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ARAŞTIRMA YAZISI / RESEARCH ARTICLE

FİBROİDLERİN DOPPLER ULTRASONOGRAFİ VE MANYETİK REZONANS GÖRÜNTÜLEMESİNİN KARŞILAŞTIRILMASI

COMPARISON OF DOPPLER ULTRASONOGRAPHY AND MAGNETIC RESONANCE IMAGING OF FIBROIDS

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ÖZET

AMAÇ: Bu çalışma, boyut ve büyüme dahil olmak üzere miyomların çeşitli özelliklerinin değerlendirilmesinde Doppler ultrasonografi (USG) ve Manyetik rezonans görüntüleme (MRG) özelliklerini karşılaştırmayı amaçlamaktadır.

GEREÇ VE YÖNTEM: Tanımlayıcı tipteki bu çalışma, Türkiye'de özel bir jinekoloji kliniğine başvuran kadın hastalar üzerinde yapılmıştır. Hastaların Doppler USG ve MRG ölçümleri yapıldı ve aşağıdaki indeksler hesaplandı: diyastolik ortalama oranı (DAR), sistolik/diyastolik oranı (SDR), end-diyastolik velosite (EDV), pik sistolik hız (PSV), hızlanma süresi (AT), zaman ortalamalı ortalama hız (Tmean), empedans indeksi (LML), akselerasyon indeksi (AI), diyastolik/sistolik oran (DSR), direnç endeksi (RI), pulsatilite indeksi (PI), zaman ortalamalı maksimum hız (TAMX). Bu indeksler tüm çalışma grubunda ve 49 yaşından büyükler arasında değerlendirildi.

BULGULAR: PSV, EDV, TAMX, Tort, PI, RI, SDR, AT, AI, DSR, LML, DAR indeksleri ve tümör boyutu değişim ortalamalarının Doppler USG ve MRI sonuçları hem çalışma grubunda hem de 49 yaşından daha büyük kadınlarda benzer bulundu. Çalışma grubundaki kadınların Doppler USG ile ölçülen PSV, EDV, TAMX, Tort, PI, RI, SDR, AT, AI, DSR, LML, DAR indeksleri ve tümör boyutu ile MRG ölçümleri arasında güçlü pozitif korelasyon olduğu bulundu.

SONUÇ: Araştırmada elde edilen sonuçlar Doppler USG'nin miyom tanısında MRG kadar uygun olduğunu ortaya koymuştur.

ANAHTAR KELİMELER: Leiomyoma, Manyetik Rezonans Görüntüleme, Ultrasonografi, Uterus

ABSTRACT

OBJECTIVE: This study aimed to compare Doppler ultrasonography (USG) and magnetic resonance imaging (MRI) in the evaluation of various characteristics of myomas, including size and growth.

MATERIAL AND METHODS: This descriptive study was conducted on female patients admitted to a private gynecology clinic in Turkey. Doppler USG and MRI measurements of the patients were performed and the following indices were calculated: Diastolic average ratio (DAR), Systolic/diastolic ratio (SDR), End-diastolic velocity (EDV), Peak systolic velocity (PSV), Acceleration time (AT), Time-averaged mean velocity (Tmean), Impedance index (LML), Acceleration index (AI), Diastolic/systolic ratio (DSR), Resistivity index (RI), Pulsatility index (PI), Time-averaged maximum velocity (TAMX). These indices were evaluated in the whole study group and also among those older than 49 years.

RESULTS: Doppler USG and MRI results of PSV, EDV, TAMX, Tort, PI, RI, SDR, AT, AI, DSR, LML, DAR indexes and tumor size change averages were found to be similar in both the study group and women older than 49 years. It was found that there were strong positive correlations between Doppler USG and MRI measurements of PSV, EDV, TAMX, Tort, PI, RI, SDR, AT, AI, DSR, LML, DAR indices and tumor size change among the women in the study group.

CONCLUSIONS: The results found in the research revealed that Doppler USG is as convenient as MRI in the diagnosis of myomas.

KEYWORDS: Leiomyoma, Magnetic Resonance Imaging, Ultrasonography, Uterus

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INTRODUCTION

Myomas are benign monoclonal tumors of myometrium smooth muscle cells (1). Uterine fibroids are the most common benign neoplasms in women of reproductive age and their lifetime prevalence is between 30-70% (2).

