



Diagnostic Value of Ultrasonography and Serum CA-125 in Predicting Malignancy in Ovarian Tumors Among Premenopausal and Postmenopausal Women

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Abstract

Background: Ovarian cancer remains one of the leading cause mortalities. In resource-limited settings, affordable and accessible diagnostic tools are essential for early detection.

Objectives: To evaluate the diagnostic performance of ultrasonography and serum CA-125 in differentiating benign and malignant ovarian tumors among premenopausal and postmenopausal women.

Methods: This cross-sectional analytical study was conducted at Sylhet MAG Osmani Medical College from January 2019 to December 2020. A total of 100 women with ovarian tumors (50 premenopausal and 50 postmenopausal) were included. All participants underwent clinical assessment, ultrasonography, and serum CA-125 estimation prior to surgery. Histopathological examination served as the reference standard. Diagnostic accuracy parameters including sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated.

Results: Malignancy was more frequent in postmenopausal women (60.0%) than in premenopausal women (22.0%). In premenopausal women, ultrasonography demonstrated a sensitivity of 90.9%, specificity of 82.1%, PPV of 58.8%, NPV of 97.0%, and diagnostic accuracy of 84.0%. In postmenopausal women, sensitivity and specificity were 83.3% and 85.0%, with PPV of 92.6%, NPV of 78.3%, and accuracy of 84.0%. Serum CA-125 showed comparable performance, with higher predictive value in postmenopausal women (PPV 88.9%, NPV 73.9%, accuracy 82.0%). When both modalities were used in combination, sensitivity increased to 90.9% in premenopausal women and 86.7% in postmenopausal women, with overall diagnostic accuracy of 80 and 82% accordingly.

Conclusion: Ultrasonography provided superior sensitivity and negative predictive value in premenopausal women, whereas serum CA-125 offers greater specificity in postmenopausal women. Their combined use enhanced diagnostic overall accuracy.

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Introduction:

Ovarian cancer remains one of the most challenging malignancies in women [1]. A woman's lifetime risk of developing ovarian cancer is approximately 1 in

91, while her lifetime risk of dying from the disease is about 1 in 143 [2]. Globally, ovarian cancer ranks as the eighth most common cancer among women, with an estimated incidence of 6.6 per 100,000 women and a mortality rate of 4.2 per 100,000 in 2020 [3]. The risk increases steadily with advancing age and is further amplified by a positive family history, hereditary cancer syndromes, and mutations in breast cancer susceptibility genes such as BRCA and menopausal status [3].

Because ovarian tumors, are largely asymptomatic, they often remain clinically silent until they reach a considerable size or have already disseminated within the peritoneal cavity [4–6]. Nearly two-thirds of ovarian cancers are diagnosed at stage III or IV, when disease is frequently inoperable [7]. This late presentation translates into a dismal prognosis, with a five-year survival rate of approximately 17% for patients diagnosed at an advanced stage 1. There is a well-established and significant correlation between early diagnosis of ovarian masses and effective management, highlighting the urgent need for reliable preoperative diagnostic strategies [8,9].

Ultrasonography plays a central role in the initial evaluation of ovarian masses because it is rapid, widely available, noninvasive, and cost-effective. Sonography has 78% sensitivity and 80% specificity [10], while transvaginal ultrasonography has demonstrated even higher diagnostic values in some studies [11,12]. In parallel, serum CA125 remains the most commonly used tumor marker in ovarian malignancy [13,14]. Although far from ideal—owing to its elevation in several benign and non-ovarian conditions—it continues to be a valuable tool for the diagnosis and monitoring of epithelial ovarian cancer. Using the standard cutoff of 35 IU/ml, CA125 is a useful but non-specific marker. In postmenopausal women, CA125 demonstrates high sensitivity and excellent specificity (often >90%), reflecting fewer benign confounders [15]. In contrast, in premenopausal women, sensitivity may be very high (up to 100%) but specificity is considerably lower (31.8%–85.1%) due to frequent false-positive elevations from benign and physiological conditions [16,17]. Recent literature therefore supports menopausal-status-adjusted thresholds, with higher cutoffs ($\approx$ 50–60 IU/ml) proposed for premenopausal women to reduce false positivity [18]. Despite advances in imaging and biomarker assessment, accurate and timely preoperative diagnosis of ovarian tumors remains a significant challenge for gynecologists. Limitations of existing diagnostic tools often lead to unnecessary surgical interventions or delayed referral to specialized oncological care. Given that prognosis in malignant ovarian tumors is closely linked to histological type, degree of differentiation, and surgical stage, improving diagnostic precision before surgery is crucial. The present study aimed to predict malignancy in ovarian tumors by ultrasonography and CA125 in pre and postmenopausal women.

