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Role of MRI Diffusion Weighted Imaging in Evaluation of Gynecological Pelvic Masses

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ABSTRACT

Background: Gynecological Pelvic masses are common problem that are commonly discovered during routine gynecologic or physical examinations. Radiologists routinely evaluate a wide range of pelvic masses during daily practice. Proper management depends on proper preoperative assessment with the help of clinical examination, laboratory tests and different imaging modalities. Radiological evaluation includes ultrasonography (US), computed tomography (CT) and recently magnetic resonance imaging (MRI). Diffusion weighted imaging (DWI) is widely used in protocols for magnetic resonance imaging (MRI) of the female pelvis. It provides functional and structural information about biological tissues, without the use of ionizing radiation or intravenous administration of contrast medium. **Objective:** This study aimed to evaluate the role of diffusion weighted imaging in the characterization of gynecological pelvic masses and differentiation between benign and malignant tumors. **Patients and Methods:** This study was performed on 63 patients. All patients had US findings of uterine and adnexal lesions then they underwent conventional MRI with contrast & DWI. **Results:** DWI is significant promising tool factors for characterization of gynecological tumors and differentiation between benign & malignant lesions with high sensitivity 95% (81%:99% with 95% CI). The sensitivity, specificity and accuracy of detection of the nature of the lesions have been increased after adding of DWI to the conventional imaging. **Conclusions:** Adding of DWI to the conventional MRI improves the sensitivity and specificity of diagnosis and allows confident diagnosis and differentiation between benign and malignant lesions.

Keywords: Gynecological masses, MRI, DWI, ADC.

INTRODUCTION

Gynecological pelvic masses are common problem that are commonly discovered during routine gynecologic or physical examinations. Radiologists routinely evaluate a wide range of pelvic masses during daily practice [(1)]. Accuracy in diagnosis and early diagnosis is extremely important because it improves the prognosis and decreases the morbidity and mortality. The evaluation of a pelvic mass begins with clinical history and physical examination then different imaging modalities starts with ultrasound, CT and finally proceeds to MRI. Each of these modalities has advantages and disadvantages [(2)].

Ultrasound is relatively cheap, assesses for ascites, delineates cystic versus solid lesions and often the first-line imaging modality for the evaluation of pelvic masses, especially in women, in whom the ovaries are a potential source. However, ultra-sound may be limited by poor acoustic windows and poor depth of penetration, preventing characterization of some masses [(3)].

CT is excellent for retro peritoneum and assesses for other organs. However, limited in the pelvis by a lack of soft-tissue contrast, which becomes problematic when, for example, trying to differentiate decompressed bowel from adnexal structures. MRI, on the other hand, provides excellent contrast resolution, resulting in accurate tissue characterization and improved anatomic delineation. As a result, MRI has been shown to be more specific and accurate than ultrasound for characterizing adnexal masses by using a systematic approach to complex pelvic masses, incorporating the patient's clinical and surgical history, and using MRI to identify the anatomic origin, shape, composition, and enhancement pattern of the mass, a short meaningful differential diagnosis, and often a definitive diagnosis, can be made [(3)].

Diffusion-weighted imaging (DWI) is widely used in protocols for magnetic resonance imaging (MRI) of the female pelvis. It provides functional and structural information about biological tissues, without the use of ionizing radiation or intravenous administration of contrast medium DWI is a valuable problem-solving tool in gynecologic malignancies with other wise equivocal features. It may be more useful in post-therapy. DWI is more sensitive for infection and inflammation in pregnant patients when avoiding gadolinium and CT. It May be a useful for other patients in whom gadolinium is contraindicated, such as patients with renal failure. DWI Improves not only the detection and potentially the characterization of small uterine tumors and complex ovarian cancer, but also the visualization of small implants of peritoneal carcinomatosis, which could significantly impact patient management [(4)].

This study aimed to evaluate the role of diffusion weighted MRI imaging in the characterization of gynecological pelvic masses and differentiation between benign and malignant tumors.

PATIENTS AND METHODS

This is an observational analytical comparative cross-sectional, retrospective study done at MRI Unit, Department of Radio-diagnosis and Interventional

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Ethical approval:

This study was approved by Faculty of Medicine, Menoufia University Institutional Ethics Committee. Informed written consent was obtained from every patient or her guardians about acceptance of participation in the study and knowing the possible risk factors of the given contrast medium before MRI scan.**This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.**

Study population: Our study was done on 63 patients referred from Surgery and Gynecology Departments having gynecological pelvic masses based on trans-abdominal/trans-vaginal U/S. The patients' age ranged from 22 to 67 years with median age of 42 years, in the period from December 2019 till December 2020,

Inclusion criteria: Patients presented with MRI findings of gynecological masses like: Solid masses, vegetations and/or septations in cystic masses, complicated cystic lesion, and complex solid/cystic patterns.

