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Radiology

EVALUATION OF ADNEXAL MASSES: A CORRELATION OF CLINICAL, ULTRASOUND AND HISTOPATHOLOGICAL FINDINGS

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ABSTRACT **Background:** Adnexal masses are common pathological conditions encountered in gynecology and can range from benign to malignant tumors. Early and accurate diagnosis is crucial for appropriate management. Ultrasonography (USG) is widely used for initial assessment, and scoring systems such as the Risk of Malignancy Index (RMI) and Sassone score are employed to predict malignancy. The study aimed to evaluate the diagnostic accuracy of USG in distinguishing benign from malignant adnexal masses and to assess the efficacy of established scoring systems (RMI and Sassone) in predicting malignancy. **Material And Methods:** This prospective observational study included 102 patients diagnosed with adnexal masses on USG. The study involved clinical, imaging, and histopathological data collection. Key diagnostic features observed via USG included echogenicity, inner wall structure, septations, intramural nodules, vascularity, and ascites. The RMI and Sassone scores were calculated and correlated with histopathological findings. **Results:** USG demonstrated high diagnostic accuracy with sensitivity of 83% for malignant masses and 90% for benign lesions. The RMI score had a sensitivity of 71.4% and specificity of 78.4%, while the Sassone score showed a sensitivity of 85.7% and specificity of 56.8%. The cut-off values for CA-125, RMI, and Sassone were found to be 21, 120, and 8, respectively, with significant correlations to malignancy. **Conclusion:** USG, in combination with biomarkers and scoring systems like RMI and Sassone, offers reliable diagnostic accuracy in differentiating benign from malignant adnexal masses. These tools are valuable in guiding clinical decision-making for appropriate management.

KEYWORDS : Adnexal masses, Ultrasonography (USG), Risk of Malignancy Index (RMI), Sassone score, CA-125, Diagnostic accuracy, Benign, Malignant, Ovarian tumors.

INTRODUCTION

According to the International Ovarian Tumor Analysis (IOTA), an adnexal lesion is described as "the part of an ovary or an adnexal mass that appears inconsistent with normal physiological function upon ultrasound imaging" [1]. Adnexal masses, which can vary from simple cysts to benign or malignant ovarian tumors, are among the most frequently encountered pathological conditions in gynecological practice and can affect women of all age groups. In premenopausal women, common causes include ovarian cysts, tumors, polycystic ovaries, abscesses, and ectopic pregnancies. In contrast, menopausal women are more likely to develop fibroids, fibromas, or malignant tumors [2]. The overall incidence of malignancy in adnexal masses is reported to range from 1% to 8%. Additionally, ovarian cancer has been identified as the fifth leading cause of cancer-related deaths in females [3]. During pregnancy, the incidence of adnexal masses is estimated to range between 1 in 81 to 1 in 8000 cases. Such masses during gestation can lead to complications, including pain caused by rupture or torsion, labor obstruction, or bleeding and infection [4].

According to the 2008 guidelines by the American College of Obstetricians and Gynecologists (ACOG), women with adnexal masses face a 5–10% risk of requiring surgery, with 13–21% of those undergoing surgery being diagnosed with ovarian cancer. The guidelines also emphasize the limited effectiveness of pelvic examinations in detecting adnexal masses, particularly in individuals with a BMI >30 kg/m² [5]. In recent years, ultrasonography (USG) has become a widely preferred method for the initial assessment of abdominal and pelvic masses due to its speed, cost-effectiveness, and reliability in lesion characterization. Advanced imaging techniques, such as computed tomography (CT) and magnetic resonance imaging (MRI), are employed for further evaluation of these lesions. However, the most definitive method for determining the malignant nature of an adnexal mass remains histopathological examination, with approximately 30% of all masses operated on for suspected malignancy ultimately being benign [6].

The present study aimed to evaluate the morphological features of various adnexal masses using ultrasonography (USG) (trans-abdominal and/or transvaginal) and color Doppler. It confirmed the diagnostic accuracy of USG in distinguishing between benign and malignant masses by correlating findings with histopathological results. Additionally, the study assessed the reliability of established ultrasound scoring systems in predicting malignancy.

