European Journal of Clinical Pharmacy

Print ISSN: 2385-409X **Online ISSN**: Applied
Website: https://farmclin.com/

Original Research Article

Diagnostic Accuracy of Diffusion Weighted Magnetic Resonance Imaging (DW-MRI) in Diagnosing Ovarian Cancer, Taking Histopathology as Gold Standard

Article History:

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Received: 10-08-2025
Revised: 04-11-2025
Accepted: 17-11-2025
Published: 30-11-2025

Abstract:

Introduction: The diagnostic accuracy of diffusion weighted magnetic resonance imaging (DW-MRI) in ovarian cancer diagnosis has to be reevaluated, despite the fact that there was previously local and worldwide literature on this subject. The studies that were accessible, however, showed wide difference in results.

Study design: Cross-sectional (validation) study.

Settings: Department of Radiology, Shalamar Hospital, Lahore.

Duration of study: 03 May 2025 to 02 August 2025

Methodology: Total 124 patients between the ages of 20 and 60 with suspected ovarian cancer were included. Patients with a history of anti-tumor treatment (surgery, chemotherapy, or radiotherapy), chronic renal failure, pelvic masses of uterine origin, contraindications to magnetic resonance imaging (such as MRI incompatible prostheses or cardiac pacemaker holders), and biopsy-proven reports were excluded. The 1.5 Tesla MR machine was then used to perform diffusion-weighted MRI on each subject. A consultant radiologist with at least five years of post-fellowship experience evaluated each DW-MRI. The histopathology report, which is considered the gold standard, was correlated with the DW-MRI results.

Results: Ovarian cancer was diagnosed with DW-MRI sensitivity of 91.03%, specificity of 86.96%, PPV of 92.21%, NPV of 89.52%, and diagnostic accuracy of 88.66%.

Conclusion: Our study found that DW-MRI scans are highly accurate in diagnosing ovarian masses, especially when it comes to differentiating between benign and malignant ones.

Keywords: Ovarian cancer, diffusion weighted, MRI, sensitivity, specificity.

INTRODUCTION

Ovarian cancer is the sixth most common cause of cancer-related deaths in women and one of the most common gynecological cancers. A non-invasive and precise diagnostic tool would be ideal because ovarian cancer has a quiet clinical history and most patients present at an advanced stage of the disease.1,2 Due to an inaccurate preoperative diagnosis, patients with benign ovarian tumors have occasionally had extra surgical procedures performed, such as bilateral oophorectomy with or without hysterectomy. A preoperative identification of ovarian cancers based on imaging is essential because biopsy is not commonly employed.3

In the case of ovarian cancer, several diagnostic techniques have been used. Computer tomography (CT) and color doppler ultrasonography are frequently utilized imaging methods for the diagnosis of ovarian cancer.4 As a blood biomarker of ovarian cancer, cancer antigen 125 (CA125) has a mediocre sensitivity but a high specificity (96–100%) for early-stage disease.5 The anatomic relationship can be clearly seen by magnetic resonance imaging (MRI), which has a high resolution for soft tissues. Due to its noninvasive nature, lack of radiation exposure risk, and lack of patient preparation, MRI is currently a reliable imaging method for ovarian cancer. MRI is far superior to CT and ultrasonography.6 DWI is a recently created magnetic resonance functional imaging method that relies on the motion of water molecules rather than their structure.7 Water molecules cannot freely travel within malignant dense masses, which are made up of haphazardly arranged tumor cells. Since hypercellularity is thought to be the cause of the

impeded diffusion of water, DWI may offer unique insights into tissue structure through the assessment of tissue cellularity.8

The diagnostic accuracy of diffusion weighted magnetic resonance imaging (DW-MRI) in ovarian cancer diagnosis has to be reevaluated, despite the fact that there was previously local and worldwide literature on this subject. The studies that were accessible, however, showed wide difference in results. In addition to being a valuable addition to the body of existing literature, my study's findings allow us to make recommendations for our routine practice regarding the use of DW-MRI in the diagnosis of ovarian carcinoma or the consideration of alternative imaging modalities. Additionally, if its diagnostic accuracy is found to be high, these patients can be given a non-invasive imaging modality for a precise pre-operative evaluation of their condition, which will assist clinicians in choosing the best course of treatment to lower their morbidity and mortality.