Exclusion criteria: Purely simple cystic lesion and general contraindications of MRI scan like cardiac pace maker, ferromagnetic aneurysm clips, cochlear implant and metallic foreign bodies.

History and examination:

Full history taking: speaking to the patients in friendly and in respectful way asking about the name, age, marital status, complaint and its onset &course and duration, past history, medical and surgical history and the aim of investigation putting in consideration the privacy of the patients. Their symptomatology included abdominal enlargement, non- specific pelvic pain, dysuria, frequency of micturition, vaginal bleeding and loss of weight. The patients were referred based on preliminary ultrasound examination.

Abdomino -pelvic ultrasonography: All patients had undergone preliminary US using ultrasound machine PHILIPS (HD11XE). Trans-abdominal and trans-vaginal ultrasound approaches were done using 5-2 MHz and 8-4 MHz probes respectively.

Technique: The patient scanned in supine position using the convex abdominal probe scanning the whole abdomen to exclude collection or hemorrhage, then in lithotomy position using the trans vaginal probe to examine the uterus, adnexa and the pelvis for better resolution and better assessment.

Gray scale image: The visualized lesion is examined in two planes axial and sagittal to determine its origin, echogenicity, composition and its relations to the nearby structures

Color Doppler study: To assess the vascularity of the solid masses or mural septations and nodularity.

Magnetic resonance imaging: All studies were performed using a 1.5T MR imaging unit (Toshiba exclerion 1.5 tesla).

Technique: Patients were instructed to fast for 3 hours and void urine 2 hours prior examination. Intravenous administration of 10 mg of an antispasmodic drug (Hyoscine butylbromide) was given immediately before MR imaging to reduce bowel peristalsis. All patients were imaged in supine position using a pelvic phased array coil. Conventional routine pelvic MRI was performed followed by DWI sequence (Table 1).

Image analysis:

The imaging findings were correlated with the pathological specimens after surgery.

First, the conventional MR images were analyzed to detect: Size, location, morphology either cystic (unilocular or multilocular), complex solid and cystic or predominately solid, signal intensity in (T1, T2), and post enhancement criteria of the lesion (homogeneous, heterogeneous or marginal).

Second, DWI and ADC map were compared with the conventional MR findings.

In our MRI interpretation:

Conventional MRI:

MR criteria of benign lesions according to:

- High signal intensity onT1WI is considered either fat or blood (e.g. dermoid/teratoma and endomterioma).
- On fat suppressed images low signal is noted with fat while high signal is still noted in blood.
- Solid masses with very low signal intensity inT2WI are characteristic to fibrous tumor (e.g. leiomyoma, ovarian fibroma, or Brenner tumor or pedunculated subserous fibroid).

Suggestive MR criteria of malignant lesions according to: In solid masses having low signal in T1WI and high signal in T2WI with post contrast enhancement with areas of necrosis and breaking down, are important features for diagnosis of malignancy (endometrial carcinoma, cervical carcinoma and vaginal carcinoma), While in ovarian complex cystic lesions, presence of wall thickness >3 mm, solid vegetations more than1cm,thick septa > 3mm, signs of tumors spread for staging: enlarged lymph nodes, ascites, peritoneal and omental6 deposits.

DWI & ADC map: Masses of interest scanned using the b values: zero, 500 and 1000 s/mm^2. DW images with a b-value of 0 and 500 s/ mm^2 were not evaluated because of the displayed less diffusion and larger T2 shine- through effect yet they are needed to provide a post processing ADC map with a good resolution and consequently develop an accurate measurement of the ADC value.

1. Qualitative analysis: ***Regarding the signal intensity:*** DW images were inspected for the presence of persistent high signal (restricted diffusion) and low ADC. Lesions with high signal on T2, DWI and ADC

map were attributed to T2 shine through effect and not true diffusion restriction. Lesions with low signal in DWI and high signal in ADC were considered facilitated diffusion. Lesions with low signal in both DWI and ADC were considered T2 blackout effect of dense fibrous tissue.

