DIAGNOSTIC ACCURACY OF RESISTIVE INDEX IN DOPPLER IMAGING IN DIAGNOSING MALIGNANT AND BENIGN ADNEXAL MASSES

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ABSTRACT

Objective: To evaluate the diagnostic accuracy of resistive index in Doppler Imaging in diagnosing benign and malignant adnexal masses, taking Histopathology as Gold standard.
Study Design: Prospective observational study.
Place and Duration of Study: Department of Radiology, Jinnah Hospital, Lahore Pakistan, from Jan to Jun 2018.
Methodology: A sample size of 200 patients was calculated using WHO calculator. Patients were selected through non probability consecutive sampling. After taking informed consent and relevant history, trans-abdominal Doppler Ultrasound of the patients with adnexal masses, using 3.5 MHz transducer on Logic 5 GE Doppler Ultrasound machine was performed. The Resistive Index (RI) was calculated in every case and threshold Resistive Index of 0.4 was used to differentiate benign from malignant lesions. Patients were followed after one month. Data analysis was done using SPSS version 24. Post stratification chi-square test was applied. A *p*-value ≤0.05 was considered significant.
Results: Total 200 patients were included in study. Mean age of patients was 40.53 ± 10.54 years. Mean size of lesion was 28.72 ± 11.48 SD. Diagnostic parameters of doppler imaging were sensitivity 91.3%, specificity 90.59%, positive predictive value 92.92% and negative predictive value 88.51%. ROC curve analysis showed 91% diagnostic accuracy of doppler imaging in diagnosing malignant and benign adnexal masses.
Conclusion: Resistive index in doppler Imaging is the non-invasive modality of choice with high diagnostic accuracy in differentiating benign and malignant adnexal masses, and has not only dramatically improved our ability of differentiating benign and malignant adnexal masses pre-operatively but also helps the surgeons for proper decision making

Keywords: Doppler imaging, Diagnostic accuracy, Resistive index.

INTRODUCTION

Worldwide, ovarian cancer is most common cause of cancer among women[1]. Ovarian cancer is leading cause of mortality in United States (8th most common cancer)[2]. An estimated 4.8% new cases of ovarian cancer were reported among women by Punjab cancer registry in 2020, Pakistan[3]. Adnexal masses are abnormal growths arising most commonly around fallopian tubes, ovaries and connective tissues. These masses could be benign or malignant. Adnexal masses etiology ranges from luteal cyst to ovarian lesions/cancer[4].

Adnexal masses are most commonly diagnosed clinically on the basis of ultrasonography as complex, solid and cysts. American College of Radiology reported that simple cysts are reported as benign while complex masses are reported as malignant in premenopausal women. These adnexal masses could be hemorrhagic cysts or endometriomas. Causes of adnexal masses include luteal cysts, ectopic pregnancy, polycystic ovaries and tubo ovarian abscess[5].

Three dimensional ultrasound and power doppler imaging are new diagnostic techniques for diagnosis of adnexal masses. Ultrasound measurements are associated with visualization of adnexal masses in different planes and further volume acquired and stored analysis while power doppler imaging is associated with assessment of mass vascularity. Resistive index is an ultrasound parameter used to assess pulsatile vascular system resistance (Resistive index=Peak systolic velocity - End diastolic velocity/Peak

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sysrolic velocity)[6]. Kalsoom *et al* reported that transvaginal Doppler ultrasonography is a highly accurate diagnostic imaging modality for differentiation between benign and malignant tumors of ovaries[7]. Stein *et al* reported that ultrasonography is primary imaging mortality for ovarian malignancy diagnosis. Doppler scan is found to be more accurate as compared to B-Mode USG (88% vs 67%, p=0.000)[8]. Hamper *et al* reported that high pulsatility and resistive indexes indicate benign adnexal processes while an overlapping of pulsatility and resistive indexes between malignant and benign lesions are reported[9]. We found limited literature on resistive index of Doppler imaging of adnexal masses in Pakistan. Present study was planned to evaluate the diagnostic accuracy of resistive index in doppler imaging in diagnosing benign and malignant adnexal masses, taking Histopathology as Gold standard.