Choosing the right medical treatment depends on determining the size, number and position of fibroids (1). Ultrasonography (USG) and Magnetic Resonance Imaging (MRI) are considered to be the most appropriate methods to evaluate the number, volume, additional structure and location of myomas, as well as providing information regarding their relationship with endometrial cavity and uterine layers in terms of vascularization and differential diagnosis (3).

USG is an easy, accessible, harmless and inexpensive diagnostic procedure (3). Color Doppler USG provides an assessment of vascularity, which may be useful in distinguishing solid and cystic uterine masses and in the differential diagnosis of adenomyosis (4). MRI has very low intra-observer variability which is perfect for precise mapping of the individual fibroid position and is also safe for the measurement of very large fibroid dimensions, despite its limitations in discriminating or directly diagnosing endometrial polyps (4). MRI helps define what can be expected in surgery and can help the surgeon be aware of all myomas during surgery (5). Despite its well-defined advantages, MRI is expensive and accessibility may be a limiting factor in some regions. Furthermore, MRI is not recommended in early pregnancy (6). Comparisons between the efficacy of Doppler USG and MRI in various diseases have been performed previously (7, 8). However, there are only a few studies evaluating Doppler USG and MRI with regard to their capabilities in the detection and assessment of myomas (9). Thus, the aim of this study was to compare Doppler USG and MRI in the evaluation of various myoma-related indices, including size and growth.

MATERIALS AND METHODS

This descriptive study was conducted with a total of 256 women who were admitted to a private gynecology clinic in Turkey.

The MRI machine used in this research was a 1.5-Tesla scanner produced by Siemens Healthcare (Erlangen, Germany). In the measurement of the masses, the classical uterine MRI protocol was followed. Following the coronal SSFSE positioning of the baseline image, small FOW and higher resolution pelvic array were used. Both T1 and T2-weighted images were recorded. The Doppler USG machine used in this research was manufactured by SonoSite Titan (Bothell, USA).

Measurements were performed by trained and experienced technicians who had 12 years of experience and were blinded to the objectives of the study.

In order to prevent systematic bias that may arise from always performing the first measurement with one of the modalities (MRI or Doppler USG), the first measurement method used was chosen randomly in each patient. Both measurements were conducted on the same day in order to prevent possible time-dependent variations in measured variables.

The following indices were calculated from both modalities: DAR: Diastolic average ratio, SDR: Systolic/diastolic ratio, EDV (cm/s):End-diastolic velocity, PSV (cm/s):Peak systolic velocity, AT (ms):Acceleration time, Tmean (cm/s):Time-averaged mean velocity, LML: Impedance index, AI: Acceleration index, DSR: Diastolic/systolic ratio, RI: Resistivity index, PI: Pulsatility index, TAMX (cm/s): Time-averaged maximum velocity. Moreover, the change in tumor size relative to the baseline value was calculated as a percentage. In addition to evaluating the results of the whole study group, we also analyzed a subgroup that was comprised of patients older than 49 years.

Collected data were analyzed by means of Statistical Package for Social Sciences program version 15.0 (SPSS IBM, Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation, and categorical variables were denoted as numbers or percentages where appropriate. The suitability of the data for normal distribution was evaluated by Smirnov-Kolmogorov test. Pearson correlation analysis was used to evaluate the correlations between Doppler USG and MRI results. Statistical significance level was accepted as $p \leq 0.05$.

Ethical Committee

Approval was obtained from the Non-Interventional Clinical Research Ethics Committee of Istanbul Medipol University (Decision Number: 518, Decision Date: 25/06/2020).The study was conducted in accordance with the Declaration of Helsinki and the Good Clinical Practice. The patients were given detailed information about the purpose and scope of the study. After the written consent of the patients who agreed to participate in the study was obtained, measurements were performed and data were recorded.

