ORIGINAL PAPER

Magnetic Resonance Imaging (MRI) and Transvaginal Ultrasonography (TVU) at Ovarian Pain Caused by Benign Ovarian Lesions

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ABSTRACT

Research goal: The aim of the research is to define the possibilities of TVU and the MRI in the diagnosis of the most common benign ovarian lesions which cause pelvic pain. **Patients and methods:** In study were included n=74 patients with pelvic pain, who were examined with TVU and then with an MRI of pelvis. Diagnostic results of all patients (n=74) divided into two groups according to the modality that was performed (TVU results n=74 and MRI results n=74 MRI). We compared the results of TVU and MRI, and with a pathohistological finding after surgery. TVU test sensitivity and MRI test sensitivity has been made for each pathological entity in particular. The overall sensitivity test of TVU was performed for all pathological entities together. The overall sensitivity test of MRI was performed for all pathological entities together. **Results:** TVU demonstrated sensitivity of 83.3% for ectopic pregnancy, 83.3% for ovarian torsion, 84% for endometriotic cyst, 88.2% for hemorrhagic cysts, 58.3% for tubo-ovarian abscesses, 62.5% for dermoid cysts. Overall sensitivity of TVU for all these pathological entities was 78.4%. MRI showed a sensitivity of 100% for ovarian ectopic pregnancy, 83.3% for ovarian torsion, 100% for endometriotic cyst, 100% of hemorrhagic cysts, 83.3% tubo-ovarian abscess, and 87.5% for dermoid cysts. Overall sensitivity of MRI in all of these pathological entities was 94.6%. The analysis using the chi square test shows that there is a significant difference in the sensitivity between the US and MRI in favor of greater overall MRI sensitivity in diagnosing ovarian pain caused by benign lesions. ($\chi 2 = 14.352$, df = 9, p = 0.0021). **Conclusion:** TVU is the first choice method for ovarian analysis due to the convenience and absence of radiation, and MRI is a very useful modality when TVU's results are confusing and unspecific.

Keywords: TVU, MRI, ovarian pain, benign ovarian lesions, diagnostic, sensitivity.

1. INTRODUCTION

Pelvic pain can have gynecological and non gynecological etiology (1). Diagnosis of pelvic pain in women can be challenging because many symptoms and signs are insensitive and nonspecific (2). The symptoms of non gynecological disease can overlap with the gynecological in the presentation of pain in the pelvis (3). The uterus, cervix, and adnexa share the same visceral innervation as the lower ileum, sigmoid colon, and rectum. Signals travel via the sympathetic nerves to spinal cord segments T10 through L1. Because of this shared pathway, distinguishing between pain of gynecologic and gastrointestinal origin is often difficult (4). Certain benign lesions of the ovary can be cause of pelvic pain and their recognition is important from the view point of therapy and prognosis (5).

The common cause of pelvis pain caused by benign ovarian lesions is: hemorrhagic cysts, ovarian torsion, endometric cyst, tubo-ovarian abscesses, dermoid cyst, malignant tumor mass.

2. RESEARCH GOAL

The aim of the research is to define the possibilities of Transvaginal Ultrasonography (TVU) and the Magnetic Resonance Imaging (MRI) in the diagnosis of the most common benign ovarian lesions which cause pelvic pain.

3. PATIENTS AND METHODS

This prospective, analytical, comparative study included 74 women who were hospitalized and outpatients at the University Clinical Center Sarajevo in a period from June 2012 to September 2016. In study were included patients with pelvic pain, which was

Dijagnosis		TVU	MRI	PH
Ovarian ectopic pregnancy	N	5	6	6
	Sensitivity	83.3	100%	
Ovarian torsion	N	5	5	6
	Sensitivity	83.3	83.3	
Endometriotic cyst	N	21	25	25
	Sensitivity	84.0	100.0	
Hemorrhagic cyst	N	15	17	17
	Sensitivity	88.2	100.0	
Tuboovarian abscess	N	7	10	12
	Sensitivity	58.3	83.3	
Dermoid cyst	N	5	7	8
	Sensitivity	62.5	87.5	
Total	N	58	70	74
	Sensitivity	78.4	94.6	

Table 1. Results of sensitivity of TVU and MRI according to diagnosis

caused by benign ovarian lesion. All patients were examined with TVU and then with an MRI of pelvis. Transvaginal ultrasound was performed on a GE apparatus with 7 MHz Imaging Frequency, Wide-band micro-convex array and footprint 16.9 x 21.2 mm.