Materials and Methods:

Study Design and Setting

This was a hospital-based cross-sectional analytical study conducted in the Department of Obstetrics and Gynaecology in collaboration with the Department of Radiology and Imaging, Sylhet MAG Osmani Medical College Hospital, Bangladesh. The study was carried out over a two-year period from January 2019 to December 2020.

Study Population

The study included women diagnosed with ovarian tumors based on clinical examination and imaging findings; who underwent surgical management and had available histopathological reports, were included in the study. Patients were excluded if they were pregnant, had pelvic inflammatory disease, previously diagnosed to have ovarian malignancy, history of chemotherapy or radiotherapy.

Sample size was calculated using Guilford's and Frucher's formula ($n = z^2pq/d^2$) considering 95% confidence level, 5% precision level (standard error) and prevalence of ovarian malignancy is 3.3% [19]. According to calculated sample size, 50 premenopausal and 50 postmenopausal women, matching the inclusion and exclusion criteria were selected for this study through purposive sampling method.

Data Collection Procedure

A structured data collection sheet was used to record demographic information, clinical features, and investigation findings. Detailed history taking and physical examination were performed in all patients. Preoperative ultrasonography was carried out using a real-time ultrasound machine (Phillips Healthcare Affinity 30) (to assess tumor size, morphology, presence of septations, solid areas, and ascites).

Ultrasonography was performed using a transabdominal approach with a 3.5–5 MHz transducer. Sonographic parameters assessed included:

- Tumor size
- Presence of solid components
- Septations
- Multilocularity
- Ascites

A scoring system was applied where one point was assigned for each suspicious feature. A total US score of 0 yielded U = 0, a score of 1 yielded U = 1, and US score of 2 yielded U = 3. A total score ≥ 2 was considered suggestive of malignancy.

Venous blood samples were collected preoperatively and serum CA-125 levels were measured using a chemiluminescent immunoassay technique (CMIA) by using

Architect i1000 SR, Abbott, USA. A cut-off value of ≥ 35 U/mL was considered indicative of malignancy [15,17].

All patients underwent surgical intervention, and excised specimens were sent for histopathological examination at the Department of Pathology, Sylhet MAG Osmani Medical College. Histopathological diagnosis was considered the gold standard for confirming the nature of the ovarian tumor and was used to classify tumors as benign or malignant.

Statistical analysis

Data were analyzed using SPSS version 28.0. Data set was tested for normality using the Shapiro-Wilk test. Continuous variables were expressed as mean $\pm$ standard deviation and categorical variables as frequency and percentage. Comparisons between groups were performed using the independent-samples t-test for continuous variables, and

Chi-square or Fisher's exact test for categorical variables. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of Sylhet MAG Osmani Medical College prior to commencement of the study. Written informed consent was obtained from all participants before enrollment. Confidentiality and anonymity of participant data were strictly maintained throughout the study.

Result:

The mean age of premenopausal women was 32.04 ± 7.73 years, whereas postmenopausal women had a mean age of 58.64 ± 9.56 year (Table 1). Malignant ovarian tumors were more frequently observed in postmenopausal women (60%) compared to premenopausal women (22%).

Table 1: Distribution of the participants according to baseline characteristics (n=100).

Variables	Premenopausal (n=50)	Postmenopausal (n=50)	p-value
Age in years	32.04 $\pm$ 7.73	58.64 $\pm$ 9.56	<0.001^t
Tumor size			
≥ 7 cm	14 (28.0%)	28 (56.0%)	0.005^c
< 7 cm	36 (72.0%)	22 (44.0%)	
Ultrasound score			
3 (≥ 2 parameters)	15 (30.0%)	27 (54.0%)	0.015^c
1 (< 2 parameters)	35 (70.0%)	23 (46.0%)	
CA 125			
≥ 35 U/L	14 (28.0%)	29 (58.0%)	0.002^c
< 35 U/L	36 (72.0%)	21 (42.0%)	

Data expressed as frequency (percentage) and mean $\pm$ SD, c= chi square test, t= independent sample t-test. P value <0.05 is statistically significant