MATERIAL AND METHODS

After obtaining approval from the institutional ethics committee, this prospective observational study was conducted in the Department of Radiology at SAMC & PG Institute. A total of 100 patients referred for ultrasonography (USG) with a clinical suspicion of adnexal masses, and subsequently diagnosed with the same during the study period, were included. The inclusion criterion was a confirmed diagnosis of adnexal mass on USG at the radiodiagnosis department. Patients were excluded if they were non-consenting, pregnant, had masses originating from the urinary or gastrointestinal tract, were undergoing ovulation induction therapy, or did not undergo histopathological evaluation of the detected mass. Informed consent was obtained from all participants meeting the criteria.

Methodology

All relevant data, including patient age, clinical presentation, imaging studies, tumor markers, intra-operative findings, and histopathological reports, were systematically collected and recorded in a pre-designed proforma. Ultrasonography (USG) was employed to identify key diagnostic features such as solid components, thick-walled cysts, papillary nodules, septa >3 mm in thickness, irregular thick septations, ascites, peritoneal deposits, and lymphadenopathy. [7]

For each patient, Risk of Malignancy Index (RMI) and Sassone scores were calculated based on the USG findings. [8, 9] USG evaluations were performed via transabdominal and/or transvaginal scanning (TAS/TVS) with Doppler using the Samsung HS70A ultrasound machine (Samsung Electronics Pvt. Ltd., Seoul, South Korea). Imaging characteristics were categorized as present or absent, and lesions were subcategorized according to the frequency and type of observed features.

The RMI score was derived using a simplified regression equation based on the product of menopausal status (M), ultrasonographic findings (U), and serum CA-125 levels. [10-12] An RMI score >200 was used as a threshold for suspected malignancy.

Post-laparotomy, surgical specimens were sent for histopathological examination, and the findings were subsequently correlated with preoperative clinical and imaging assessments to validate the accuracy of the diagnostic approach.

Statistical Analysis

The collected data was coded and entered into Microsoft Excel 2010, then analyzed using both Excel and SPSS 20.0 for Windows. Study findings were systematically organized into tables and subjected to statistical analysis. Descriptive statistics were used to characterize adnexal masses, and the results were expressed as percentages. To

validate the effectiveness of ultrasound in predicting malignancy, sensitivity, specificity, and positive predictive value (PPV) were calculated. Each study variable was cross-tabulated with the final histopathological diagnosis to assess its predictive potential for malignancy. This approach ensured a comprehensive evaluation of the diagnostic performance of ultrasound and associated scoring systems.

RESULTS

The study included 102 patients diagnosed with adnexal masses on USG, comprising 60 premenopausal and 42 postmenopausal subjects. A comparison of menopausal status with the final diagnosis revealed that 83% of premenopausal patients had benign lesions, while only 57% of postmenopausal patients showed benign pathology.

In terms of echogenic characteristics, approximately 45% of the lesions displayed mixed echogenicity. Lesions with smooth inner walls were benign in 92% of cases, whereas those with irregular inner walls were malignant in 45% of cases. Nearly 50% of the lesions with septations were benign in 71–76% of cases. Furthermore, a comparison of intramural nodules or solid areas with the final diagnosis showed that 96% of lesions without solid components were benign, whereas 52% of lesions with solid components were malignant (Table 1).

Regarding vascularity, approximately 57% of lesions with internal vascularity were malignant, whereas 94% of avascular lesions were benign. Among patients without ascites, 81% had benign lesions.

Ultrasonography (USG) demonstrated high diagnostic accuracy in evaluating adnexal masses, correctly identifying 90% of benign lesions and 83% of malignant lesions (Table 1). Key variables significantly associated with differentiating benign and malignant lesions included menopausal status (P=0.0311), echogenicity (P=0.0147), inner wall structure (P=0.0082), intramural nodules or solid areas (P=0.0001), vascularity (P=0.0041), and the presence of ascites (P=0.0210). Additionally, the overall use of USG in distinguishing between benign and malignant lesions was found to be highly significant (P=0.000) (Table 1).