2. Quantitative analysis: The ADC values of each tumor were measured on DW images using an advantage Windows workstation (Toshiba). The data analysis focused on measured ADC values at areas of high DWI signal especially for the solid tissue or the septa and wall of multilocular lesion lacking solid components. ROI was specifically placed at areas of high SI on DW images. For masses with obvious solid component, a large ROI was applied to cover as much as possible of the pathology, in case of masses with vegetations or thickened septae, multiple ROIs were applied on solid areas, and their mean was calculated.

Statistical analysis:

The MR imaging and DWI suggested pathology whether benign or malignant had been correlated with surgical pathology specimen being the gold standard reference. Computer software package SPSS 15.0 was used in the analysis. For quantitative variables, mean (as a measure of central tendency) and standard deviation (as measures of variability) were presented. Frequency and percentages were presented for qualitative variables, Sensitivity, specificity, PPV, NPV and accuracy all were calculated for the conventional MRI and for the DWI. T-test was used to estimate differences in quantitative variables. P Value ≤ 0.05 is considered to be significant.

RESULTS

This study included sixty three female patients of age ranged from 22 to 67 years (mean age 41.68). The patients with benign tumors (No. = 39) showed an age ranged from 25 to 65 years (mean age 41.6 ± 13.8), while those with malignant tumors (No. = 24) their age ranged from 22 to 67 years (mean age 46.2 ± 10.676). Regarding pathological type of the gynecological masses included in the study, the most frequent gynecological masses seen were benign (No. = 39).

Benign tumors included 7 leiomyoma, 5 adenomyosis, 3 non-invasive mole, 4 endometriomas, 5 mature cystic teratomas, 4 serous cystadenoma, 3 tubo-ovarian abscess, 3 hydrosalpinx & 3 mucinous cystadenoma. ***Malignant*** tumors included 7 endometrial carcinoma, 5 cervical carcinoma, 3 invasive vesicular moles, 3 vaginal adenocarcinoma, 4 mucinous cystadenocarcinoma and 4 serous cystadenocarcinoma (Table 1).

Table (1): The origin of different masses

Uterine 31 (49.3%)		**Ovarian 32(50.7%)**	
Benign	**Malignant**	**Benign**	**Malignant**
15 (23.8%)	**16 (25.4%)**	**24 (38%)**	**8 (12.7%)**

Regarding the signal intensity of the lesions, low signal in T1WI was the most frequent signal intensity seen at the lesions. The bright signal in T2WI was the most frequent signal intensity seen at the lesions. The lesions showed variable signal intensities in T1 and T2 WI (Table 2).

Table (2): Signal intensities of the pathological lesions presented in the current study regarding DWI at different b-values and corresponding ADC map

Histopathology	**DWI**			**ADC map**
	b-0	**b-500**	**b-1000**	
Serous cystadenocarcinoma (No.=4)	**Low(No.=2)** **Low(No.=2)**	**Low** **High**	**Low** **High**	**High** **Low**
Mucinous cystadenocarcinoma (No.=4)	**Low**	**High**	**High**	**Low**
Endometrioma (No.=4)	**Low**	**High**	**High**	**Low**
Hydrosalpinx (No.=3)	**Low**	**Low**	**Low**	**High**
Mature cystic teratoma (No.=5)	**Low (No.=1)** **High (No.=4)**	**High Low**	**High Low**	**Low High**
Serous cystadenoma (No.=5)	**Low(No.=3)** **Low(No.=2)**	**Low** **Low**	**Low** **Low**	**High** **Low**
Mucinous cystadenoma(No.=4)	**High**	**Low**	**Low**	**High**
Tubo-ovarian abscess (No.=3)	**Low**	**High**	**High**	**Low**
fibroid(No.=7)	**Low**	**Low**	**Low**	**Low**
Endometrial carcinoma (No.=7)	**Low**	**High**	**High**	**Low**
Noninvasive Vesicular mole (No.=3)	**Low**	**Low**	**High**	**Low**
Invasive vesicular mole (No.=2)	**Low**	**High**	**High**	**Low**
Adenomyosis (No.=5)	**High**	**High**	**High**	**Low**
Cervical carcinoma (No.=5)	**Low**	**High**	**High**	**Low**
Vaginal carcinoma (No.=2)	**Low**	**High**	**High**	**Low**

The gynecological masses showed different pattern of enhancement:
Contrast media was not used in five patients because history of contrast-related sensitivity. In rest of patients, they showed homogenous enhancement in 7 patients (11.1%), heterogeneous in 24 patients (38%), wall enhancement in 3 patients (4.7%) and lack of enhancement in 19 patients (30.2%).