METHODOLOGY:

Total 124 patients between the ages of 20 and 60 who presented to the Shalamar Hospital's Department of Radiology in Lahore with suspected ovarian cancer (defined as having a mass of hyper- or hypo-echoic or solid/moderately echogenic loculi and a wall thickness of ≥ 3 mm) of any size or duration were included in this descriptive, cross-sectional study. With a 95% confidence level, a sample size of 124 cases has been determined. The expected prevalence of ovarian cancer is 68.3%[9], the DW-MRI sensitivity and specificity are 91.7%[10] and 82.4%[10], respectively, and the margin of error for sensitivity and specificity is 6% and 12%. Patients were selected using a non-random consecutive sampling technique. Patients with a history of anti-tumor treatment (surgery, chemotherapy, or radiotherapy), chronic renal failure, pelvic masses of uterine origin, contraindications to magnetic resonance imaging (such as MRI incompatible prostheses or cardiac pacemaker holders), and biopsy-proven reports were excluded.

Age, length of illness, and lesion size were recorded following informed consent. The 1.5 Tesla MR machine was then used to perform diffusion-weighted MRI on each subject. We employed single-shot spin-echo echo-planar imaging to get DW-MR images in the axial plane with b values of 50, 500, and 1000. The TE was 70, the TR was 5400, the slice thickness was 4 mm without an intersection gap, and the number of signal acquisitions was 4. The scan lasted for 4 minutes and 54 seconds. Following image acquisition, regions of interest, which were defined as areas of 5–10 mm2 and excluded from areas with necrosis, calcification, and cystic components, were sketched on ADC maps for each suspicious nodule. A consultant radiologist with at least five years of post-fellowship experience evaluated each DW-MRI. The histopathology report, which is considered the gold standard, was correlated with the DW-MRI results. A custom created proforma was used to record all of this information.

		Ovarian carcinoma on Histopathology	
Ovarian carcinoma on DW-MRI		**Positive**	**Negative**
	Positive		
	Negative		

Software called SPSS 25.0 was used to evaluate the data that was gathered. The mean and SD or median (IQR) were used to represent age, lesion size, parity, and length of disease. The frequency and percentage of ovarian cancer on DW-MRI and histology, as well as menopausal status (pre- or post-menopause), were displayed. The sensitivity, specificity, PPV, NPV, and diagnostic accuracy of DW-MRI in ovarian cancer diagnosis, using histopathology as the gold standard, were calculated using a 2×2 contingency table. Additionally, the likelihood ratio and ROC curve were computed.

Mean age was 45.81 ± 7.36 years. Mean duration of disease was 6.56 ± 1.42 months. Mean size of lesion was 3.0 ± 1.05 cm. The distribution of patients with various factors is shown in Table I.

71 patients (True Positive) had ovarian cancer among those who tested positive for them on DW-MRI, whereas 06 patients (False Positive) had no ovarian cancer according to histopathological results. As shown in Table II, of the 47 patients who had negative DW-MRI results, 07 (False Negative) have ovarian cancer on histopathology, while 40 (True Negative) did not (p=0.0001). Ovarian cancer was diagnosed with DW-MRI sensitivity of 91.03%, specificity of 86.96%, PPV of 92.21%, NPV of 89.52%, and diagnostic accuracy of 88.66%. The diagnosis accuracy stratification by confounding variables is shown in Table III.

