Diagnostic Accuracy of Doppler Ultrasonography and Contrast Enhanced MRI in Differentiating Malignant from Benign Adnexal Masses

Farah Naz Mugheri and Ayesha Isani Majeed

1Trainee Department of Radiology, Shaheed Zulfiqar Ali Bhutto Medical University Islamabad
2Associate Professor Department of Radiology Shaheed Zulfiqar Ali Bhutto Medical University Islamabad

Abstract
Objective: To compare the diagnostic accuracy of Doppler ultrasonography and Contrast enhanced magnetic resonance imaging in differentiating malignant from benign adnexal masses

Materials & Methods: This Cross-sectional study was conducted at Radiology department Pakistan Institute of Medical Sciences from June 2014 to May 2015. A total of 90 patients of 20-60 years of age with adnexal mass were included in the study. Patients already operated for adnexal mass, having biopsy proven report, history of hypersensitivity to contrast agents, contraindication to contrast enhanced magnetic resonance imaging and any chronic disease were excluded. First, all the patients underwent trans-abdominal doppler ultrasonography and then contrast enhanced magnetic resonance imaging for malignant or benign lesion. Doppler ultrasonography and contrast enhanced MRI results were correlated with histopathology report.

Results: Trans-abdominal Doppler ultrasonography supported the diagnosis of malignant adnexal mass in 53 (58.89%) patients. Contrast enhanced MRI has shown malignant adnexal mass in 59 (65.56%) cases. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of trans-abdominal doppler ultrasonography in assessing adnexal masses are 85.18%, 80.56%, 86.79%, 78.38% and 83.33% respectively while for contrast enhanced MRI was 94.83%, 87.50%, 93.22%, 90.32% and 92.22% respectively.

Conclusion: This study showed that contrast enhanced magnetic resonance imaging (MRI) is a reliable modality with high diagnostic accuracy compared to trans-abdominal doppler ultrasonography for differentiating the malignant and benign adnexal masses.

Keywords: Imaging, Malignant, Ovarian, Tumour

Introduction
Ultrasonography with Colour Doppler is the initial imaging study of choice in the evaluation of women with suspected adnexal masses. Contrast enhanced magnetic resonance imaging is a valuable modality for non-invasive evaluation of the adnexal masses and has become an important tool in diagnosing benign and malignant masses. We conducted this study to compare the diagnostic accuracy of Doppler ultrasonography and Contrast enhanced magnetic resonance imaging in differentiating malignant from benign adnexal masses. An adnexal mass is a lump in tissue of the adnexa of uterus, usually in the ovary or fallopian tube. Adnexal masses can be benign or cancerous. Adnexal masses present a diagnostic dilemma; the differential diagnosis is extensive, and most masses are benign. However, without histopathological diagnosis, a definitive diagnosis is generally precluded. Physicians must evaluate the likelihood of concerning pathologic process using clinical and radiologic information and balance the risk of surgical intervention for a benign versus malignant process. A study showed 46% prevalence of malignant adnexal mass. Since many patients with adnexal masses are asymptomatic, there has been extensive research into effective screening strategies for ovarian cancer. The most widely studied potential screening test is the serum measurement of cancer antigen 125 (CA-125). The role of imaging is to detect and characterize adnexal masses, and recognize unusual findings that may suggest atypical pathology. Sonography with doppler is the initial imaging study of choice in the evaluation of women with suspected adnexal masses because of its widespread availability, relatively low cost, and high sensitivity in the detection of masses. However, doppler ultrasonography is limited by its decreased specificity for the diagnosis of benign masses and as many as 20% of adnexal masses being classified as indeterminate. Magnetic resonance imaging (MRI) is a valuable modality for non-invasive evaluation of...
the adnexal masses and has become an important tool in diagnosing benign and malignant masses. MRI is an excellent modality, which is being increasingly used to evaluate adnexal masses because of its excellent spatial and tissue contrast resolution, good tissue characterization and multiplanar imaging capability. Moreover, MRI does not depend on ionizing radiations. We planned this study to compare the diagnostic accuracy of Doppler ultrasonography and contrast enhanced magnetic resonance imaging in differentiating malignant from benign adnexal masses, taking histopathology as gold standard. This would provide the clinicians a non-invasive imaging modality for accurate pre-operative assessment of this condition and would help them for selection of proper treatment option.

