Role of Preoperative Red Cell Distribution Width (RDW), Mean Platelet Volume (MPV) and CA-125 for Differential Diagnosis of Benign and Malignant Ovarian Tumor

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KEYWORDS

Ovarian tumor, RDW, MPV, CA-125, malignancy, biomarkers, preoperative diagnosis

ABSTRACT:

Background: Distinguishing between benign and malignant ovarian tumors remains a clinical challenge. Red cell distribution width (RDW), mean platelet volume (MPV) and CA-125 levels have emerged as potential biomarkers for preoperative differentiation. This study evaluated the diagnostic utility of these markers for ovarian tumor classification. The objective of this study was to assess the role of RDW, MPV and CA-125 in distinguishing benign from malignant ovarian tumors.

Methods: This cross-sectional analytical study was conducted at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from September 2023 to August 2024. Ninety patients with ovarian tumors scheduled for surgery were included in the study. Preoperative blood samples were analyzed for RDW, MPV and CA-125 levels. Statistical analysis was performed using SPSS, with statistical significance set at $P < 0.05$.

Results: RDW was significantly higher in malignant cases (14.11±2.51) than in benign cases (12.98±1.79) (p=0.02). MPV was also elevated in malignant tumors (13.69±3.95 vs. 10.69±1.65, p=0.001). CA-125 levels were markedly higher in malignancies (257.56±412.31 vs. 75.73±125.82, p=0.01). MPV exhibited the highest sensitivity (76.92%) and specificity (78.95%), followed by CA-125 and RDW.

Conclusion: RDW, MPV, and CA-125 are valuable biomarkers for differentiating malignant from benign ovarian tumors. MPV demonstrated the highest specificity, suggesting its potential as a reliable preoperative marker.

INTRODUCTION

Ovarian cancer is a major health concern in Bangladesh, with its annual mortality rate increasing by 40.3% since 1990, averaging 1.8% per year [1]. The incidence and mortality rates rise with age, with most cases occurring in women over 50. However, no age group is immune, as ovarian cancer can be diagnosed at any stage of life, including infancy [3]. Due to a lack of early clinical manifestations and reliable diagnostic methods, distinguishing ovarian cancer from benign ovarian tumors remains challenging. More than 70% of patients are diagnosed at an advanced stage, leading to a poor 5-year survival rate of only 30% [3]. Identifying early ovarian cancer indicators is therefore crucial for improving diagnosis, treatment, and prognosis.

Red cell distribution width (RDW) measures the variation in red blood cell size and reflects volume heterogeneity [4]. Recently, RDW has gained attention for its potential role in diagnosing malignancies, with research focusing on endometrial, lung and liver cancers [5, 6, 7]. RDW is associated with chronic inflammation, which plays a role in cancer progression [8]. This study will analyze the correlation between RDW levels and benign versus malignant ovarian tumors.

Platelet-based markers, including Mean Platelet Volume (MPV), Platelet Count (PLT), and Platelet Distribution Width (PDW), are emerging as potential cancer diagnostic tools [9, 10]. MPV is a low-cost, non-invasive parameter reflecting platelet activation, production rate, and stimulation degree [11]. Increased MPV levels have been linked to various malignancies [12, 13]. Investigating MPV alterations in ovarian cancer may offer insights into diagnosis, treatment response and prognosis. This alternative approach to a standard examination could provide supplementary data regarding the detection and evolution of the illness. Such information is crucial, considering that many forms of cancer may not exhibit symptoms until they have progressed to advanced stages [14].

Cancer antigen 125 (CA125) is a commonly used biomarker for ovarian cancer, but its sensitivity is limited, with frequent false positives in benign gynecological conditions such as endometriosis and pelvic inflammatory disease [15, 16]. Given these limitations, combining CA125 with RDW and MPV may enhance diagnostic accuracy.

is study aims to evaluate the preoperative roles of RDW, MPV, and CA125 in differentiating between benign and malignant ovarian tumors, potentially improving early detection and patient outcomes.

OBJECTIVE

The objective of this study was to evaluate the role of preoperative red cell distribution width (RDW), mean platelet volume (MPV) and CA-125 for differential diagnosis of benign and malignant ovarian tumor.