Table I: Distribution of patients with other confounding variables (n=124)

		Frequency	%age
Age (years)	20-40	36	29.03
	41-60	88	70.97
Parity	≤3	40	32.26
	>3	84	67.74
Duration (months)	≤6	64	51.61
	>6	60	48.39
Size (cm)	≤3	89	71.77
	>3	35	28.23
Menopausal status	Pre-menopause	55	44.35
	Post-menopause	69	55.65

Table-II: Diagnostic accuracy of diffusion weighted magnetic resonance imaging (DW-MRI) in diagnosing ovarian cancer.

	ovarian cancer on Histopathology (+ive)	ovarian cancer on Histopathology (-ive)	P-value
ovarian cancer on DW-MRI (+ive)	71 **(True positive)**	06 **(False Positive)**	**0.0001**
ovarian cancer on DW-MRI (-ive)	07 **(False negative)**	40 **(True Negative)**	

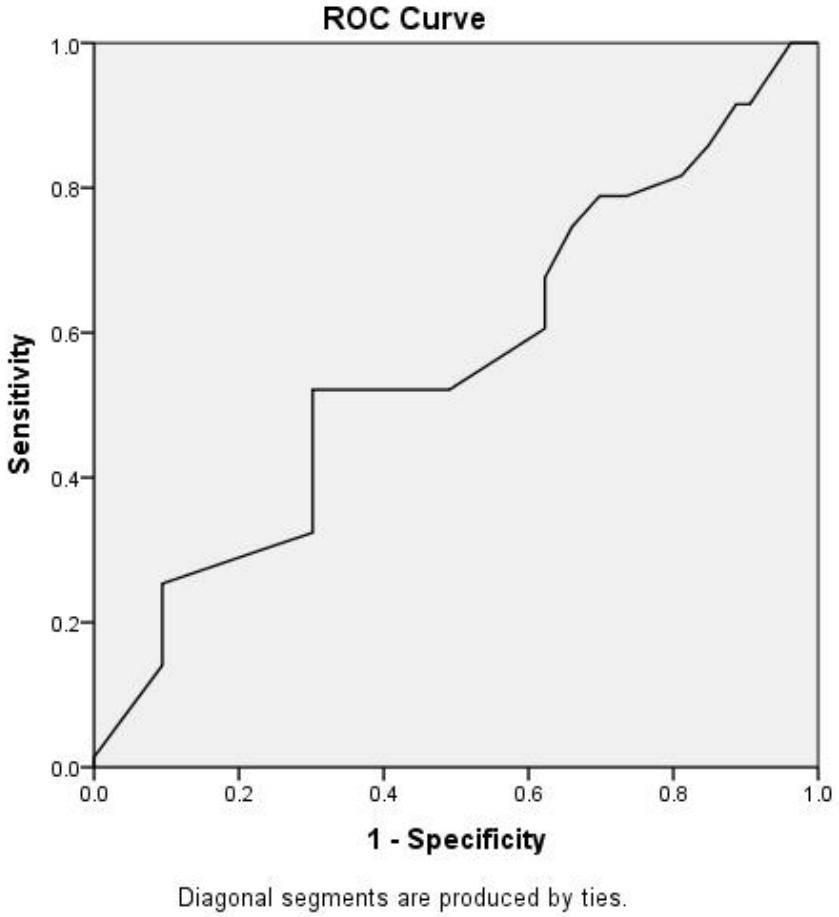
Sensitivity: 91.03%

Specificity: 86.96%

Positive Predictive Value (PPV): 92.21%

Negative Predictive Value (NPV): 85.11%

Diagnostic Accuracy: 89.52%



Area under the curve = 0.560

Table III: Stratification of diagnostic accuracy with respect to confounding variables.

		Sensitivity	Specificity	PPV	NPV	DA	
Age (years)	20-40	94.74%	94.12%	94.74%	94.12%	94.44%	**0.001**
	41-60	89.83%	82.76%	91.38%	80.0%	87.50%	**0.001**
Parity	≤3	76.19%	94.74%	94.12%	78.26%	85.0%	**0.001**
	>3	96.49%	81.48%	91.67%	91.67%	91.67%	**0.001**
Duration (months)	≤6	96.97%	83.87%	86.49%	96.30%	90.63%	**0.001**
	>6	86.67%	93.33%	97.50%	70.0%	88.33%	**0.001**
Size (cm)	≤3	88.89%	100.0%	100.0%	78.79%	92.13%	**0.001**
	>3	100.0%	70.0%	71.43%	100.0%	82.86%	**0.001**
Menopausal status	Pre-menopause	80.0%	75.0%	84.85%	68.18%	78.18%	**0.001**
	Post-menopause	100.0%	96.15%	97.77%	100.0%	98.55%	**0.001**

