wrist, accounting for 70% or more of masses (6, 7). They are most common in young women, although they can occur at any age and in both sexes (8).

The most frequently seen masses in our study were ganglia and giant cell tumor of the tendon sheath. On ultrasonography, ganglion cysts are noncompressible, well defined, and anechoic with posterior acoustic enhancement (Figure 1) (6). Most arise from the dorsum of the wrist, in relation to the dorsal scapholunate ligament (9). Although MRI has been traditionally used to characterize ganglia, ultrasonography has been shown to be very accurate for specifically diagnosing these lesions (10).

Giant cell tumor of the tendon sheath is also known as localized nodular tenosynovitis or focal pigmented villonodular synovitis, due to its pathological appearance (1, 9, 11). It is the second most common lesion of the hand and wrist (6, 8, 9, 11). And also, it is the most common soft tissue tumor of the hand and wrist (1, 12). Middleton et al defined ultrasonographic appearance of these tumors as hypoechoic and mostly homogenous (11). Some may exhibit posterior acoustic enhancement but none show cystic components (11). Classically, ultrasonography shows a homogenous, hypoechoic, well-delineated solid mass adjacent to the tendons. However, on dynamic ultrasonography these lesions do not move, because they originated from the tendon sheath (11).

Color Doppler ultrasonography shows vascularity of these tumors but no specific flow pattern was described in previous studies (8, 9, 11). We observed them to be well-defined, hypoechoic solid masses by ultrasonography (Figure 2). Color Doppler showed weak internal vascularity.

Glomus tumors arise from the neuromyoarterial bodies and are found mostly in the fingertips or subungual locations in the fourth and fifth decades (8, 13, 14). Patients with this tumor are hypersensitive to cold and touch in the affected area, and experience paroxysmal pain aggravated by temperature changes (6, 14). Ultrasonographically, the lesions are solid but very hypoechoic and may show posterior acoustic enhancement (8). Color Doppler assessment shows the hypervascularity of the tumor (Figure 3).

Schwannoma, also known as neurilemmoma, arises from Schwann cells at the periphery of nerves (8). This tumor usually grows slowly and may appear as a painless mass for several years before diagnosis (15). Accurate preoperative differentiation of schwannoma from solitary neurofibroma is important, because solitary neurofibromas grow intraneurally and potentially require full resection (15).

Ultrasound shows sharply delineated, homogenous, and hypoechoic lesion with posterior acoustic enhancement (8). However, it can be diagnosed definitively only when continuity with the nerve can be documented (16).

In general, a specific diagnosis may be achieved by taking into account the location of the lesion within the hand and wrist and its signal characteristics by MRI (17). The differential diagnosis of benign tumors and tumor-like lesions of the hand and wrist is important in determining

whether therapy should be medical or surgical or whether mere follow-up is adequate (18). On MRI, ganglion cysts are seen as unilocular or multilocular, well marginated, rounded or lobular fluid-signal masses adjacent to a joint or the tendon sheath. Typically, they are hypointense on T1-weighted images and hyperintense on T2-weighted images (17, 19). MRI typically shows the giant cell tumor of the tendon sheath as a well-defined mass adjacent to or enveloping a tendon (18, 20). The mass is hypointense on both sequences (Figure 4) (17). Uniform enhancement can be seen on post-contrast series (Figure 5) (17, 20).

Glomus tumors are typically smooth-contoured lesions with low or intermediate signal intensity on T1-weighted images and homogenously high intensity on T2-weighted images (17, 18). Typically, uniform and significant contrast enhancement is observed (18). The most important facet of imaging neurogenic tumors is recognition of a fusiform mass with a dural tail (21). This is possible when the nerve is large and deep, but in the case of superficial and small tumors, this feature may not be seen (17).

Technical excellence of MRI scanning is very important in order to achieve diagnostic results. A dedicated wrist coil is recommended to achieve high resolution in a small field of view in the order of 8–12 cm, with a matrix of at least 256x512 and a slice thickness of 1.5–3 mm. A number of pulse sequences and image planes can be used (17). The main limitation of our study is the small number of our patient group. Future studies with higher number of patients should be performed.

High-resolution ultrasonography is well suited for screening soft tissue masses because of its safety, low cost, and real-time dynamic imaging ability. Sonography enables a reliable diagnosis of the cystic or solid nature of soft tissue lesions, accurate estimation of the volume, and can facilitate pathologic diagnosis according to the lesions. Examiners should perform a dynamic examination and trace the adjacent structure to obtain more diagnostic clues. Color Doppler ultrasonography demonstrates blood flow and may provide clues for differential diagnosis.

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