RESULTS

Doppler and MRI results of PSV, EDV, TAMX, Tort, PI, RI, SDR, AT, AI, DSR, LML, DAR indexes and tumor size change averages were found to be statistically similar with the two modalities Table 1. In the analysis of the whole study group, we found very strong positive correlations between the Doppler USG and MRI measurements of the following indices: PSV, EDV, TAMX, Tort, PI, RI, SDR, AT, AI, LML and DAR. Additionally, we also found that there was an excellent positive correlation between DSR index (as measured by Doppler USG) and tumor size change (as measured by MRI) **(Table 1)**.

Table 1: Correlation of Doppler US and MRI indices

	Doppler USG	MRI		
	Mean±Sd (%99 CI)	Mean±Sd (%99 CI)	r	p
PSV (cm/s)	90.47±27.82 (85.95-94.98)	91.32±28.54 (86.69-95.95)	0.98	< 0.0001*
EDV (cm/s)	28.97±17.09 (26.20-31.74)	29.30±17.44 (26.47-32.13)	0.99	< 0.0001*
TAMX (cm/s)	52.82±21.46 (49.33-56.29)	53.32±21.98 (49.75-56.88)	0.99	< 0.0001*
Tort (cm/s)	26.55±12.68 (24.49-28.61)	26.79±12.96 (24.68-28.89)	0.99	< 0.0001*
PI	1.53±0.68 (1.42-1.64)	1.54±0.69 (1.43-1.65)	0.99	< 0.0001*
RI	0.80±0.10 (0.78-0.82)	0.81±11 (0.79-0.83)	0.90	< 0.0001*
SDR	3.52±1.34 (3.30-3.74)	3.56±1.37 (3.33-3.78)	0.99	<0.0001*
AT (ms)	115.83±27.11 (111.43-120.23	116.95±28.09 (112.39-121.50)	0.97	< 0.0001*
AI	0.82±0.25 (0.78-0.86)	0.83±0.26 (0.79-0.87)	0.98	< 0.0001*
DSR	0.26±1.63 (0.31-0.41)	0.26±1.65 (0.31-0.41)	1.00	< 0.0001*
LML	3.62±1.35 (3.40-3.84)	3.66±1.39 (3.43-3.88)	0.99	< 0.0001*
DAR	0.57±0.18 (0.54-0.60)	0.58±0.18 (0.55-0.61)	0.98	< 0.0001*
Tumor size change (%)	10.77±21.07 (7.32-14.19)	10.68±20.92 (7.29-14.10)	1.00	< 0.0001*

* p values less than 0.05 are accepted as statistically significant

In women older than 49 years, similarly, the indices and tumor size change were found to be statistically similar with Doppler USG and MRI Table 2. The PSV, TAMX, Tort, PI, RI, SDR, AT, AI, LML, DAR indices were found to have a very strong positive correlation in measurements performed with Doppler USG and MRI. In addition, it was found that the Doppler USG and MRI results of EDV, DSR indices and tumor size change correlated significantly **(Table 2)**.

Table 2: Correlation of Doppler US and MRI indices in women older than 49 years

	Doppler USG	MRI		
	Mean±sd (%99 CI)	Mean±sd (%99 CI)	r	p
PSV (cm/s)	88.87±26.19 (80.69-98.45	89.35±26.30 (81.17-99.54)	0.98	< 0.0001*
EDV (cm/s)	27.00±16.24 (21.26-32.73)	27.24±16.87 (21.28-33.20)	1.00	< 0.0001*
TAMX (cm/s)	55.20±21.59 (47.57-62.82)	55.67±22.21 (47.82-63.51)	0.99	< 0.0001*
Tort (cm/s)	27.57±13.54 (22.79-32.56)	27.73±13.90 (22.82-32.64)	0.99	< 0.0001*
PI	1.48±0.67 (1.25-1.72)	1.49±0.65 (1.26-1.72)	0.99	< 0.0001*
RI	0.80±0.11 (0.76-0.84)	0.80±0.11 (0.76-0.84)	0.91	< 0.0001*
SDR	3.35±1.27 (2.90-3.79)	3.38±1.33 (2.91-3.85)	0.99	< 0.0001*
AT (ms)	113.46±30.35 (102.74-124.18)	114.10±30.65 (103.27-124.92)	0.98	< 0.0001*
AI	0.82±0.26 (0.72-0.91)	0.82±0.26 (0.73-0.91)	0.98	< 0.0001*
DSR	0.37±0.39 (0.23-0.51)	0.37±0.38 (0.23-0.50)	1.00	< 0.0001*
LML	3.55±1.41 (3.05-4.04)	3.58±1.48 (3.05-4.10)	0.99	< 0.0001*
DAR	0.56±0.17 (0.50-0.62)	0.56±0.17 (0.50-0.62)	0.98	< 0.0001*
Tumor size change (%)	11.87±23.15 (3.69-20.04)	11.71±23.25 (3.50-19.92)	1.00	< 0.0001*

