ORIGINAL ARTICLE

VALIDITY OF GRAYSCALE ULTRASOUND AND RESISTIVE INDEX IN THE DETECTION OF NATURE OF OVARIAN NEOPLASMS BY TAKING HISTOPATHOLOGY AS A GOLD STANDARD

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Background: The utility of ultrasound has long been established in the diagnosis of benign and malignant ovarian neoplasms. Ultrasound is a safe and non-invasive imaging modality that has a high sensitivity and specificity. The objective was to determine the validity of grayscale ultrasound and resistive index in the detection of nature of ovarian neoplasms by taking histopathology as a gold standard. **Methods:** It was Cross-sectional study conducted in department of Radiology, Ayub Teaching Hospital Abbottabad from May 16 to November 30, 2014. Two-hundred-twenty-one female patients in whom an adnexal mass was noted on pelvic ultrasound were included in the study. **Results:** Out of these 221 patients, malignant ovarian masses were present in 50 (22.62%) patients on grayscale ultrasound. While a resistive index ≤0.6 was found in 56 (25.34%) patients. Over all the sensitivity of grayscale ultrasound was 95% and the specificity was 93.37%. Likewise, the sensitivity and specificity of resistive index were 95% and 90.06% respectively. **Conclusion:** This study showed the grayscale ultrasound is a sensitive imaging modality for differentiation of benign and malignant ovarian masses.

Keywords: Adnexal masses; Ultrasound; Doppler; Resistive Index; Carcinoma; Ovary

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INTRODUCTION

Ultrasound has long been established as a useful investigation in the detection of an ovarian tumour and in differentiation of ovarian masses from uterine masses.[1] In fact it has been designated as the primary imaging modality for the assessment of adnexal masses.[2] Ultrasound is useful because it can detect as well as characterize the ovarian mass during a single examination. Therefore, the use of ultrasound has become valuable as an imaging technique for the evaluation of ovarian masses.[3]

There are many different types of ovarian masses. They can broadly be classified into non-neoplastic and neoplastic lesions. Non neoplastic ovarian cysts constitute a majority of ovarian masses. A quarter of ovarian neoplasms are malignant lesions and the rest are benign neoplasms.[3]

Ovarian cancer ranks fourth among leading causes of cancer-related deaths in women.[4] With a cure rate of around 40% in across all stages, in the United States, ovarian cancer was responsible for 13,850 deaths in 2010.[5] Ovarian cancer is the second most common cancer in Pakistan.[6]

Surgery is often the treatment of choice of neoplastic ovarian lesions. The type of surgery performed in these situations depends on the probability of finding a malignant lesion. Currently, no well-defined diagnostic criteria and ultrasound techniques are available that might help in characterization of a suspected ovarian malignancy. Various methods of sono-logical evaluation of ovarian neoplasms have been suggested with variable accuracy. Commonly used methods of ultrasound include, gray-scale ultrasound, colour Doppler flow imaging and measurement of Doppler arterial resistance. Their reported accuracies are 65–94%, 35–88% and 48–99% respectively.[3] The ultrasound is not the sole method for evaluation of suspected ovarian neoplasms. Many diagnostic algorithms as well as scoring systems have also been put into place to improve the test performance in detection of malignant neoplasms.[5]

The ultrasound technique that allows the operator to best visualize and identify the ovarian lesion is yet to be determined. It has been suggested in literature that the determination of blood flow resistance in and around the adnexal masses is a sensitive method for detection of ovarian malignancy and, on the basis of resistive index, differentiation between benign and malignant ovarian neoplasms is easily possible.[7] When Resistive Index of ≤0.6 was used to classify ovarian masses as malignant, the reported sensitivity and specificity approached 97.5% and 84.1% respectively.[8]

The sonographic features of benign and malignant ovarian masses are different and recognition of these features help in correct identification of these masses. Common benign

masses include endometriotic cysts with diffuse low-level echoes with or without septations, dermoid cysts which may have a fluid layer, and other anechoic lesions with no septations and smooth thin wall. Malignant lesions may show irregular wall thickness, solid components, thick septations and abnormal Doppler wave-form analysis.[3,7] The current study is designed to test the validity of gray scale ultrasound and resistive index in evaluation of suspected benign and malignant ovarian neoplasms. This study, although limited in scope, will enable us to look at the possible role for resistive index in evaluation of suspected ovarian neoplasms in our setup.