METHODOLOGY

A prospective observational study was conducted at department of Radiology, Jinnah Hospital, Lahore, from January to June 2018. Sample size of 200 cases was calculated with 95% confidence level, with expected sensitivity of 18%10 with margin of error 11% and specificity 84.6%[10] with margin of error 5% of Resistive Index in diagnosing benign and malignant adnexal masses, taking histopathology as gold standard by taking expected prevalence of adnexal masses 18%[10]. Patients were selected through non probability consecutive sampling. Ethics approval was taken from respective hospital and all participating patients signed written consent forms. Inclusion criteria of patients was based upon females with adnexal masses on sonographic evaluation, Any isoechoic, hypoechoic or hyperechoic lesion in adnexa with internal septations, solid component, fat or calcification, age limit 18-60 years and patients who have to undergo surgical removal of lesion for histopathological confirmation. Exclusion criteria was based upon patient's with simple cysts (physiological) who will not undergo any surgery for their masses, patients with metabolic disorders (diabetes mellitus), patients with cardiovascular, respiratory disorders and immunocompromised patients. After taking relevant history, transabdominal Doppler Ultrasound of the patients with adnexal masses, using 3.5 MHz transducer on Logic 5 GE Doppler Ultrasound machine was performed. The Resistive Index (RI) was calculated in every case and threshold Resistive Index of 0.4 was used to differentiate benign from malignant lesions. Patients were followed after one month. Masses would be characterized prospectively as probably benign or possibly malignant on the basis of their sonographic appearance. The results thus obtained were correlated with histopathology report. This all data was recorded on a specially designed proforma which contained two parts. Final calculations were reported after one month. Data was analyzed using SPSS version 24. Mean and Standard deviation was calculated using numerical data while percentages and frequency was calculated for categorical data. Chi-square test was applied. A p-value ≤0.05 was reported as statistically significant value.

RESULTS

Total 200 patients were included in study. Mean age of patients was 40.53 ± 10.54 years. There were 39 (19.5%) patients in age group 18-30 years, 57 (28.5%) in 31-40 years age group, 64 (32%) in 41-50 years and 40 (20%) patients were in age group 51-60 years. Mean size of lesion was 28.72 ± 11.48 SD. Size of lesion was ≤25mm in 91 (45.5%) and >25 mm in 109 (54.5%) patients. Among all the cases, there were 105 (52.5%) true

Table-I: Cross tabulation of histopathology and Doppler imaging.

	Positive Result on Doppler Imaging	Negative result on Doppler imaging	Total	*p*-value
Positive on Histopathology	105 (52.5%)	10 (5%)	115(57.5%)	0.000
Negative on Histopathology	8 (4%)	77 (38.5%)	85(42.5%)	
Total	113 (56.5%)	87 (43.5%)	200 (100%)	

positive cases, 77 (38.5%) true negative cases, 10 (5%) were false negative and 8 (4%) were false positive cases as shown in table-I. Diagnostic parameters of doppler imaging were sensitivity 91.3%, specificity 90.59%, positive predictive value 92.92% and negative predictive value 88.51% as shown in table-II. ROC curve analysis showed

Table-II: Diagnostic accuracy parameters of doppler imaging.

Diagnostic Accuracy Parameters	Doppler Imaging
Sensitivity	91.3%
Specificity	90.59%
Positive predictive value	92.92%
Negative predictive value	88.51%
Accuracy	91%

91% diagnostic accuracy of doppler imaging in diagnosing malignant and benign adnexal masses as shown in figure.

