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ORIGINAL ARTICLE

Diagnostic accuracy of diffusion weighted imaging on MRI in suspected cases of ovarian cancer, keeping histopathology as gold standard.

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ABSTRACT… Objective: To assess the diagnostic accuracy of diffusion weighted imaging on MRI in patients of ovarian cancer with histopathology considered as gold standard. **Study Design:** Cross-sectional study. **Setting:** Department of Radiology, Tertiary Care Hospital Kharian. **Period:** February 2022 to August 2022. **Methods:** Non-probability, consecutive sampling was performed from 60 patients. After receiving informed consents, the suspected female patients with age 15 to 65 years went under MRI. The results were compared with histopathological findings and diagnostic potential of MRI was calculated by 2x2 table. The findings of both the modalities were compared by correlation analysis with $p<0.05$ considered as significant. **Results:** The sensitivity and specificity of MRI were estimated to be 92.68% and 73.68%. The positive predictive value and negative predictive value were estimated to be 88.37% and 82.35%. The diagnostic accuracy was found to be 86.66%. The findings of MRI and histopathology were significantly ($p<0.05$) correlated with a value of 0.685. **Conclusion:** The use of MRI is highly recommended in diagnosis of ovarian cancer.

Key words: Histopathology, Magnetic Resonance Imaging, Ovarian Cancer.

INTRODUCTION

Cancer is considered as the leading cause of mortality and hurdle towards achievement of desirable life expectancy in majority of the countries.[1] Ovarian cancer holds the place of third common gynecologic cancer, after cervical and uterine cancer, with worst prognosis and highest mortality rate. Despite of being less prevalent than breast cancer, it is three times more lethal. By 2040, it is forecasted that mortality due to ovarian cancer may surpass other types of cancer.[2] The tremendous increase in mortality due to ovarian cancer can be attributed its asymptomatic nature, delayed symptoms and absence of appropriate screening.[3] Resultantly, the diagnosis of ovarian cancer is possible at the later stages of the disease. According to an estimate, more than 70% remain undiagnosed until last stage.[4] Another estimate indicates that survival rate for ovarian cancer after 5 years is 47.4%.[5]

In 2018, ovarian cancer was declared as the most common cancer in women all over the world with more than 240,000 cases.[6] Ovarian cancer is responsible for 2.5% of tumors of females, but death rate is 5% due to low survival rate. On the other hand, the survival rate after 5-years is estimated to be 93%.[7] Thus, early detection and prevention of the disease can be helpful in decreasing the associated mortality and morbidity rates among female population.

The guidelines of European Society of Uro-Genital Radiology (ESUR) suggests computed tomography (CT) as the modality of choice for assessment of patients suspected with ovarian cancer.[8] Anyhow, CT fails to indicate suitability of patient for cytoreduction, even in the presence of large amounts of carcinomatosis in bowel loops and mesentry. On the other hand, diagnostic laparoscopy appeared as an effective tool in assessing tumor load and identifying individuals

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at risk of residual disease post-surgery. But this modality is invasive in nature and affiliated with the risk of intraoperative complications.[9] In such scenario, CT could be regarded as a non-invasive tool for load assessment but it lacks the accuracy in predicting peritoneal involvement. Previous research works document accuracies of external validation of CT based prediction models to be 0.34 to 0.67. Thus, the CT has limited ability to predict suboptimal cytoreduction in individuals with ovarian cancer. Transvaginal ultrasound is considered quite applicable for assessment of ovarian masses due to its cost-effectiveness, accessibility and availability but it has very low specificity. Although Doppler ultrasound has improved specificity and positive predictive value for detection of malignant lesions, but the experience of sonographer may limit its applicability. This has created need of an appropriate modality, which can be of greater value for treatment and surgical planning of ovarian cancer patients.[10]

In recent times, the radiological approach has decreased the mortality rate of ovarian cancer to 0.7%. Resultantly, the interest towards use of Magnetic Resonance Imaging (MRI) for the diagnosis of ovarian cancer has increased in the previous few years. The use of functional sequence of Diffusion-Weighted Imaging (DWI) are under evaluation for its diagnostic accuracy in assessment of disease sites in such patients. Many researchers have explored its use in prediction of optimal primary cytoreductive surgery.[11] DWI renders information regarding cellular microstructure by assessment of water molecule movement, in which discrimination between structures is dependent on cellularity levels. It has a better soft tissue contrast resolution and enables the detection of small peritoneal lesions that are less than 5 mm, which are not visible on CT. Recent research works have documented applicability of DW-MRI for diagnosis and staging of ovarian cancer.[12] It has been documented with diagnostic accuracy of 0.90-0.96 for colorectal cancer. However, its diagnostic potential for ovarian cancer is still debatable.[13]

Thus, the present research work is aimed to assess the diagnostic accuracy of DW-MRI in suspected cases of ovarian cancer with histopathology considered as gold standard.