MRI sequences were acquired on a Siemens at 1.5T with a phased-array pelvic coil in the supine position. Contrast sequences were made with gadolinium which was applied via iv. access. The protocol has the following sequences -T1fl3d cor fsFOV400 slice thickness 2 mmTR 3.25 ms PE 1.2 mls voxelsize 1.7 x 1.6 x 2 mm. T2 trufi 3d cor FOV 450, slth1 mm TR 4.09, TE 1.8 voxel size 1.6 x 1.4 x 1, T2 tsesag FOV 280 slth4mmm TR 3700, TE 101 voxel size 0.7 x 0.7 x 4. Afterwards T2tse tra FOV 210, slth 4 mm TR 3730, Te101 voxel size 0.8 x 0.8 x 4. T2 cor FOV 300 slth 4 mm, TR 5230 Te 99, voxel size 0.7 x 0.7 x 4. Vibe T1 fs tra FOV 450, TR 4.99, Te 2.61, slth 2.5 mm voxel size 2.7 x 1.8 x 2.5 T1 tsetra Fov210, slth4mm, TR 666, TE10, voxel size 0.8 x 0.8 x 4.1p2d, diff fov380, tr4600t,e76slth 4mm, b value 50 300 600 with ADC map.

Diagnostic results of all patients (n=74) were presented into two groups according to the modality that was made (TVU results n=74 and MRI results n=74 MRI). We compared the results of TVU and MRI, and with a pathohistological finding after surgery. TVU test sensitivity has been made for each pathological entity in particular. MRI test sensitivity has been made for each pathological entity in particular. A overall sensitivity test of TVU was performed for all pathological entities together. A overall sensitivity test of MRI was performed for all pathological entities together. Statistical analysis was carried out using the statistical package for biomedical researches MedCAlc v 12.3.

4. RESULTS

The average age of patients included in the study was 37±12.2 years, the younger was 17 years old and the oldest 53 years of age. Results of this study show that out of total 72 patients were: ovarian ectopic pregnancy n=6 (8.1%), ovarian torsion n=6 (8.1%), endometriotic cysts n=25 (33.8%), hemorrhagic cysts n=17 (23%), tubo-ovarian abscesses n=12 (16.2%) and dermoid cyst n=8 (10.8%) (Figure 1).

TVU demonstrated sensitivity of 83.3% for ectopic pregnancy, 83.3% for ovarian torsion, 84% for endometriotic cyst, 88.2% for hemorrhagic cysts, 58.3% for tubo-ovarian abscesses, 62.5% for dermoid cysts. Overall sensitivity of TVU for all 6 analyzed pathological entities was 78.4%. MRI showed a sensitivity of 100% for ovarian ectopic pregnancy, 83.3% for ovarian torsion, 100% for endometriotic cyst, 100% of hemorrhagic cysts, 83.3% tubo-ovarian abscess, and 87.5% for dermoid cysts. Overall sensitivity of MRI for all of 6 analyzed pathological entities was 94.6%. The analysis using the chi square test shows that there is a significant difference in the sensitivity between the US and MRI in favor of greater overall MRI sensitivity in diagnosing pain caused by benign ovarian lesions ($\chi 2 = 14.352$, df = 9, p = 0.0021) (Figure 2, Table 1).

This chi-square test refers to the comparison of US vs.