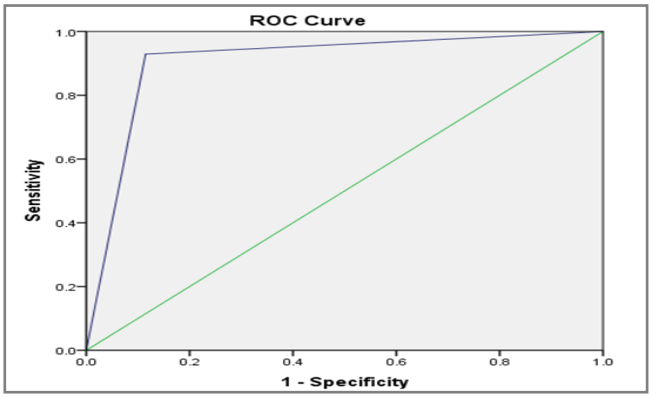

Figure: ROC Curve analysis.

DISCUSSION

Ovarian carcinoma is an emerging public health problem, globally[11]. During women life course, anatomical and histological ovary changes explain complexity of ovarian cancer[12]. Literature reported more than 80% survival rate in initial stages of cancer and less than 5% survival rate at stage IV. This significance led us to understand detection and characterization of ovarian masses through radiological imaging[13].

Goyal *et al* reported that malignant adnexal masses appear as multiple cysts, mural nodules, thick and irregular septa, echogenic elements and solid components on ultrasonography, however, color doppler imaging lead us to understand vasularity, abnormal vessel morphology, random vessel arrangement and vessel central site[14]. Moreover, Buy *et al* reported that resistive index ≤0.4 while pulsatility value ≤1 is significant suggestive of malignant adnexal masses[15].

Present study showed high sensitivity and specificity (91.3% & 90.59%) of Doppler imaging for benign and malignant adnexal masses. Majed *et al* reported that validity of resistive index with 18.18% sensitivity and 84.61% specificity, 33.33% PPV while 70.96% NPV. They also determined accuracy of resistive index 64.86%[16]. Salem *et al* reported that high impedance flow in benign adnexal disease and a significant low impedance flow were found in malignant lesions with resistive index[17]. Madan *et al* reported that resistive index in doppler imaging for adnexal masses showed high sensitivity and specificity (95.2% and 76.6% respectively). They also presented as trend of vascular scoring with positive predictive value (68.9% and 80.4%) for malignancy prediction[18].

This study ROC analysis showed high diagnostic accuracy of resistive index doppler imaging for adnexal masses (91%). Mugheri *et al* reported that 85.18%, 80.56%, 86.79%, 78.38% and 83.33% sensitivity, specificity, PPV, NPV and accuracy of Doppler imaging in assessment of adnexal masses[19]. Sokalska *et al* reported that sensitivity of Doppler imaging was highest for dermoid cyst (86%), peritoneal pseudocysts (80%), Benign rare tumors (11%) and adenofibromas (8%)[20]. Guerriero *et al* reported that in color doppler energy imaging, a mass was considered malignant when arterial flow was visualized in an echogenic portion of a mass defined as malignant by B-mode. Intra-tumoral arterial blood flow could be readily detected by color doppler imaging in all malignant tumors and in 94% accuracy of the benign tumors. The combined use of transvaginal B-mode ultrasonography and color doppler energy imaging has greater accuracy in the diagnosis of ovarian malignancies than transvaginal ultrasonography alone (value of kappa:

0.81 and 0.63, respectively), reducing the number of false positive results[21].

LIMITATION OF STUDY

Conduction of study at single center limits generalisability of our study.

CONCLUSION

Resistive index in doppler imaging is the non-invasive modality of choice with high diagnostic accuracy in differentiating benign and malignant adnexal masses, and has not only dramatically improved our ability of differentiating benign and malignant adnexal masses pre-operatively but also helps the surgeons for proper decision making. So, we recommend that resistive index in Doppler Imaging should be done routinely in all suspected cases of adnexal mass for accurate differentiation of benign and malignant adnexal masses pre-operatively and opting proper surgical approach.

CONFLICT OF INTEREST

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

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