METHODOLOGY & MATERIALS

This cross-sectional analytical study was conducted at Department of Gynecological Oncology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh from September 2023 to August 2024. Ninety patients with clinically diagnosed ovarian tumors who were selected for surgical management in the Department of Gynecological Oncology, BSMMU, Dhaka, were included in this study population.

INCLUSION CRITERIA

Patients with clinically diagnosed ovarian tumor and who were selected for surgical management in the department of Gynecological Oncology, BSMMU.

EXCLUSION CRITERIA

Pregnancy with ovarian tumor

Ovarian cancer with NACT

Known Case of

- Diabetes mellitus,
- Hypertension
- Chronic liver disease
- Cardiovascular disease,
- Kidney disease,
- Blood dyskaryosis,
- Acute inflammation,
- Anemia, recent iron therapy, venous thrombosis for period of>6 months, and recent blood transfusion (within the past 3 months).

Study procedure: Permissions were obtained from the Institutional Review Board of BSMMU. Patients with clinically diagnosed ovarian tumors who were selected for surgical management in the Department of Gynecological Oncology, BSMMU, were included in this study. During the study period, the participants met the inclusion and exclusion criteria. Venous blood samples (2 mL) were obtained from each patient 48 h before the operation to estimate RDW, MPV, and serum CA 125. Blood was placed in EDTA-K2 anticoagulation tubes. RDW and mean platelet volume (MPV) were directly obtained using a hematology analyzer. Serum CA-125 concentration was detected by Anility i-Machine. The samples were collected using a preformed datasheet.

Statistical analysis of data: The data were analyzed with the SPSS for Windows (version 26.0) software. For descriptive statistics means, medians, standard deviations & ranges were analyzed for numerical data and frequencies & proportions for categorical data were calculated as required. A "p" value <0.05 was considered as significant.

Ethical consideration: There is minimum physical, psychological, social and legal risk during history taking, examination and investigations. Proper safety measures were taken throughout the study. Only the researcher could access the collected data. Ethical clearance was obtained from the Institutional Review Board (IRB) of BSMMU. According to Helsinki Declaration for Medical Research involving Human Subjects 1964, all patients were informed about the study design, hypothesis and right to withdraw at any time, for any reason. Informed written consent was obtained from each subject who voluntarily agreed to participate.

RESULTS

Table 1: Baseline characteristics of the participants (n=90)

Variables		Types of participants	
		Benign (n=38)	Malignant (n=52)
Age group (year)	8-20	7 (18.4)	4 (7.7)
	21-33	16 (42.1)	17 (32.7)
	34-46	12 (31.6)	13 (25.0)
	47-59	1 (2.6)	10 (19.2)
	60-72	2 (5.3)	8 (15.4)
Mean±SD		30.55±13.85	40.44±14.96
BMI	<18	6 (15.8)	2 (3.8)
	18-24.9	9 (23.7)	5 (9.6)
	25-29.9	15 (39.5)	15 (28.8)
	≥30	8 (21.1)	30 (57.7)
Parity	Nullipara	18 (47.4)	16 (30.8)
	Multipara	20 (52.6)	36 (69.2)
Menopausal status	Yes	4 (10.5)	18 (34.6)
	No	34 (89.5)	34 (65.4)
Family History of Ovarian Malignancy	Yes	0 (0.0)	8 (15.4)
	No	35 (92.1)	42 (80.8)
Duration of symptom	<6 months	15 (39.5)	33 (63.5)
	>6 months	23 (60.5)	19 (36.5)

Table 1 presents the baseline characteristics of 38 patients with benign ovarian tumors and 52 with malignant ovarian tumors. The mean age was higher in the malignant group (40.44±14.96 years) compared to the benign group (30.55±13.85 years). A higher proportion of malignant tumor patients had a body mass index (BMI) of ≥30 (57.7% vs. 21.1% in benign). Multiparity was more common among malignant cases (69.2%), while 47.4% of benign cases were nulliparous. Menopausal status differed significantly, with 34.6% of malignant cases being postmenopausal compared to 10.5% in benign. A positive family history of ovarian malignancy was observed in

15.4% of malignant cases, with no such history in benign cases.