Regarding the origin of the lesion and its criteria: Benign adnexal masses were the most frequent findings among gynecological masses 24 (38%)**.** ADC values of malignant tumors showed a minimum of 0.5 x 10^{-3} mm^2/s and maximum of 1.9 x 10^{-3} mm^2/s with a mean of 1.05 ± 38722. While, ADC values of benign masses showed a minimum of 0.6 x 10^{-3} mm^2/s and maximum of 2.8 x 10^{-3} mm^2/s with a mean of 1.4 ± 5463.
The correlation between the number of patients diagnosed as benign or malignant by the conventional MR imaging and DWI regarding the pathology is illustrated in table (3).

Table (3): The correlation between the number of patients diagnosed as benign or malignant by the conventional MR imaging and DWI regarding to the pathology

	Conventional MRI	DWI	Pathology
Benign (No. & %)	**36 (58.7%)**	**25 (39.6%)**	**39 (62%)**
Malignant (No. & %)	**27 (41.3%)**	**38 (60.4%)**	**24 (38%)**
Total	**63(100%)**	**63(100%)**	**63(100%)**

According to conventional MRI:
36 cases showed typical benign morphological criteria whereas 27 cases showed typical malignant morphological criteria. 3 pathologically proven to be benign masses were misdiagnosed malignant by the conventional MRI (FP); 2 were serous cystadenoma and 1 was mucinous cystadenoma. While, single lesion pathologically proven to be malignant was misdiagnosed benign by MRI (FN) (1 mucinous cystadenocarcinoma) as shown in table (4).

Table (4): Results of conventional-MRI compared to pathology. With CI 95%

TP	TN	FP	FN	Sensitivity	Specificity	PPV	NPV
24	35	3	1	(99%) 83:99%	(94%) 81:95%	91% (73:98%)	(99%)83:99%

TP: True positive. TN: True negative. FP: False positive. FN: False negative

According to DWI :
38 cases showed restriction by DWI (high signal in diffusion images & low signal in corresponding ADC map) (table 2), 22/40 proved to be malignant by pathology (true positive). 16 cases proved to be benign by pathology (false positive) and included 3 noninvasive vesicular mole (hemorrhagic content), 3 tubo ovarian abscess, 1 mature cystic teratoma, 4 endometrioma and 5 adenomyosis (hemorrhagic content) (Table 5).

Table (5): Results of DWI imaging compared to pathology

TP	TN	FP	FN	Sensitivity	Specificity	PPV	NPV
22	23	16	2	95% (81%:99%)	54% (37%:70%)	57% (83%:100 %)	95% (81:99%)

Both conventional MRI and DWI showed the same sensitivity but DWI had low specificity and accuracy due to false positive 16 cases (Table 6)**.**

Table (6): Statistical analysis for conventional MRI and the DWI

	Conventional MRI (95%CI)	DWI (95%CI)
Sensitivity	85.799% (83:99%)	85.795% (81:99%)
Specificity	88.894% (81:95%)	66.754% (37:70%)
PPV	7591% (73:98%)	5057% (83:100%)
NPV	94.195% (83:99%)	92.395% (81:99%)
Accuracy	8897% (88:99%)	7271% (58:82%)
P value	0.03	0.2