Table-1: Comparison of different variables with the final diagnosis

Variables	Final Diagnosis		P Value
	Benign, No. of subjects (%)	Malignant, No. of subject (%)	
Menopausal status			0.0311*
Pre-menopausal	50 (83%)	10 (17%)	
Post-menopausal	24 (57%)	18 (43%)	
Echogenicity			0.0147*
Sonolucent	36 (95%)	2 (5%)	
High	4 (100%)	0 (0%)	
Low	2 (100%)	0 (0%)	
Mixed	32 (55%)	26 (45%)	
Inner wall structure			0.0082*
Smooth	46 (92%)	4 (8%)	
Irregular	22 (55%)	18 (45%)	
Mostly solid	6 (50%)	6 (50%)	
Wall thickness			0.3058
Mostly solid	3 (50)	3 (50)	
Thick	6 (67)	3 (33)	
Thin	28 (78)	8 (22)	
Septations			0.7142
Thick	1	1	
Thin	19	6	
No	17	7	
Intramural nodule or solid areas			0.0001*
Present	12 (48)	13 (52)	
Absent	25 (96)	1 (4)	
Vascularity			0.0041*
Present	6 (42)	8 (57)	
Minimal	4 (57)	3 (43)	
Peripheral	10 (83)	2 (16)	
Absent	17 (94)	1 (6)	
Ascites			0.0210*
Present	7 (50)	7 (50)	
Absent	7 (19)	30 (81)	
USG accuracy			0.0000*
Benign	35 (90)	4 (10)	
Malignant	2 (17)	10 (83)	

*P<0.05: Significant

The comparison of the size of adnexal masses between benign and malignant lesions showed that benign masses ranged from 21 to 221, while malignant masses ranged from 39 to 172 (Table 2). The ROC curve analysis for CA-125 determined a cut-off value of ≥ 21. The corresponding sensitivity and specificity were 71.4% and 56.8%, respectively, with an area under the curve (AUC) of 0.64 (P=0.023, significant) (Fig. 1a). For benign cases, CA-125 values ranged from 0.5 to 830 (median = 18.8), while for malignant lesions, values ranged from 8 to 627 (median = 78.7). For the Risk of Malignancy Index (RMI), the cut-off value was determined to be ≥120, with corresponding sensitivity and specificity of 71.4% and 78.4%, respectively, and an AUC of 0.75 (P=0.01, significant) (Fig. 1b). The ROC curve for the Sassone score indicated a cut-off value of ≥8, with sensitivity and specificity of 85.7% and 56.8%, respectively, and an AUC of 0.71 (P=0.015, significant) (Fig. 1c).

Table-2: Comparison of the average size of the lesions benign vs. malignant

Variables	Benign	Malignant
No. of Subjects	74	28
Maximum	221	172
Minimum	21	39
Mean	101.68	100.57
SD	56.23	41.55
Median	85	100.50