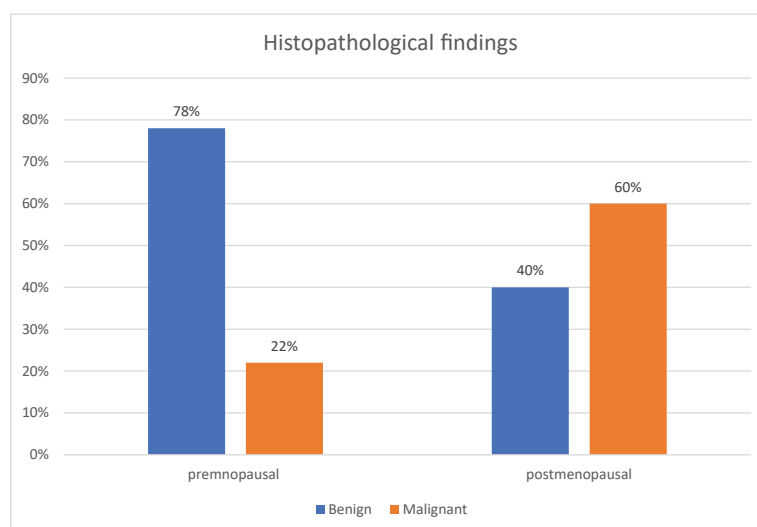


Figure 1: Distribution of the participants according to histopathological nature of the ovarian tumor (n=100).

Among premenopausal women, tumors ≥ 7 cm were found in 81.8% of malignant cases whereas only 17.9% of benign tumors were ≥ 7 cm. Similarly, in postmenopausal women, 80.0% of malignant tumors measured ≥ 7 cm compared to only 20.0% of benign tumors. The associations between tumor size and histological type of ovarian tumor was statistically significant ($p < 0.001$) (Table 2).

Table 2: Comparison of Nature of Ovarian Tumours According to Tumour Size, Ultrasound Score, and CA-125 Level in Premenopausal and Postmenopausal Women (n = 100).

Variables	Premenopausal (n=50)		p value	Postmenopausal (n=50)		p value
Tumor size	Malignant	Benign (n=39)		Malignant	Benign (n=20)	
	(n=11)			(n=30)		
≥ 7 cm	9 (81.8%)	7 (17.9%)	<0.001^f	24 (80.0%)	4 (20.0%)	<0.001^f
<7 cm	2 (18.2%)	32 (82.1%)		6 (20.0%)	16 (80.0%)	
Ultrasound score						
3 (≥ 2 parameters)	10 (90.9%)	7 (17.9%)	<0.001^f	25 (83.3%)	3 (15.0%)	<0.001^f
1 (0–1 parameter)	1 (9.1%)	32 (82.1%)		5 (16.7%)	17 (85.0%)	
CA-125 level						
≥ 35 U/mL	9 (81.8%)	5 (12.8%)	<0.001^f	24 (80.0%)	3 (15.0%)	<0.001^f
<35 U/mL	2 (18.2%)	34 (87.2%)		6 (20.0%)	17 (85.0%)	

f= Fisher's Exact test

Ultrasound score demonstrated a significant association with the nature of the tumor ($p < 0.001$). In premenopausal women, 90.9% of malignant tumors had an ultrasound score ≥ 2 , whereas only 17.9% of benign tumors showed similar findings. Among postmenopausal women, 83.3% of malignant tumors had an ultrasound score ≥ 2 compared to 15.0% of benign tumors (table 2).

Table 3: Validity of ultrasonography and serum CA 125 in predicting ovarian malignancy in pre and postmenopausal women (n=100).

Parameter	Sensitivity	Specificity	PPV	NPV	Accuracy
USG (≥ 2 parameters)					
Premenopausal	90.90%	82.10%	58.80%	97.00%	84.00%
Postmenopausal	83.30%	85.00%	92.60%	78.30%	84.00%
CA 125 (≥ 35 U/ml)					
Premenopausal	81.80%	87.20%	64.30%	94.40%	86.00%
Postmenopausal	80.00%	85.00%	88.90%	73.90%	82.00%
Combined					
Premenopausal	90.90%	76.90%	52.60%	96.80%	80%
Postmenopausal	86.70%	75%	83.90%	78.90%	82%

In premenopausal women, CA-125 ≥ 35 U/mL was observed in 81.8% of malignant cases compared to 12.8% of benign cases. Similarly, among postmenopausal women, 80.0% of malignant tumors had CA-125 ≥ 35 U/mL, whereas only 15.0% of benign tumors showed elevated levels. The association was statistically significant ($p < 0.001$) (table 3).