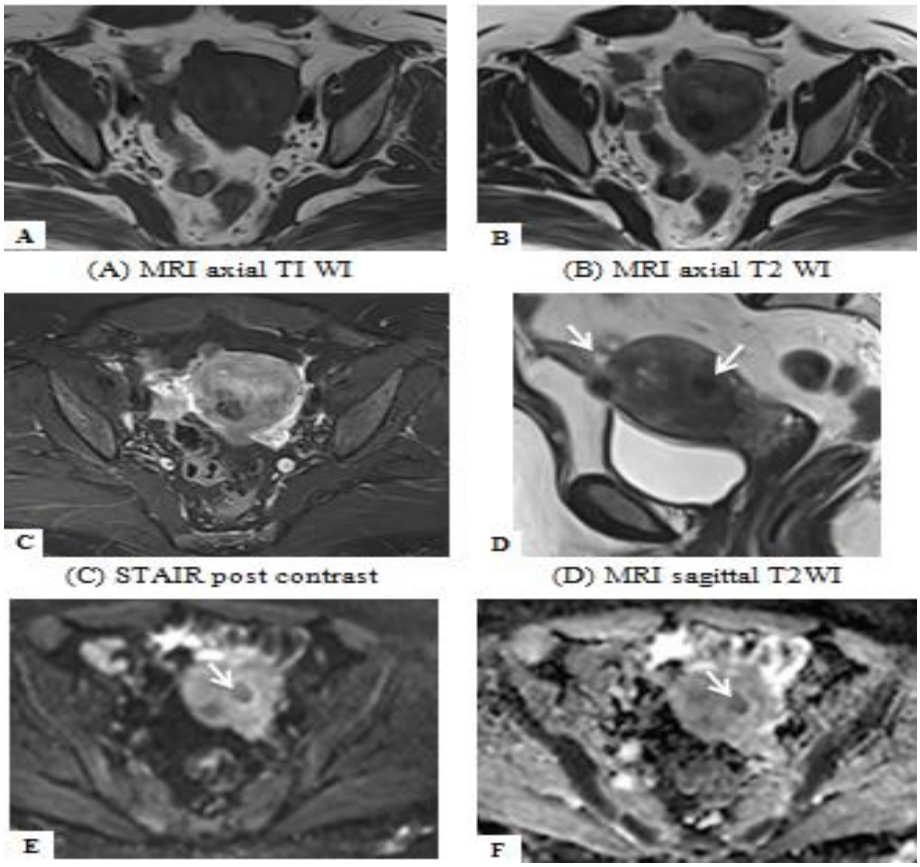

Figure (1): Showing two small fibroids located intramural (posterior wall) and sub serous (fundal) with low signal in T2WI sagittal plane white arrows (D) and low signal in T1 WI, T2WI & DWI and in ADC demonstrated in (A) & (B). White arrow in (E) & white arrow in (F) respectively with post contrast enhancement in (C).

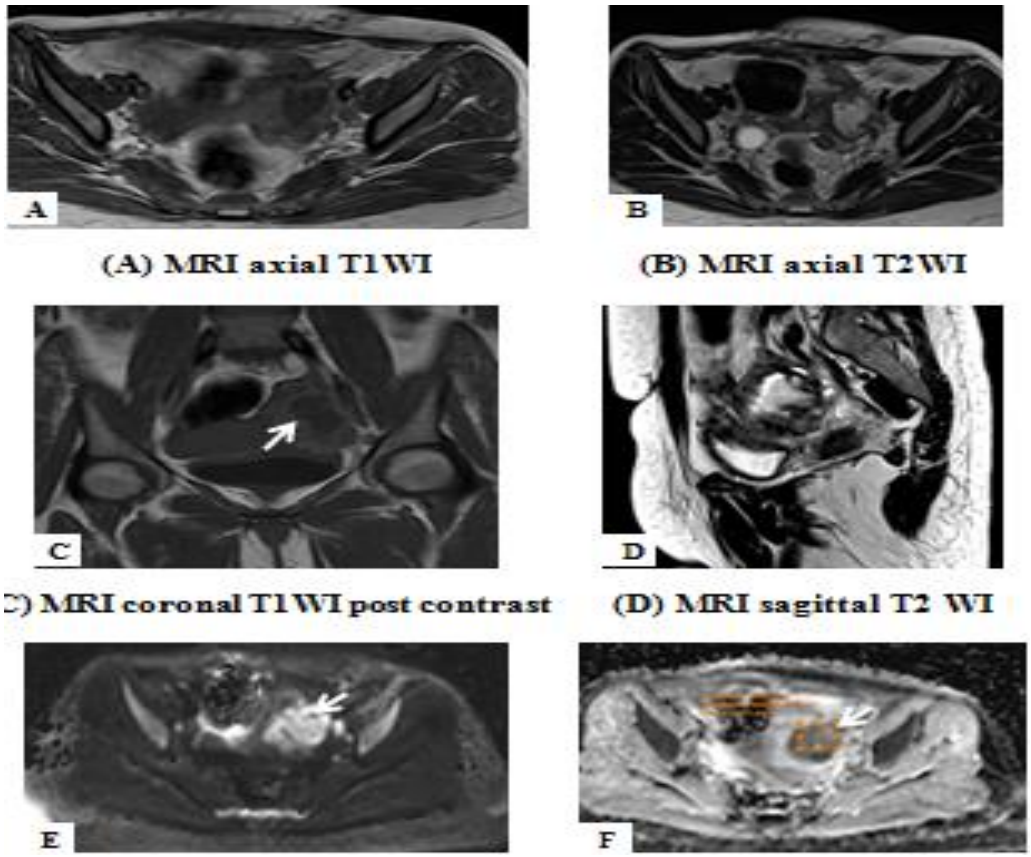

Figure (2): Showing left tuboovarian abscess elicits low signal in T1WI (A), high signal in T2WI axial & sagittal planes (B) & (D) respectively with post contrast study showed marginal enhancement white arrow in (C) with restricted diffusion, high signal in DWI white arrow in (E) and low signal in ADC white arrow in (F).