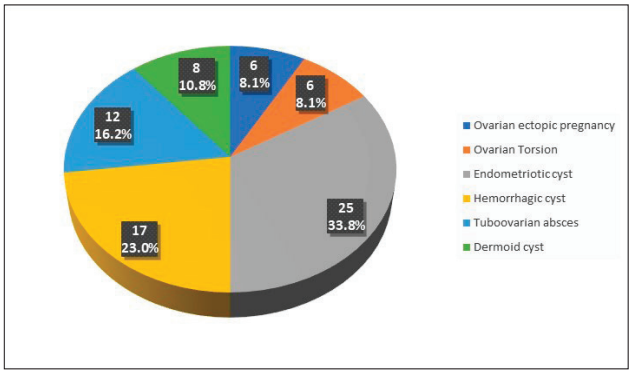

Figure 1.Distribution of patients according to the cause of ovarian pain

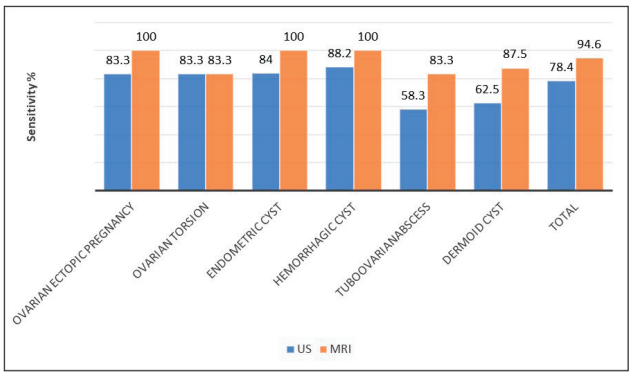

Figure2. Comparison of overall sensitivity between TVU and MRI

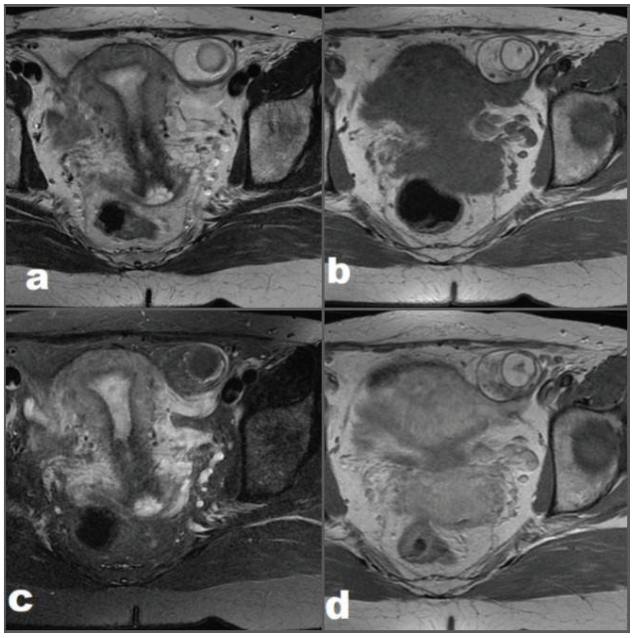

Figure 3. MRI tra of dermoid cyst: a. T2w, b. T1w, c. T1fs, d. CE T1w

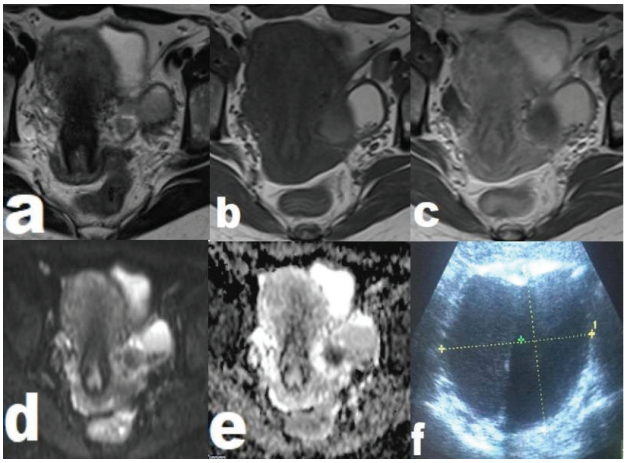

Figure 4. MRI and TVU images of endometriotic cysts of the left ovary

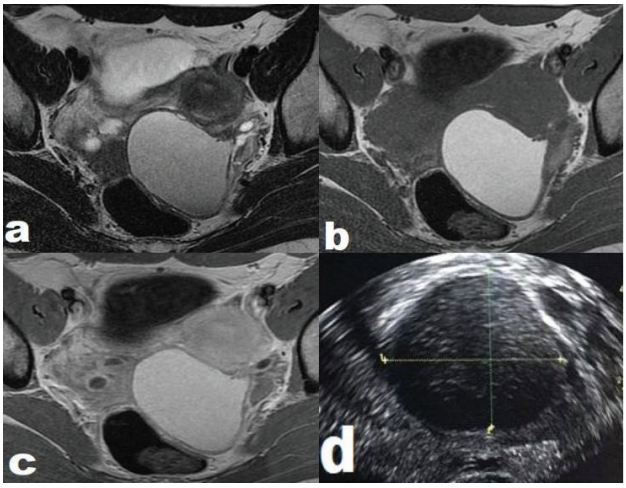

Figure 5. MRI and TVU images of the hemorrhagic cyst of the left ovary

MRI across all 6 analyzed pathological entities.

5. DISCUSSION

Diagnostic imaging plays a crucial role in detection, characterization of gynecological cause of pelvic pain end may influence patient's management. In the initial evaluation of pelvic masses, ultrasound has become the imaging modality of choice (6). The ultrasound image can usually make the diagnosis in conjunction with the clinical parameters. Standard pelvic screening tests consist of traditional transabdominal approach combined with transvaginal sonography (TVU). In many cases a combination of the two ultrasonic approaches get the diagnostic information that are complementary. Transabdominal sonography uses a distended bladder providing a greater global overview than transvaginal approach, showing the ovaries and ovarian structures better in the cases of their high positions.

On the other hand, transvaginal sonography may have limited visualization of the pelvic organs due to attenuation through the abdominal wall which often makes the use of higher-frequency probes. TVU facilitated excellent visualization of internal architectural details adnexal mass. As a primary imaging modality, u sing a pattern recognition approach through gray-scale TVU, ovarian masses can be diagnosed with high specificity and sensitivity. Doppler US may allow ovarian masses to be diagnosed as benign or malignant with even greater confidence (7).