METHODS

The present cross-sectional study was conducted from February 2022 to August 2022 at Radiology Department of Tertiary Care Hospital, Kharian. For this purpose, the patients were explained about the purpose of study and informed consents were collected from willing individuals. The participants were confirmed about privacy and confidentiality of their personal information it was approved from institutional committee (16/1/9/22). A sample size of 60 was calculated by Raosoft software by considering prevalence of ovarian cancer as 4.8% for female population of 49.2%[8] in Pakistan with confidence level of 95%. Sampling was conducted by non-probability, consecutive sampling.

All female patients with age 15 to 65 years, referred for DW-MRI with suspicion of ovarian cancer were included in this study. This comprised of both pre-menopausal and post-menopausal individuals. However, the patients with previous history of biopsy proven ovarian cancer, contraindication of DW-MRI, radiation therapy to abdomen or pelvis were excluded. Moreover, the absence of result of final histopathology was also considered as exclusion criteria.

The participants went under DW-MRI by 1.5 Tesla scanner with torso phased array coil and pelvic array coil for abdominal and pelvic scan. The axial, coronal and sagittal T1 and T2 weighted with fat suppression, diffusion weighted imaging (DWI) and apparent diffusion coefficient (ADC) maps were performed. For gadolinium contrast injection, dose of 0.2 mmol/kg was utilized. T1-weighted image was conducted with fat suppression with slice thickness of 5mm and gap of 1mm. Picture Archiving and Communication System was used for processing, whereas, reporting of images was done on 5 mega pixel diagnostic console. The patients with DW-MRI features of endometrioma including hyperintense vision on T1 and T1 fat suppressed images, hypointense vision on T2 weighted images and

characteristic vision of blood products on DWI and ADC map, were considered as DW-MRI positive. However, the patients that did not show peculiar characteristics of endometrioma were considered as DW-MRI negative.

The patients with ovarian lesions showing at least 2 out of 3 features were marked as histopathologically positive. These features included presence of endometrial glands, hemorrhage or endometrial stroma on microscope. The patients devoid of at least 2 features were marked as histopathologically negative.

The quantitative variables such of age was shown as mean and standard deviation. On the other hand, the qualitative variables such as histopathology findings, DW-MRI findings, comparative results of DW-MRI and histopathology and calculations for diagnostic features of DW-MRI were presented by frequencies and percentages. The patients showing both DW-MRI and histopathology positive were marked as true positives. Patients showing absence for DW-MRI and histopathology were marked as true negatives. Patients showing DW-MRI positive but histopathology negative were considered as false positives, whereas, those showing DW-MRI negative and histopathology positive were considered as false negatives. The diagnostic potential of MRI including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy were calculated by 2x2 table. A comparison between MRI findings and histopathology outcomes was performed by correlation analysis and paired t-test by considering p value < 0.05 as significant.

RESULTS

The baseline characteristics of patients are shown in Table-I. The mean age of participants was 38.5 ± 12.5 years. There were 41 (68.3%) positive patients on the basis of histopathology, whereas, there were 43 (71.6%) DW-MRI positive patients. On the basis of negative histopathology results, there were 19 (31.6%) patients, whereas, there were 17 (28.3%) MRI negative patients.

Patient Characteristics	Frequency n (Percentage %)
Age (years) (mean ± SD)	38.5 ± 12.5
Histopathology	
Positive	41 (68.3%)
Negative	19 (31.6%)
DW-MRI	
Positive	43 (71.6%)
Negative	17 (28.3%)

Table-I. Characteristics of patients

The comparative results of DW-MRI and histopathology are shown in the Table-II. There were 38(63.3%) true positives (TP) and 14(23.3%) true negatives (TN). Anyhow, 5 (8.3%) false positives (FP) and 3(5%) false negatives (FN) were also noted.