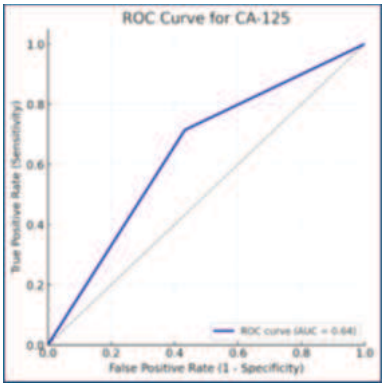

Figure 1a. ROC Curves for CA-125

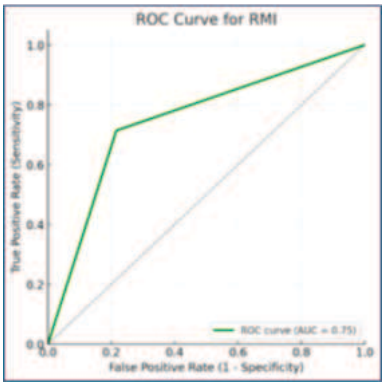

Figure 1b. ROC Curves for RMI

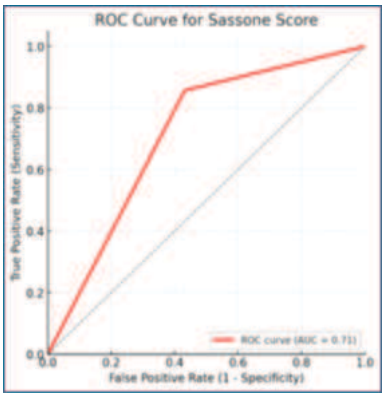

Figure 1c. ROC Curves for Sassone Score

Figure-1: ROC curves showing the association between specificity

and sensitivity for CA-125, RMI and Sassone score in diagnosing malignant lesions

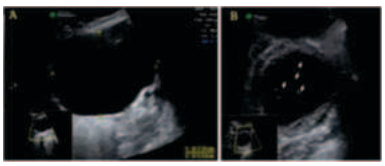

Figure-2: Right papillary cystadenoma and left hemorrhagic cyst: TAS showing a large cystic lesion in the right ovary and a cystic lesion with lace-like internal septations in the left ovary

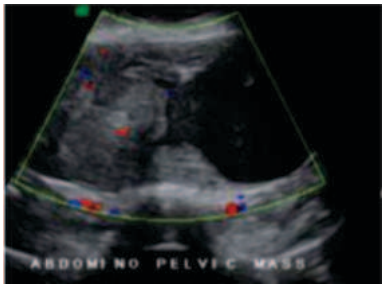

Figure-3: Low grade papillary serous carcinoma: Solid component with vascularity (Malignant adnexal mass)

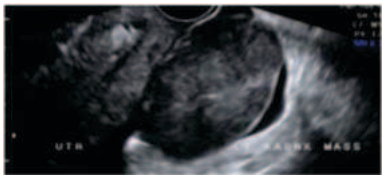

Figure-4: Fibrothecoma: Solid ovarian lesion seen on TVS

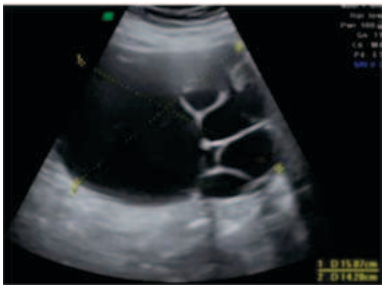

Figure-5: Serous cystadenoma: Multiloculated cystic lesion replacing the ovary on USG

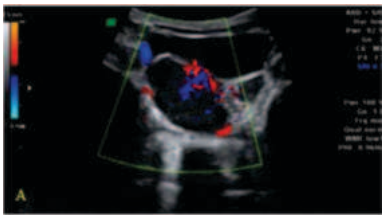

Figure-6: Small round blue cell tumour: A solid lesion appearing predominantly hypoechoic on USG with internal vascularity

DISCUSSION

The present study examined various features associated with the decision-making process in determining the malignancy of adnexal masses, and cross-tabulated the frequency of each finding with the final diagnosis. This analysis provided valuable insights into specific characteristics that could predict malignancy. The study found that factors such as menopausal status, echogenicity, inner wall structure, intramural nodules or solid areas, vascularity, and the presence of ascites were significant in differentiating between benign and malignant lesions.

In line with these findings, a review by Brown et al. has emphasized the importance of considering factors such as menopausal status, age, personal or family history of breast or ovarian cancer, and serum CA-125 levels, in addition to imaging features. The researchers also highlighted that ultrasound characteristics, including the presence of ascites, solid components, and thick septa, are instrumental in distinguishing benign from malignant adnexal masses [13].

The median size of malignant masses was found to be slightly larger than benign masses (100.5 mm vs. 85 mm). The size of an adnexal mass has been suggested as a potential screening tool for distinguishing malignancy. A study by McDonald et al. in nonpregnant pre- and postmenopausal women reported a significant association between a tumor diameter >10 cm and a diagnosis of malignancy. However, multivariate analyses indicated that size alone is not a reliable discriminator of malignancy [14]. A study by Granberg et al., which examined 1017 ovarian tumors and correlated their gross appearance with histological diagnosis, established a relationship between macroscopic appearance and the risk of malignancy [15]. This study found that unilocular cysts had a 0.3% chance of malignancy, while complex multiloculated masses carried a 36% risk and predominantly solid lesions had a 39% risk. Valentin et al. reported that the sensitivity of pattern recognition in ultrasound for adnexal masses ranged from 88% to 100%, while specificity ranged from 62% to 96% [16].