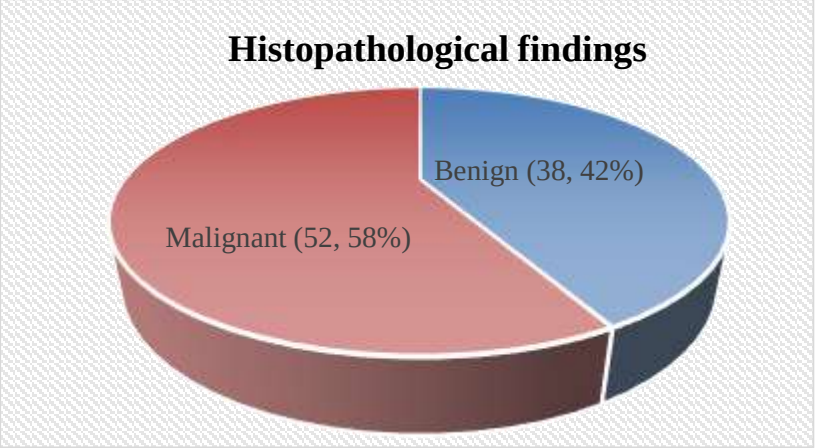

Figure 2: Histopathology of the study participants (n=90)

Table 2: Distribution of the participants according to symptom (n=90)

Symptom	Benign (n=38)	Malignant (n=52)
Abdominal distension	20 (52.6)	18 (34.6)
Lower abdominal pain	34 (89.5)	34 (65.4)
Menstrual abnormality	3 (7.9)	7 (13.5)
Nonspecific GI symptom	9 (23.7)	10 (19.2)
Infertility	2 (5.3)	1 (1.9)

Table 2 outlines the clinical symptoms of study participants. Lower abdominal pain was the most frequently reported symptom in both groups, affecting 89.5% of benign cases and 65.4% of malignant cases. Abdominal distension was more common in benign tumors (52.6%) compared to malignant cases (34.6%). Menstrual abnormalities were present in 7.9% of benign cases and 13.5% of malignant cases. Non-specific gastrointestinal (GI) symptoms were reported in approximately 20% of both groups. Infertility was noted in 5.3% of benign cases and 1.9% of malignant cases.

Table 3: Distribution of the participants according to biochemical parameter (n=90)

Variables	Types of participants		P value
	Benign (n=38)	Malignant (n=52)	
RDW	12.98±1.79	14.11±2.51	0.02
MPV	10.69±1.65	13.69±3.95	0.001
CA-125	75.73±125.82	257.56±412.31	0.01

Table 3 summarizes the levels of RDW, MPV, and CA-125 in both groups. The mean RDW was significantly higher in the malignant group (14.11±2.51) compared to the benign group (12.98±1.79) (p=0.02). Similarly, MPV was elevated in malignant cases (13.69±3.95 vs. 10.69±1.65, p=0.001). CA-125 levels were substantially higher in the malignant group (257.56±412.31) than in the benign group (75.73±125.82) (p=0.01).

Table 4: Sensitivity and specificity of RDW, MPV and CA-125 in malignant ovarian cancer

Parameter		**Percentage (%)**
RDW	Sensitivity	73.08
	Specificity	57.89
MPV	Sensitivity	76.92
	Specificity	78.95
CA-125	Sensitivity	71.15
	Specificity	71.05

Table 4 details the diagnostic performance of RDW, MPV, and CA-125 in differentiating malignant from benign ovarian tumors. MPV exhibited the highest sensitivity (76.92%) and specificity (78.95%), followed by CA-125 with a sensitivity of 71.15% and specificity of 71.05%. RDW demonstrated a sensitivity of 73.08% and specificity of 57.89%.

Table 5: Distribution of the participants according to histopathological parameter (n=90)

Variables	**Types of participants**		**P value**
	Epithelial (38)	**Non-epithelial (52)**	
RDW	16.16±2.74	15.70±2.51	0.41
MPV	13.94±4.06	12.52±3.26	0.06
CA-125	288.48±444.77	109.85±124.47	0.07

Table 5 categorizes participants based on histopathological subtypes (epithelial vs. non-epithelial). The mean RDW was slightly higher in epithelial tumors (16.16±2.74) than in non-epithelial tumors (15.70±2.51), though the difference was not statistically significant (p=0.41). MPV was also elevated in epithelial tumors (13.94±4.06) compared to non-epithelial tumors (12.52±3.26) (p=0.06). CA-125 levels were markedly higher in epithelial tumors (288.48±444.77) than in non-epithelial tumors (109.85±124.47) (p=0.07).