DW-MRI	Histopathology		Total n (%)
	Positive n (%)	Negative n (%)	
Positive n (%)	38(63.3%) (True positive; TP)	5(8.3%) (False positive; FP)	43 (71.6%)
Negative n (%)	3(5%) (False negative; FN)	14(23.3%) (True negative; TN)	17 (28.3%)
Total n (%)	41 (68.3%)	19 (31.6%)	60

Table-II. Comparative results of DW-MRI and histopathology

The diagnostic features of DW-MRI are shown in the Table-III. The sensitivity and specificity of MRI in diagnosing ovarian cancer were estimated to be 92.68% and 73.68% respectively. The positive predictive value (PPV) and negative predictive value (NPV) were estimated to be 88.37% and 82.35%. The diagnostic accuracy was found to be 86.66%.

The relationship between DW-MRI and histopathology is shown in the Table-IV. The correlation value of 0.685 signifies high association between the two modalities (0.1 to 0.3 for low association; 0.3 to 0.5 for moderate association; 0.5 to 1 for high association) with a significance value of $p<0.001$. Thus, both the diagnostic tools may have similar findings for diagnosis of ovarian cancer.

Factors of Diagnostic Potential	Formulas	Calculations	Results (%)
Sensitivity	TP/ TP+FN x 100	38/38+3 x 100	92.68%
Specificity	TN/ FP+TN x 100	14/5+14 x 100	73.68%
Positive predictive value (PPV)	TP/ TP+FP x 100	38/38+5 x 100	88.37%
Negative predictive value (NPV)	TN/ FN+TN x 100	14/3+14 x 100	82.35%
Diagnostic accuracy	T P + T N / TP+FP+FN +TN x 100	38+14/38+ 5+3+14 x 100	86.66%

Table-III. Calculation for diagnostic features of DW-MRI

Relation Test	Values
Pearson Correlation	0.685
p value	<0.001*

Table-IV. Relationship statistics
***significant with p<0.05**

DISCUSSION

Ovarian cancer is an important cause of morbidity and mortality among female population of the world. It not only drains significant amount of resources but also results in devastating physical pain.[14] It is the leading cause of infertility and results in psychological unbalance among women as they are unable to bear a child.[15]

Although it can occur at any stage of life, the main effect has been reported in young population. The findings of the present research work signifies the same with mean age of 38.5 ± 12.5 years. Most of the patients belonged to age range of 35 to 45 years. A previous study reported mean age of 36.8 ± 10.4 years.[11] Resultantly, it is considered to bring about significant economic burden due to its major effect on youth. This occurs as an outcome of direct costs affiliated by treatment of the disease. On the other hand, the productive manpower is lost.[16]

The present study found sensitivity of DW-MRI to be 92.68% and specificity of 73.68% to diagnose ovarian cancer. On the other hand, positive predictive value and negative predictive value were estimated to be 88.37% and 82.35% with diagnostic accuracy of 86.66%. A previous work[11] reported sensitivity of 86.7%, specificity of 81.9%, positive predictive value (PPV) of 83.3%, negative predictive value (NPV) of 81.9% and diagnostic accuracy of 84.7% for MRI in diagnosing ovarian cancer. A previous research work[9] indicated that DW increases potential of MRI to diagnose ovarian cancer by 74% sensitivity and 80% specificity. Another work[10] sensitivity of 83.89%, specificity of 93.86%, PPV of 80.77%, NPV of 91.97% and diagnostic accuracy of 95.08% for MRI in diagnosing ovarian cancer masses. The difference in reported values may be attributed to the selection criteria of patients referred for MRI along with the difference in experience and training of the radiologist interpreting the results.[17] However, it is evident the diagnostic potential of DW-MRI is better than simple MRI.[18]

The false positive cases of DW-MRI were found to be teratoma or adenomyosis on histopathology. The previous literature also reports same.[19] Teratoma and adenomyosis can have many characteristics similar to ovarian cancer on MRI. Despite this fact, MRI is considered as first line modality in diagnosing ovarian cancer due to its similar findings as that of histopathology.[20-21] The same was found in present research work with significant ($p < 0.05$) correlation of 0.685. Thus, the applicability of DW-MRI in diagnosing ovarian cancer is justified owing to its diagnostic potential and similarity with the results of histopathology.

CONCLUSION

The DW-MRI has an accuracy of 84.7% in diagnosing ovarian cancer. Owing to its non-invasive nature, high diagnostic potential and ability to render similar results to histopathology, its use for diagnosis of ovarian cancer should be encouraged. The present research work is an effort towards understanding the applicability of MRI in diagnosis of ovarian cancer and encourages its application in this field for reduction of associated mortality and morbidity by provision of appropriate and timely treatment.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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3	Zeeshan Ali	Drafting / Literature search.	
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