Discussion:

The current study assessed the diagnostic performance of ultrasonography and serum CA-125 in discriminating benign from malignant ovarian tumors, with a focus on the differences between premenopausal and postmenopausal women. Our findings confirmed that menopausal status has a significant impact on the predictive values.

In this cohort, malignancy was significantly more common among postmenopausal women (60%) than among premenopausal women (22%), which is consistent with existing epidemiological evidence showing that ovarian cancer risk increases with age [20]. Elderly women (58.64 years) with comparatively larger ovarian mass (> 7 cm=56%) were more prevalent in postmenopausal group but a substantial number of small masses were also present in the same group (44%). Clinically, this emphasizes the significance of maintaining a high level of suspicion for cancer when evaluating adnexal masses in older women, even if the symptoms are mild or ambiguous – as stated by The American College of Obstetricians and Gynecologists (ACOG) [21,22]. Tumor size appeared as a significant factor

of malignancy in both groups. This finding is consistent with prior research indicating that increased tumor size correlates with aggressive growth patterns and a higher risk of malignant transformation [23,24].

Ultrasonographic scoring provided excellent diagnostic performance in both premenopausal and postmenopausal women. In premenopausal individuals, ultrasonography had a very high sensitivity (90.9%) and a good negative predictive value (97.0%), showing that a low ultrasound score reliably excludes cancer in this population. This is clinically significant since premenopausal women typically appear with benign ovarian cysts, and needless surgery has physical and reproductive repercussions. In postmenopausal women, ultrasonography maintained good sensitivity (83.3%) and specificity (85.0%), with a particularly high positive predictive value (92.6%), indicating the greater pretest risk of cancer in this age group. These findings support ultrasonography as a key component of early evaluation across the menopausal spectrum [10,20].

Serum CA-125 indicated a strong correlation with malignancy in both groups, but its diagnostic behavior differed depending on menopausal status. In premenopausal women, CA-125 showed good sensitivity (81.8%) and a high negative predictive value (94.4%), but a lower positive predictive value. This mirrors the well-known limitation of CA-125 in younger women, where benign and physiological circumstances usually result in false-positive increases [25]. In contrast, among postmenopausal women, CA-125 had a greater positive predictive value (88.9%) and acceptable specificity, making it a more reliable predictor of malignancy in this population. These findings are consistent with previous research, which found that CA-125 is most relevant when read in the context of menopausal state [20,24].

Importantly, neither ultrasonography nor CA-125 provided 100% diagnosis accuracy. However, when used together, their complementing strengths become clear. Ultrasonography gave greater sensitivity and reassurance in excluding malignancy, particularly in premenopausal women, but CA-125 increased specificity and confidence in detecting malignant disease in postmenopausal women. This complimentary pattern lends support to a combined diagnostic strategy, which may prevent wasteful surgical operations in low-risk patients while assuring prompt referral and proper therapy for those at high risk.

This study's findings are especially important for resource-limited healthcare settings, where access to advanced imaging techniques and novel biomarkers is frequently limited. This method can improve clinical decision-making, optimize surgical planning, and potentially improve patient outcomes by allowing for earlier and more accurate detection of ovarian cancer.

Conclusion

This study highlights the important role of both ultrasonography and serum CA-125 in the evaluation of ovarian tumors. Ultrasonography demonstrated better sensitivity and overall diagnostic performance, particularly among premenopausal women, where physiological variations often limit the reliability of biochemical markers. In contrast, serum CA-125 showed greater specificity and positive predictive value in postmenopausal women, reflecting its stronger association with malignant pathology in this age group. The complementary use of these two modalities significantly enhances diagnostic confidence and assists in identifying patients who require timely surgical intervention.

Some limitations have to be acknowledged. Transvaginal ultrasonography and Doppler assessment—known to enhance diagnostic accuracy—were not uniformly applied. CA-125 levels is influenced by benign gynecological and inflammatory conditions, particularly in premenopausal women, which could have affected specificity; which were not all excluded.

Future multicenter studies with larger sample sizes and combined diagnostic accuracy are recommended to further refine diagnostic accuracy and strengthen early detection strategies for ovarian malignancy.

Author contributions

Nasrin Mariom, Nasreen Akhter, Luthfa Monir Liza, Shibani Deb equally contributed to the work

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Data availability statement

Data will be available upon request

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