DISCUSSION

One of the leading causes of illness and death among women worldwide is ovarian cancer. It causes excruciating physical agony in addition to consuming a large quantity of resources.11 Due to the inability to conceive, it is the primary cause of infertility and causes psychological imbalance in women.12

The primary effect has been documented in the elderly population, despite the fact that it can happen at any stage of life. With a mean age of 45.81 ± 7.36 years, the current study's findings support this. The majority of the patients were between the ages of 41 and 60 years. A mean age of 36.8 ± 10.4 years was observed in a prior study.13 As a result of its substantial impact on young people, it is thought to result in a considerable financial burden. This happens as a result of direct expenses related to disease treatment. However, the productive workforce is lost.14

According to the current study, DW-MRI has a 91.03% sensitivity and an 86.96% specificity for ovarian cancer diagnosis. However, with a diagnosis accuracy of 89.52%, the predicted PPV and NPV were 92.21% and 85.11%, respectively. In a prior study13, MRI was found to have 86.7% sensitivity, 81.9% specificity, 83.3% positive predictive value (PPV), 81.9% negative predictive value (NPV), and 84.7% diagnostic accuracy in the diagnosis of ovarian cancer.

According to a prior study15, DW improves MRI's capacity to detect ovarian cancer by 74% in terms of sensitivity and 80% in terms of specificity. Another study discovered that MRI had a diagnostic accuracy of 95.08%, a sensitivity of 83.89%, a specificity of 93.86%, a PPV of 80.77%, an NPV of 91.97%, and a diagnostic accuracy of 83.89% for ovarian cancer masses. The selection criteria used to choose which patients were referred for MRIs, as well as the radiologist's training and expertise, could be the cause of the discrepancy in reported values.16 DW-MRI's diagnostic capability is clearly superior to that of standard MRI, nonetheless.7

According to a study, the sensitivity and specificity of DW-MRI were assessed to be 92.68% and 73.68%, respectively, while the prevalence of ovarian cancer was determined to be 68.3%.9 The sensitivity is 91.7% and the specificity is 82.4%, according to another study.10 The sen, spec, PPV, NPV, and accuracy for DWI have been demonstrated by Abd El Razeq GM et al. to be 100%, 94.4%, 96.3%, 100%, and 97.7%, respectively.17

Histopathology revealed that the false positive DW-MRI cases were either adenomyosis or teratoma. The same is reported in earlier publications as well.18 On MRI, teratoma and adenomyosis can share many traits with ovarian cancer. Despite this, MRI is still used as a first-line diagnostic method for ovarian cancer because its results are comparable to those of histopathology.19,20 Therefore, DW-MRI's diagnostic potential and resemblance to histopathological data justify its use in the diagnosis of ovarian cancer.

Diffusion-weighted MR imaging without invasive procedures provides insightful new information.21 Because diffusion-weighted MR imaging can be challenging, it's important to be aware of the potential risks and confirm the accuracy of the data by comparing them to anatomic sequences. With this new understanding, radiologists will be more comfortable using ADC calculation and modification tools to help physicians treat women with known or suspected gynecologic malignancies.22

There are several issues with the current study. First, only primary cases were taken into account; second, scans are expensive. Recurrent or previously operated situations where fibrosis or scar tissue changes the anatomy and presents a special challenge are not covered by our analysis.

CONCLUSION:

Our study found that DW-MRI scans are highly accurate in diagnosing ovarian masses, especially when it comes to differentiating between benign and malignant ones. Its usage for ovarian cancer diagnosis should be promoted because to its non-invasive nature and capacity to produce results that are comparable to those of histopathology. Understanding the usefulness of MRI in ovarian cancer detection and promoting its use in this area to lower related mortality and morbidity through prompt and suitable treatment are the goals of the current research project.

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