*p values less than 0.05 are accepted as statistically significant

DISCUSSION

Imaging is crucial for the diagnosis and management of myomas. The main purpose of imaging is the determination of the number, size and location of fibroids as well as the dimensions of the uterus, and determination of vascularity (4). This study aims to compare Doppler USG and MRI to determine whether there are any differences that might affect the imaging indices related to the size and properties of myomas.

The average values of the various indices and tumor size change measured by both imaging modalities were statistically similar in the study groups and also in women aged over 49 years. It was found that the Doppler USG and MRI measurements of baseline PSV, EDV, TAMX, Tort, PI, RI, SDR, AT, AI, LML, DAR indices demonstrated significant and positive correlations. In women aged over 49 years, it was found that there were significant and positive correlations between Doppler USG and MRI results of PSV, TAMX, Tort, PI, RI, SDR, AT, AI, LML and DAR. In addition, it was found that EDP, DSR indices and Doppler USG and MRI results of the tumor size change correlated significantly.

In a systematic review evaluating the importance of USG and MRI in the diagnosis of myoma, it was reported that MRI (sensitivity 77%, specificity 89%) was superior to transvaginal USG (sensitivity 72%, specificity 81%) in the diagnosis of myoma (10). In another study, it was reported that the results of MRI (sensitivity: 0.77, specificity: 0.89) were more favorable than the results of transvaginal USG (sensitivity: 0.72-0.82, specificity: 0.85-0.81) in the diagnosis of adenomyoma (11). According to the results of

a meta-analysis in which the results of 31 studies were previously evaluated, the diagnostic performance of transvaginal USG (sensitivity 0.79, specificity 0.83) and MRI (sensitivity 0.78, specificity 0.93) was reported to be similar in the diagnosis of adenomyosis (12). In the study of Sam et al., Transvaginal USG was reported to be a highly specific (91.8%), cost-effective and readily available alternative for the diagnosis of uterine adenomyosis compared to MRI, but less sensitive (36.8%) (13). According to Hameed's research, the correct detection rate of myoma on USG (73.3%) was significantly lower than the rate of correct detection on MRI (98.1%). According to this study, the mean number of fibroids detected by USG (1.62±1.07) was lower than the number detected by MRI (2.14±1.49) (14).

Interestingly, Kim et al. reported that Doppler USG (sensitivity: 100%, specificity: 92%) was more reliable than MRI (sensitivity: 91%, specificity: 91%) in detecting subserosal and extrauterine myomas (9). This latter result suggests that the localization of the tumor may provide some advantages to USG evaluation, especially considering that MRI results would not be particularly altered with regard to location. However, it is also possible that better results related with USG examination are associated with the personal experience and skillfulness of the sonographers. Measurement of fibroid growth rates has an important role in the development of tumor-inhibiting treatment modalities for perimenopausal women. Unlike Doppler USG, MRI remains as an expensive imaging tool that requires more resources (15). Previously, findings from some other studies have confirmed the general evidence for the reliability of Doppler USG when performed by experienced and skilled sonographers (16 - 22). In the present study, the results of Doppler USG and MRI related to fibroid size changes and other indices were similar.

The findings of the present study indicate that Doppler USG is as successful as MRI in measuring fibroid growth and other features of myomas. As such, in settings where MRI is unavailable, clinical diagnosis of myomas and decision making for treatment can be safely based on Doppler USG findings. Therefore, Doppler USG can still be addressed as a reliable tool for the diagnosis and management of fibroids.

More extensive research is needed to evaluate the possible limitations of both Doppler USG and MRI in the detection and assessment of myomas.

Limitations

The power of the present study is limited by a relatively small cohort size, its conductance at a single center and lack of comparison with histopathological findings.

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