Magnetic Resonance Imaging (MRI) is an essential problem solving tool to determine origin of a ovarian pathology and then to characterize ultrasound indeterminate lesions. The main advantages of MRI are the high contrast resolution with excellent soft tissue contrast and lack of ionizing radiation exposure, which is particularly important in young female patients (8). For that reason, MRI is fast growing as the imaging modality of choice following ultrasound (9). Thanks to the excellent tissue characterizing the MRI reliably distinguishes blood, fat and liquid from the soft tissue. One of the biggest advantages of MRI over other diagnostic modalities is a possibility of achieving direct images in each orthogonal plan.

Ovarian torsion occurs when the vascular pedicle of the ovary twists along its suspensory ligament and causes initial obstruction of venous and lymphatic outflow. Sensitivity of TVU for the diagnosis of ovarian torsion is variable and depend on the operator (10, 11). The results of the sensitivity we achieved for ovarian torsion using TVU were 83.3%, and MRI were 83.3%. Rostamzadeh published the sensitivity and specificity of TVU for ovarian torsion of 72.1% and 99.6%. In the same study, preoperative MRI demonstrated a sensitivity of 91.7% and a specificity of 100% for predicting the viability of a torsed ovary **(12).** The Rostamzadeh study shows the superiority of MRI vs. TVU, while our TVU vs. MRI results are identical.

Mature cystic teratomas (dermoid cyst) are cystic tumors composed of well-differentiated derivations from at least two of the three germ cell layers. In our study TVU sensitivity for dermoid cysts was 62%, MRI sensitivity was 87.5% (Figure 3). In the Ekici study, the US sensitivity of dermoid cyst was found of 94%. On the other hand, the sensitivity for the detection of dermoid cyst in the study carried out by Mais et al. was 84.6% **(13).** Our TVU results are lower compared to the above mentioned studies, which can be explained by the operator's subjectivity. Our MRI results are similar to results from Ekici study and to the studies conducted 20 years ago (14).