DISCUSSION

The study examined how preoperative red cell distribution width (RDW) together with mean platelet volume (MPV) and CA-125 measurements help distinguish benign from malignant ovarian tumors. Our research shows that malignant ovarian tumor patients exhibited elevated RDW and MPV along with increased CA-125 levels compared to patients with benign conditions thus indicating their potential diagnostic value.

A significant difference in mean RDW existed between malignant ovarian tumor patients and those with benign conditions (14.11±2.51 vs. 12.98±1.79, p=0.02). Research findings demonstrate alignment with Kemal et al. because they found that elevated RDW levels associate with active inflammation and cancer progression [5]. Multiple studies have confirmed that Red Cell Distribution Width (RDW) counts increased in patients who had lung, liver and endometrial cancer (Koma et al., Smirne et al.,) [6,7]. The connection between cancer progression and RDW levels stems from elevated oxidative stress together with systemic inflammation that drives increased heterogeneity of erythropoiesis (Lippi and Plebani) [8]. Our study displayed limited comparison potential with previous research (Qin et al.,) because we omitted the tumor staging stratification of RDW measurements [16].

The value of MPV as an indicator of platelet activation showed higher levels in malignant patients (13.69±3.95 vs. 10.69±1.65, p=0.001). Scientific investigations reveal that MPV elevation functions as a pathogenic factor in cancers because it indicates the hypercoagulable condition linked to tumor growth and spreading (Shen et al.,) [9]. Studies have already established MPV as a diagnostic marker for different cancers including gastric and colorectal cancers according to Stojkovic Lalosevic et al., [14]. The higher MPV levels in malignant ovarian tumors might result from platelet-enhanced cancer proliferation because platelets promote tumor progression through their actions with tumor cells to enable proliferation and immune avoidance (Wang et al.,) [10]. The specificity value measured for MPV (78.95%) exceeded the value of RDW (57.89%) which supports the prediction potential of MPV in diagnosing malignancy.

The detection of ovarian cancer by using CA-125 as a biomarker faces challenges due to its poor unique diagnostic abilities according to Mai et al.) [16]. The CA-125 values proved higher in malignant cases when compared to

benign ovarian masses (257.56±412.31 vs. 75.73±125.82, p=0.01) in accordance with previous research (Bast et al.,) [17]. The diagnostic value of MPV exceeds that of CA-125 since its specificity rate (71.05%) falls short compared to MPV thus reinforcing the importance of multiple diagnostic methods. Research indicates that using RDW together with MPV and CA-125 blood metrics provides a better method to identify malignant ovarian tumors compared to isolated testing (Qin et al.,) [18]. Our analysis reinforces this method since it adds these markers to improve diagnostic precision while minimizing incorrect test results.

The clinical implications of our findings suggest that incorporating RDW and MPV into routine preoperative assessments may improve early ovarian cancer detection. Given their availability in standard blood tests, these markers provide a cost-effective, non-invasive adjunct to CA-125 testing.

LIMITATIONS AND RECOMMENDATION

This study was conducted at a single center with a limited sample size, which may affect generalizability. Additionally, potential confounding factors influencing RDW and MPV were not fully explored. Future research should include larger, multicenter studies with diverse populations to validate findings and explore the prognostic value of these markers in ovarian cancer diagnosis and management.

CONCLUSION

This study highlights the potential of RDW, MPV and CA-125 as complementary biomarkers for distinguishing malignant from benign ovarian tumors. MPV demonstrated the highest specificity, suggesting its valuable role in preoperative risk stratification.

ACKNOWLEDGMENT

I would like to express my sincere gratitude for the invaluable support and cooperation provided by the staff, participants, and my co-authors/colleagues who contributed to this study.

FINANCIAL SUPPORT AND SPONSORSHIP

No funding sources.

CONFLICTS OF INTEREST

There are no conflicts of interest.

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

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