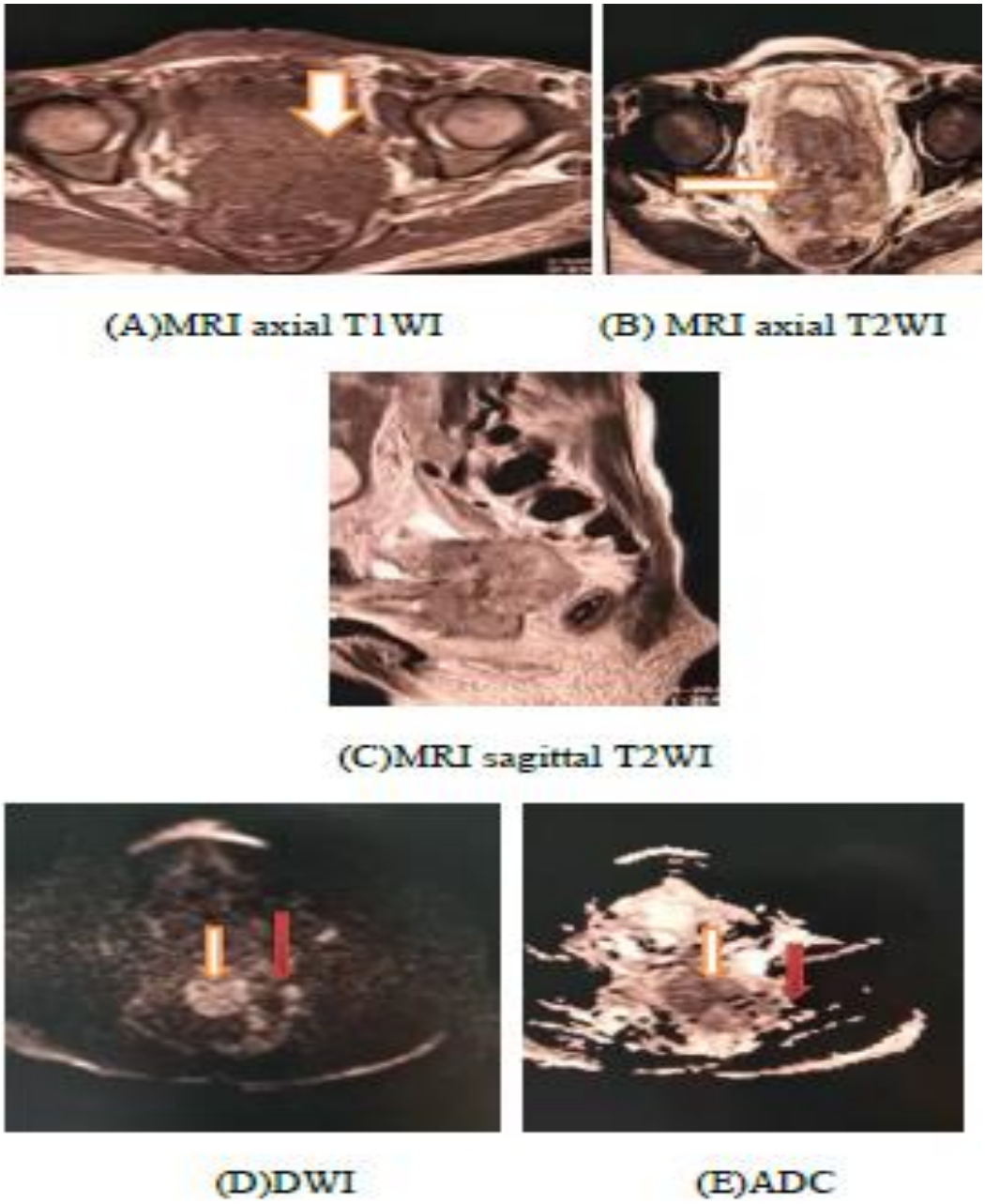

Figure (3): Recurrent cervical soft tissue mass lesion in female patient with ESRD with past history of operated cervical carcinoma with no contrast administration the mass elicits low signal in T1WI white arrow in (A) and high signal in T2WI axial and sagittal planes white arrow in (B) & (C) respectively with restricted diffusion, high signal in DWI white arrow in (D) and low signal in ADC white arrow in (E), with lymph node metastasis demonstrated in DWI exhibiting high signal red arrow in (D) and low signal in ADC red arrow in (E) confirmed pathologically to be recurrent cervical carcinoma with lymph node metastasis.