Endometriosis is characterized by ectopic endometrial tissue, primarily within the ovaries and pelvic peritoneum (15). When it comes to the ovary, an endometriotic cysts (endometriomas) are formed (Figure 4). In our study TVU sensitivity for endometrial cysts was 84%, and MRI sensitivity was 100%. Transvaginal ultrasound was found to have a sensitivity of 88% and specificity of 90% for differentiating endometrioma from other ovarian lesions **(16).** Sensitivity and specificity values of 3DUS for the diagnosis of endometrial cysts were (study of Grasso) 87.5% and 100%, respectively; those of MRI were 96.8% and 91.1%, respectively (17). Magnetic resonance imaging (MRI) is useful for making the positive diagnosis and assessing the spread of endometriosis (18). MR imaging for the diagnosis of endometriotic cysts has a sensitivity of 90-92 %, a specificity of 91- 98 % (19). Togshi at al, published that the overall diagnostic of endometriomas sensitivity, specificity, and accuracy were 90%, 98%, 96%, respectively (20). Our results on sensitivity are approximately similar to those of the aforementioned studies.

Hemorrhagic ovarian cysts display a wide spectrum of diagnostic appearances depending on when they are imaged as the cyst progresses through stages of acute hemorrhage, for-

mation and retraction of clot, and eventual resolution (21, 22) (Figure 5). Recently, many studies have focused on the ability of DWI/MRI in identifying lesions such as hemorrhagic cysts and endometriotic cysts (endometriomas). In addition DWI improves MRI sensitivity to 97%, specificities of 86% and overall accuracy 95%. Transvaginal US showed a sensitivity of 88%, specificity of 33% and total accuracy 76%. In our study hemorrhagic ovarian cysts, the sensitivity is 88,2% of the MRI sensitivity was 100% **(23).** The moderate MRI sensitivity of 68% and moderate specificity of 83% were published by Outwater in differentiating hemorrhagic ovarian lesions (21).

Tubo-ovarian abscess (TOA) is a late complication of pelvic inflammatory disease (PID) and involves a frank abscess or an inflammatory mass resulting from breakdown of the normal structure of fallopian tubes and ovaries by inflammation. MRI is more accurate than ultrasonography for the diagnosis of tubo-ovarian abscess when an adnexal mass is identified. In our study for tubo-ovarian abscess TVU sensitivity was 84%, and MRI sensitivity was 100%.

In our study there was overall US sensitivity for all pathological entities was 80.8%. ($\chi 2$ = 14.352, df = 9, p = 0.0021). Overall MRI sensitivity of MRI for all pathological entities was 94.6%. Analysis by chi-square test shows that there is a significant difference in sensitivity between TVU and MRI in favor of greater overall sensitivity of MRI when diagnosing the etiology pain caused by benign ovarian lesions ($\chi 2$ = 14.352, df = 9, p = 0.0021). Theodoros published that TVU of the benign ovarian lesion had high overall sensitivity (89-100%) and specificity (73-83%), while TVU of dermoid cyst and endometrioma ware 100% (24). These results are better than in our study, but as opposed to our study paraovarian cysts and cystadenomas had been included. The recently published Salooja's article reports MRI sensitivity of 86.4%, specificity of 94.2%, and accuracy of 91.5% in distinguishing malignant benign ovarian lesions (25). This study included benign and malignant ovarian lesions, so the comparison with our study is insufficient.

6. CONCLUSION

TVU and MRI are a reliable methods in the evaluation cause of ovarian pain caused by benign lesion and provide a basis for optimal preoperative planning. TVU is the first choice method for ovarian analysis due to the convenience and absence of radiation, and MRI is a very useful modality when TVU's results are confusing and unspecific.

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- Author Contribution: Each author participated in each step of article preparation and gave final approval for publishing.

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