MATERIAL AND METHODS

It was Cross-sectional study, conducted in Department of Radiology, Ayub Teaching Hospital, Abbottabad from May 16 to November 30, 2014. Sample size for this study was 221, which was calculated using the formula for calculation of sample size for validation study. These assumptions were made for calculating the sample size: Sensitivity =97.5%, Specificity=84.1%, and Prevalence=47.6%. Desired precision =2.5% for sensitivity and d2 = 10% for specificity. Consecutive non-probability sampling technique was used for sample selection.

All adult female patients who were diagnosed to have adnexal mass on pelvic ultrasound were included. Patients who had physiological cysts (simple cyst of less than 5cm) on ultrasound examination, who refused transvaginal ultrasound examination, whose histopathology reports were not available for comparison of results, and Patients diagnosed to have ectopic pregnancy were excluded. The study was conducted after approval from hospitals ethical and research committee. All patients meeting the inclusion criteria were included in the study after they arrived at the Department of Radiology. The purpose and benefits of the study was explained to all patients and patients' relatives if patients were not stable enough to understand the objectives of this study and they were assured of the confidentiality of data and informed written consent was obtained from all patients.

Patients were subjected to gray scale trans-abdominal pelvic ultrasound with a 3.5-MHz transducer by the trainee under the supervision of two consultant radiologists. Colour Doppler ultrasound machine Toshiba Nemio XG was used for this examination. Upon noting an adnexal mass, transvaginal ultrasound with a 7-MHz transducer and with Doppler capability was done to evaluate the lesion. Each mass was assessed in terms of size, echo texture, wall thickness, presence of septations or internal echoes, solid component, calcification, colour flow and resistive index and the radiological impression was duly noted. Biopsy of the adnexal mass was done by the senior gynaecologist of Ayub Teaching Hospital and sent for histopathology. Histopathology of the adnexal masses was performed by two senior pathologists in the pathology department of Ayub Medical College. The results of ultrasound were, later, compared with the histopathology reports to note the accuracy of gray scale ultrasound and resistive index in identifying benign or malignant ovarian masses.

Data was analysed using SPSS version 10. Mean ± SD were calculated for numerical variables like age and size of mass. Frequencies and percentages were calculated for categorical variables like type of mass, i.e., benign or malignant. The following 2x2 contingency tables were constructed.

RESULTS

A total of 221 patients were enrolled in this study. The mean age of these patients was 28.44±4.70 years. The youngest patient was 21 years old and the oldest patient was 37 years old. The mean resistive index of these patients who had adnexal masses on ultrasound was 0.74±0.27. The lowest resistive index was 0.1 while the highest recorded resistive index was

1.40. Mean adnexal mass size was 9.31 cm. The smallest lesion was 6 cm in size and the largest was 12 cm in diameter. A standard deviation of 1.91 was noted.

On ultrasound examination malignant masses were identified in 50 (22.62%) patients. One hundred and seventy-one (77.38%) patients were found to have benign adnexal masses. Resistive index was found to be 0.6 or less in 56 (25.34%) patients and it was raised in 165 (74.66%) patients. Results of Biopsy showed that 40 (18.10%) patients had malignant lesions while benign lesions were found in 181 (81.90%) patients. On cross tabulation, the sensitivity of gray scale ultrasound was found to be 95%. The specificity of gray scale ultrasound was 93.37%. The positive predictive value of gray scale ultrasound was 76% and the negative predictive value was 98.83%. Likewise, the sensitivity and specificity of resistive index were 95% and 90.06% respectively. The positive and negative predictive values of the test were 67.86% and 98.79% respectively. All data is presented as tables.

Table-1: Cross-tabulation of ultrasound impression of adnexal mass and the biopsy report

Impression of Adnexal Mass	Biopsy report of adnexal mass			*p*-value
	Malignant Lesion	Benign lesio	Total	
Malignant Mass	38	12	50	**0.00**
Benign Mass	2	196	171	
Total	40	181	221	

p-value≤0.05significant. Specificity=d/b+d × 100 = 93.37%, Predictive value for a positive test = a/a+b ×100 = 76%, Predictive value for a negative test = d/c+d ×100 = 98.83%