DISCUSSION

The primary goal of imaging in the evaluation of gynecological mass is to differentiate malignant from benign lesions. Proper diagnoses will direct patients to the appropriate treatment to reduce the number of women unnecessarily undergoing cancer surgery, to preserve fertility in young women (by allowing laparoscopy). DWI contributes functional and structural information about biological tissues, without the use of ionizing radiation or intravenous contrast administration [(5)]. This MRI modality is gaining ever increasing importance in MRI and is now used routinely. Many non-malignant lesions have high SI on DWI at b = 1000 s/mm^2 and low SI on ADC maps, resembling the behavior of malignant neoplasms. The interpretation and correlation of DWI sequences with conventional T1W and T2W images is mandatory, given that DWI is considered only a complementary sequence [(6)].

The aim of that study was to determine whether the addition of DW sequences to the routine MR imaging protocol can improve the diagnostic accuracy of gynecological pelvic masses.

We informed the patients about our study and after taking their permission in contribution in such study we proceeded to take complete history. We did ultrasound examination using both convex and trans-vaginal probe using grey scale and CDS and then we did the MRI examination including T1WI, T2WI, FATSAT, contrast and DWI sequences.

We performed an individual analysis for the conventional MR sequences and DWI regarding their gynecological masses. Masses differentiation on the conventional MR was based on the morphological features, which is a very important issue that was considered for many years. Blinded evaluation was done for the functional data supplied by diffusion weighted imaging regardless specific signal intensity of the masses included on the conventional series. The aim of such performance was to get an unbiased judgment for the utilized MRI tools of assessment and to find out whether diffusion weighted imaging is a necessity or luxury in case we need to assess gynecological masses.

The MR imaging and DWI-suggested pathology whether benign or malignant had been correlated with surgical pathology specimen being the gold standard reference. Computer software package SPSS 15.0 was used for statistical analysis.

This study included sixty three female patients of age ranged from 22 to 67 years (mean age 41.68). The patients with benign tumors (No. =39) showed ages ranged from 25 to 65 years (mean age 41.6 ± 13.8 SD), while those with malignant tumors (No. =24) with ages ranged from 22 to 67 years (mean age 46.2 ± 10.676 SD). In our study we found that the most frequent gynecological masses seen were benign (No. =39, 62%), while the most frequent benign masses were uterine leiomyoma (No. =7), mature cystic teratoma (No. =5), adenomyosis (No. =5), serous cystadenoma (No. = 5), endometrioma (No. =4). Also the most frequent malignant masses were endometrial carcinoma (No. =7), cervical carcinoma (No. = 5).The malignant masses showed larger diameters than benign lesions. Predominately solid lesions were the most frequent morphological features of gynecological masses seen (No. =32).

The low signal in T1WI was the most frequent signal intensity seen at the lesions. The bright signal in T2WI was the most frequent signal intensity seen at the lesions, but as regarding contrast enhancement the gynecological masses showed different pattern of enhancement. Contrast media was not used in five patients because of history of contrast-related sensitivity. In rest of patients, they showed homogenous enhancement in 7 patients (11.1%), heterogeneous in 24 patients (38%), wall enhancement in 3 patients (4.7%) and lack of enhancement in 19 patients (30.2%). **Thomassin-Naggara *et al.*** [7] evaluated the contribution of DWI in conjunction with morphological criteria to characterize 77 gynecological masses (30 benign and 47 malignant). In their results, low signal intensity both on DWI and T2-weighted images in the lesion would predict benignity and could help in differentiating benign from malignant lesion. This result matches with our study as we had presented with low signal on T2WI and DWI as in uterine leiomyoma (N=7) (11.1%) and endometrioma (N=4) (6.3%) figure (1)

In current study, The DWI showed restriction in 38 patients (22 malignant lesions and 16 benign lesions), facilitated diffusion in 16 patients (14 benign lesions and 2 malignant lesions) and T2 black out effect in 9 patients. Different ADC values were detected, although some overlaps were found in the ADC values of benign and malignant lesions, yet the mean ADC value of malignant masses was significantly lower than that of benign. ADC values of malignant tumors showed a minimum of 0.5 x 10^{-3} mm^2/s and maximum of 1.9 x 10^{-3} mm^2/s with a mean of 1.05 ± 38722, while ADC values of benign masses showed a minimum of 0.6 x 10^{-3} mm^2/s and maximum of 2.8 x 10^{-3} mm^2/s with a mean of 1.4 ± 5463.