Materials and Methods

This cross sectional study was done on 90 patients of adnexal mass referred by clinician to the radiology department of Pakistan Institute of Medical Sciences (PIMS) Islamabad for ultrasonography. Patients already operated for adnexal mass and having biopsy proven report, h/o hypersensitivity to contrast agents, contraindication to magnetic resonance imaging and any chronic disease (chronic renal failure, chronic liver disease) were excluded from the study. After taking informed consent and relevant history, all the subjects underwent doppler ultrasonography with 7 MHz probe after optimally distending the urinary bladder. Uterus, adnexa were viewed in sagittal, transverse and oblique views. All the masses were recorded for the following characteristics, i.e. size, site, septations, lobulations, papillary projections, solid component, presence of fat or calcification, ascites and metastatic deposit. The ovarian masses having echo patterns like papillary projection, solid component, septations >3mm, loculations, free fluid and metastatic deposits were considered as malignant masses. The benignity of a mass was considered if the septations were <3mm or of 3mm, or a mass having fat, calcification. After this MRI was performed in every patient by using 1.5 Tesla MR system equipped with magnetic quantum gradients with circularly polarized spine array coils. Presence of high signal intensity on T1-weighted images and low signal intensity on T2-weighted images alongwith papillary projection, solid component septations >3mm and free fluid were considered as malignant masses, otherwise taken as benign. All the results were interpreted by a consultant radiologist (with at least 5 years post-fellowship experience). All patients then underwent operation in the concerned surgical ward and specimen was sent for histopathology in the institutional laboratory where histopathology report was interpreted by consultant pathologist. Doppler ultrasonography and contrast enhanced MRI results were correlated with histopathology report. The collected data was analyzed through computer software SPSS 20.0. Mean and standard deviation was calculated for quantitative variables. Frequency and percentage was calculated for qualitative variables. 2×2 contingency table was used to calculate sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of Doppler ultrasonography compared to contrast enhanced magnetic resonance imaging in differentiating benign and malignant adnexal masses.

Results

Age range in this study was from 20 to 60 years with mean age of 47.76 years ± 7.34 SD. Out of 90 patients 41 (45.56%) were between 40 to 50 years of age. Mean size of mass was 3.69cm±1.82 SD. All the patients were subjected to Trans-abdominal Doppler ultrasonography and then contrast enhanced magnetic resonance imaging. Trans-abdominal Doppler ultrasonography supported the diagnosis of malignant adnexal mass in 53 (58.89%) patients. Contrast enhanced MRI has shown malignant adnexal mass in 59 (65.56%) cases. In trans-abdominal Doppler ultrasound positive patients, 46 (True Positive) had malignant adnexal mass and 07 (False Positive) had benign on histopathology. Among, 37 trans-abdominal Doppler ultrasound negative patients, 08 (False Negative) had malignant mass on histopathology where as 29 (True Negative) had benign. In contrast enhanced MRI positive patients, 55 (True Positive) had malignant adnexal mass and 04 (False Positive) had benign on histopathology. Among, 31 contrast enhanced MRI negative patients, 03 (False Negative) had malignant mass on histopathology where as 28 (True Negative) had benign (Table I).

| Table 1: Comparison of Trans-abdominal Ultrasoundography and MRI in Adnexal masses (n 90) |
|-----------------------------------------------|----------------|----------------|--------|--------|
| Positive result on Histopathology            | USG          | MRI           |
|                                             | + ive | - ive | + ive | -ive  |
| 46 (TP)                                      | 08 (FN) | 55 (TP) | 03 (FN) |
| Negative result on Histopathology            | 07 (FP) | 29 (FN) | 04 (FP) | 28 (FN) |

From these values sensitivity, specificity, positive predictive value, negative predictive value and accuracy of trans-abdominal doppler ultrasonography in assessing adnexal masses were calculated and they were 85.18%, 80.56%, 86.79%, 78.38% and 83.33% respectively while MRI was 94.83%, 87.50%, 93.22%, 90.32% and 92.22% respectively.