The accuracy of USG in distinguishing between benign and malignant masses was found to be highly significant in the current study (P=0.000). The corresponding accuracy of USG in detecting malignancy and benignancy were 83.3% and 89.2%, respectively. An Indian study involving 100 patients suspected of having adnexal masses recommended the use of USG as the primary modality for evaluating adnexal masses. The researchers observed that the majority of benign ovarian tumors were serous cyst adenomas, while all malignant tumors were serous cyst adenocarcinomas and poorly differentiated adenocarcinomas [17].

The current study found that scoring systems are statistically significant in detecting malignancy. For CA-125, a cut-off value of 21 was used to predict malignancy. The corresponding sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), with an area under the curve of 70.8% (p = 0.023, significant), were 71.4%, 56.8%, 38.5%, and 84%, respectively. The corresponding values of variables noted in a 2012 cross-sectional study by Hartman et al. were 90%, 87%, 69%, and 97%. In contrast, the researchers noted that CA-125 alone has comparatively lesser potential than USG in differentiating malignant from benign adnexal tumors [18].

With regard to the Risk of Malignancy Index (RMI), the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) noted when using a cut-off value of 120, with an area under the curve of 81.2% (P = 0.01, significant), were 71.4%, 78.4%, 52.2%, and 92.8%, respectively. The study by Javdekar and Maitra concluded that RMI is an effective tool in discriminating benign from malignant masses. The corresponding sensitivity, specificity, PPV, and NPV noted with RMI in their study were 70.5% (95% CI 46.87–86.72), 87.8% (95% CI 74.46–94.68), 70.5%, and 87.8%, respectively [8].

The present study has also corroborated the efficacy of the Sassone score. A cut-off value of 8 was calculated for the Sassone score, and the corresponding sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) noted in predicting malignancy, with an area under the curve of 76% (P = 0.05, significant), were 85.7%, 56.8%, 42.8%, and 91.3%, respectively. Shende et al. recommended the use of the Sassone scoring system with gray scale ultrasonography (USG) in routine practice to differentiate benign and malignant adnexal masses. They used a cut-off value of 9, and the corresponding sensitivity and specificity in predicting malignancy were 88% and 94%, respectively [19]. Scoring systems were found to be statistically significant in detecting malignancy. Myers et al. assessed the most frequently used scoring systems and found that the pooled sensitivity and specificity of detecting malignancy with these systems varied from 82% to 91% and 68% to 77%, respectively. In the current study, these values ranged from 80% to 85% [20].

Though the required number of patients was comfortably achieved, the total number of patients included in this study was smaller compared to other studies with similar objectives. This limitation can be attributed to the restricted amount of time available for data collection. While the study considered a considerable number of patients who presented with adnexal masses during the study period, a significant proportion of them were lost to follow-up. However, the present study holds

greater clinical significance as very few studies have explored the predictive potential of various ultrasonographic (USG) features in distinguishing benign and malignant adnexal masses, particularly within the Indian population. Further studies involving larger populations are essential to corroborate these findings and strengthen the evidence.

CONCLUSION

Ultrasound (USG) demonstrates very high accuracy in classifying adnexal masses as either benign or malignant. The distinguishing USG features, such as echogenicity, inner wall structure, intramural nodules or solid areas, vascularity, and the presence of ascites, are essential in making a reasonably confident diagnosis between benign and malignant masses. Additionally, the use of biomarkers like CA-125 and scoring systems such as the Risk of Malignancy Index (RMI) and Sassone score further enhance the predictive ability for malignancy, proving to be valuable tools in routine clinical practice. These methods allow for more accurate and efficient decision-making in managing patients with adnexal masses.

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