Focusing on the quantitative and not the qualitative analysis of DWI was the purpose of **Inci *et al.*** [8] study, which evaluated 59 gynecological masses. The study group declared that the ADC values of benign and malignant lesions overlap and DWI cannot be used for discrimination. The drawback in their analysis was the unawareness about DWI pitfalls. They included purely cystic lesions such as endometriomas, hemorrhagic cysts and dermoid cysts, which in spite of being cystic yet they present with low ADC values and so can overlap with those of malignant masses. Also the studied sample size was limited. Another study carried out by **Fujii *et al.*** [6] on 123 masses that included 42 malignant and 81 benign lesions. In this study, the majority of the malignant tumors were mature cystic teratomas, and the endometriomas that showed abnormal signal intensity on DWI, whereas fibroid and other benign lesions did not. The main locations of abnormal signal intensity were solid portions in malignant ovarian tumors, keratinoid substances and Rokitansky protuberance in mature cystic teratomas, and intracystic clots in endometriomas. They finally concluded that DWI of lesions and the detected ADC values are not useful for differentiating benign from malignant lesions.

According to current study, DWI had shown (95%) sensitivity in its individual performance during the assessment of the included gynecological masses, yet the specificity was low (54%). Such low specificity elicited in our research was explained by the presence of 16 benign masses (25.5%) that have mimicked malignancy on DWI; starting from their misleading signal intensities of restricted diffusion, down to the low ADC values measured. Masses included: 3 noninvasive vesicular mole (hemorrhagic content), 3 tuboovarian abscess, 1 mature cystic teratoma, 4 endometrioma and 5 adenomyosis (hemorrhagic content). A study was

carried out by **Zhang *et al.* [9]** on one hundred and 91 patients with 202 masses. The purpose of that study was to evaluate differences in ADC values for the solid component of benign and malignant tumors with the goal of differentiating benign versus malignant tumors preoperatively. The results of that study showed that DWI appears to be a useful method for differentiating between benign and malignant tumors, and is associated with high sensitivity and specificity, however, after exclusion of endometriomas, mature cystic teratomas and pure cystic lesions from the analysis, which may have elevated the specificity of the DWI in that study. This result matches with our study as we found that both conventional MRI and DWI showed the same sensitivity but DWI had low specificity and accuracy due to false positive 16 cases. This means that DWI is good sensitive but bad specific test and good negative but bad positive test with low statistical significance. This means that the solo performance of DWI was not an applicable way to discriminate benign from malignant gynecological masses.

Advantage and pitfalls of the current study: The strength of the current study lies in: the use of the advantages of DWI as well as taking care of the sequence pitfalls in assessment. Moreover, DWI can be used as an alternative to contrast sequences for patients with renal failure and in case of pregnancy. In the current work five patients had benefit from such advantage. Conventional MRI combined with DWI was able to provide accurate diagnose in all of them. Despite these advantages, there were also limitations associated with this preliminary study. For example, the population of patients evaluated was relatively not large.

CONCLUSION

The solo performance of DWI is not an applicable way to discriminate benign from malignant gynecological masses. DWI can confirm or exclude potential malignancy in gynecological masses provided i) inclusion of the conventional MRI data, ii) combined analysis of DWI quantitative and qualitative criteria and iii) awareness of the possible sequence pitfalls.

RECOMMENDATIONS

For clinical purpose: We recommend Using DWI in clinical practice as it can confirm or exclude potential malignancy in gynecological masses, increase the sensitivity and the specificity of the MRI and could be also used in patients cannot use the contrast like RF patients or in pregnancy. For research and statistical purpose : we recommend that our results will need to be confirmed in larger clinical studies putting in consideration the pitfalls of DWI and excluding the purely cystic lesions or inflammatory process that's accurately diagnosed clinically, labs and radiologically, thus specificity of the DWI will increase.

List of abbreviations:

ADC	Apparent diffusion coefficient
CDS	Color Doppler study
CT	Computed tomography
DWI	Diffusion weighted imaging
FN	False negative
FP	False positive
MRI	Magnetic resonance imaging
NPV	Negative predictive value
PPV	Positive predictive value
SD	Standard deviation
US	Ultrasonography

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