Discussion

When deciding on the type of surgery for a patient with an adnexal mass, estimating the risk of malignancy is essential. Benign masses can be managed conservatively or with laparoscopy, avoiding unnecessary costs and morbidity. On the other hand, peri-operative rupture of a stage I ovarian cancer may worsen the prognosis. Sonography is a
clinically important imaging modality for assessing whether an adnexal mass is likely benign or possibly malignant. This diagnostic modality has been directly related to the operator ability and experience. Contrast enhanced MRI also increases the specificity of diagnosis in suspicious masses on ultrasonography. Contrast enhanced MR imaging was most valuable when the tumor marker CA-125 level was normal or only minimally elevated.\textsuperscript{10}

In our study, all the patients were subjected to first trans-abdominal doppler ultrasonography and then contrast enhanced magnetic resonance imaging and then we calculated sensitivity, specificity, positive predictive value, negative predictive value and accuracy of trans-abdominal doppler ultrasonography in assessing adnexal masses are 85.18\%, 80.56\%, 86.79\%, 78.38\% and 83.33\% respectively while contrast enhanced MRI was 94.83\%, 87.50\%, 93.22\%, 90.32\% and 92.22\% respectively. In a study by Ahmed A et al\textsuperscript{4}, the sensitivity, specificity, positive predictive value, positive predictive value and negative predictive value was found to be 78.0\%, 88.8\%, 85.7\% and 82.7\% respectively. Another study by Pourissa M et al showed that abdominal sonography had a sensitivity of 70\% and a specificity of 98.55\% for predicting ovarian cancer.\textsuperscript{13}

Benacerraf BR et al\textsuperscript{13} indicated that trans-abdominal ultrasound which has a sensitivity and specificity of over 80\%. Marret H showed that the ultrasound and morphologic parameters have a sensitivity of 80\% and a specificity of 93\%.\textsuperscript{14} On the other hand; Campbell S et al\textsuperscript{15} reported much larger sensitivity of 100\%, a specificity of 97.7\%, and a positive predictive value of 1.5\% of trans-abdominal ultrasonography in detecting malignant adnexal masses. In a study, the sensitivity and specificity of magnetic resonance imaging was found to be 95\% and 94.1\% respectively in differentiating adnexal masses (benign versus malignant).\textsuperscript{16} In another study of 91 benign and 96 malignant adnexal masses, gadolinium-enhanced MRI depicted 94\% of adnexal masses and had an overall accuracy of 93\% for diagnosis of malignancy.\textsuperscript{17}

Komatsu et al\textsuperscript{18} found that the magnetic resonance imaging was 91\% sensitive and 88\% specific for differentiation of benign from malignant adnexal masses. Recently, a study done in Pakistan has shown the sensitivity and specificity of magnetic resonance imaging in ovarian masses as 97.3\% and 96\% respectively.\textsuperscript{19} Dwivedi A et al in his study has reported the sensitivity, specificity and diagnostic accuracy of MRI for the mass of ovarian origin as 97.7\%, 73.1\% and 92.1\% respectively. He has also shown that the mass of uterine origin had a sensitivity of (73.1\%) and diagnostic accuracy (99.1\%).\textsuperscript{20}

According to Adusumilli S et al\textsuperscript{21} the specificity of MRI for correctly making a benign diagnosis was 94\% and its sensitivity for correctly identifying a malignant lesion was 100\%.\textsuperscript{21} A prospective study of 103 women with adnexal masses found that MRI had sensitivity and specificity of 96\% and 100\% for diagnosis of pedunculated leiomyomas, 100\% and 99\% for dermoid cyst, and 92\% and 91\% for endometriomas.\textsuperscript{22} In a study of women with a variety of gynecologic diseases, including adnexal masses, pelvic MRI was shown to alter treatment in up to 73\% of patients, decrease the number of invasive surgeries, and reduce overall expenditures for care.\textsuperscript{23}

\section*{Conclusion}

This study concluded that Contrast enhanced MRI is a reliable modality with high diagnostic accuracy compared to trans-abdominal doppler ultrasonography for differentiating the malignant and benign adnexal masses. So, we recommend that this should be used as primary modality for assessing the adnexal masses pre-operatively and thus proper management could be taken in these patients in order to reduce the morbidity and mortality of these particular patients.

\section*{Conflict of interest}

This study has no conflict of interest declared by any author.

\section*{References}


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