Table-2: Cross-tabulation of resistive index and the biopsy report

Resistive index ≤0.6	Biopsy report of adnexal mass			*p*-value
	Malignant Lesion	Benign lesion	Total	
Yes	38	18	56	**0.00**
No	2	163	165	
Total	40	181	121	

p-value≤0.05 significant. Sensitivity=a/a+c × 100 = 95%, Specificity=d/b+d × 100 = 90.06%, Predictive value for a positive test=a/a+b × 100 = 67.86%, Predictive value for a negative test=d/c+d ×100 = 98.79%

DISCUSSION

The value of ultrasound as a useful investigation in the detection of ovarian tumours and in the differentiation of ovarian masses from uterine masses has long been established. It is usually the first imaging modality when it comes to assessing the adnexal masses. Ultrasound has become a valuable imaging technique because ovarian masses can be detected and assessed in one single session. Broadly the many different ovarian masses can be classified into non-neoplastic and neoplastic lesions. While majority of the ovarian masses are non-neoplastic in nature, a quarter of ovarian masses are malignant. Worldwide, ovarian cancer is the 4th leading cause of cancer related mortality in women and, in Pakistan; it is the second most common cancer in women. There is no well-defined ultrasound based diagnostic criteria and ultrasound techniques which can characterize a suspected ovarian malignancy though various methods of sonological evaluation have been suggested. These methods, which include gray-scale ultrasound, Doppler waveform assessment and measurement of resistive index on doppler have variable accuracy.

The aim of this study was to determine the role of gray scale ultrasound and the resistive index in ascertaining the nature of ovarian neoplasms. The study enrolled 221 patients who had presented to the department of radiology for a pelvic ultrasound and in whom an adnexal mass was noted on the subsequent ultrasound examination. Over all, on the basis of gray scale ultrasound, malignant lesions were noted in 50 (22.62%) patients.

While on the basis of resistive index, a diagnosis of malignancy was made in 56 (25.34%) patients. The biopsy reports showed presence of malignancy in only 40 (18.10%) out of 121 patients. The overall sensitivity and specificity of gray scale ultrasound and resistive index were 95% & 93.37% and 95% & 90.06% respectively. The assessment of nature of ovarian neoplasms using gray scale or Doppler colour ultrasound has a moderate accuracy, usually in the range of 80–90%.[9,10] Recently, Gupta reported a sensitivity and specificity of 90.9 and 92.3% respectively colour doppler studies. However, the cut-off value for differentiating between benign and malignant masses was kept at <0.4.[7]

The sensitivity and specificity of resistive index reported in this study are comparable with those reported by Gupta. However, the cut-off value for resistive index in this study was ≤0.6. Similarly, Brown *et al* reported a sensitivity and specificity of 93% each for gray scale ultrasound in differentiating benign from malignant adnexal masses.[11] However; they did not report the results of resistive index in their research. The results reported by Brown et al are comparable with those in this study. Fleischer *et al* have reported a specificity of 85% for gray scale ultrasound in the differential diagnosis of benign and malignant ovarian masses.[12] The specificity of gray scale ultrasound was 93.37% in this study. These results are in contrast to earlier results reported by Valentin in which specific diagnosis could be made only in about 42% of adnexal tumours scheduled for surgery.[13] However, in another report, Timmerman *et al,* reported a sensitivity of 95% and a specificity of 93% for ultrasound for the purpose of differentiating benign and malignant adnexal masses.[14] They concluded that it was easy to categorize most adnexal tumours on the basis of simple ultrasound based rules.

The variation in the reported sensitivity and specificity of ultrasound may well be due to the experience of the sonographer. The role of sonographer's experience has been highlighted by Smorgick and colleague in a recently published research who stress that the experience of sonographer plays an important role in providing the best management to patients with suspected adnexal mass.[15]

CONCLUSION

Ovarian carcinoma accounts for a quarter of adnexal masses present in women. Prompt diagnosis of these adnexal masses and determination of their nature results in provision of best available healthcare to the patient. In this regard, transabdominal and / or transvaginal ultrasound appears to be a safe and non-invasive imaging modality that has a high sensitivity and specificity in differentiation of benign from malignant adnexal masses. The results of this imaging modality can be reasonably relied upon when diagnosing malignant adnexal masses.

AUTHORS' CONTRIBUTION

FA, AA: Concept of main theme, study design, literature search, write-up. SK, BA: Data collection, analysis and interpretation. SB, DZ: Write-up, Proof reading

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