

Diagnostic Accuracy of Risk of Malignancy Index (RMI) in Evaluation of Ovarian Masses

Huma binte Afzal¹, Humera Noreen², Shazia Syed³, Ayesha Noor⁴, Humaira Bilqis⁵, Lubna Ejaz⁶

¹Ex PGT of Benazir Bhutto Hospital, Rawalpindi,

²Associate Professor Obs/Gynae unit 1, Holy Family Hospital, Rawalpindi

³Professor Nawaz Sharif medical college, Gujrat, ⁴PGT Obs/Gynae unit 1, Holy Family Hospital, Rawalpindi

⁵Assistant Professor Obs/Gynae unit 1, Holy Family Hospital, Rawalpindi, ⁶Dean Obs/Gynae RMU and allied

Correspondence: Dr. Humera Noreen

Associate Professor Obs/Gynae unit 1, Holy Family Hospital, Rawalpindi

Email: humeranoreen@gmail.com

Abstract

Objectives: To determine the diagnostic accuracy of RMI in predicting malignancy in patients presenting with ovarian masses, using histopathology of the mass as the gold standard.

Methodology: This cross-sectional study was conducted at the Department of Gynecology & Obstetrics, BBH, Rawalpindi, from August 23, 2019, to August 22, 2020. A total of 92 patients aged 25-75 years, with ovarian masses detected on ultrasound, were included. Those with previously diagnosed secondary metastatic disease were excluded. RMI was calculated in all these patients using ultrasound scores and CA-125 levels. Histopathology of the mass was performed after complete surgical removal, and the histopathology reports were compared with RMI values to determine its accuracy.

Results: The mean age was 48.78 ± 12.45 years. RMI supported the diagnosis of malignant adnexal masses in 53 (57.61%) patients. Histopathology findings confirmed malignant adnexal masses in 56 (60.87%) cases. Among RMI-positive patients, 49 were true positives and 4 were false positives. Among the 39 RMI-negative patients, 7 were false negatives, while 32 were true negatives ($p = 0.653$). Overall, RMI had a sensitivity of 87.50%, specificity of 88.89%, positive predictive value of 92.45%, negative predictive value of 82.05%, and diagnostic accuracy of 88.04% in predicting malignancy in patients presenting with ovarian masses.

Conclusion: This study concluded that RMI has a high diagnostic accuracy in predicting malignancy in patients presenting with ovarian masses.

Keywords: Ovarian masses, ovarian malignancy, malignant, risk of malignancy index.

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Introduction

Cancer is the most common cause of mortality in most parts of the world and currently is the most common hindrance in achieving desirable life expectancy worldwide.¹ Ovarian cancer is the seventh most common type of malignant neoplasm and eighth most common cause of mortality in women.² It is an age related disease that mostly affects postmenopausal women.³ Most of the ovarian carcinoma remain undiagnosed due to vague presenting complaints like bloating, abdominal pain, distension and weight loss. This late diagnosis is a dilemma leading to overall 5-year survival rate of 44%.⁴

High index of suspicion for malignancy may lead to improve this poor prognosis so, various modalities have

been introduced to differentiate benign from malignant ovarian tumors.

The currently available approaches include physical assessment by clinician, imaging of adnexa by ultrasonography and measurement of protein biomarker cancer antigen 125 (CA-125). Most commonly used chemical biomarker for ovarian cancer is CA-125 but its use is limited due to its lack of sensitivity in type I epithelial tumors and early stage ovarian cancer⁵ on the other hand, ultrasound is the most common non-invasive tool in evaluating ovarian masses as it detects 90 – 95 percent of cases accurately⁶. Ovarian masses (OM) on ultrasound is an important finding in detecting ovarian malignancy if it is associated with certain features like

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bilaterality, multilocularity, and solid areas. These masses are the main reason for referral and hospitalization. Almost 12 to 20% of ovarian masses with these features detected on ultrasound come out malignant.⁷

In 1990 an ultrasound based scoring system named Risk of malignancy index (RMI) was introduced for pre-operative diagnosis of malignant ovarian tumors.⁸ It uses menopausal status, serum CA-125 levels and ultrasound features. Cut off value for RMI is taken as 200 but RCOG cut off value is 250.⁹ This higher value can detect true negatives more accurately.¹⁰ Several studies have assessed diagnostic accuracy of RMI, the results are controversial. Some studies have shown sensitivity of RMI as high as 85% and specificity up to 97%¹¹ in detecting malignant ovarian tumors while others have found lesser sensitivity and specificity. The only limitation of RMI found in several studies was its dependency on CA-125 level, which is raised in other benign conditions like endometriosis, therefore in areas with high prevalence of endometriosis RMI can lead to misdiagnosis of ovarian tumors.¹²

The aim of my study is to determine the diagnostic accuracy of RMI in discriminating benign from malignant ovarian tumors in both premenopausal and postmenopausal patients of our region. This non-invasive technique would enable us to make pre-operative diagnosis, counselling the patients, and plan surgery accordingly.

Methodology

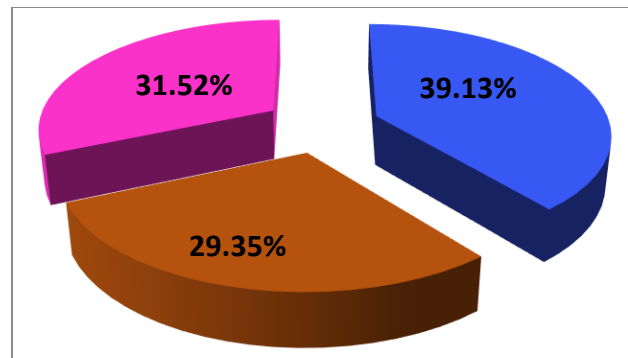
A total of 92 patients, of age group 25-75 years were included in the study. This hospital based cross-sectional study was conducted at Benazir Bhutto Hospital between August 2019 to August 2020. Approval from the institutional ethical committee was taken. Written informed consent was taken from the patients before their inclusion in the study. Patients between the ages 25-75 years presenting with any symptom and diagnosed to have adnexal mass diagnosed on ultrasound. Detailed history of patient, clinical examination, pre-operative serum CA-125 levels and

trans-abdominal abdominopelvic ultrasound was performed. Characteristics of mass were determined on ultrasonography by senior radiologist. Patients were managed as per protocol pre-operatively and during surgery. Their tumor masses were sent to hospital lab for histopathology along with all other tissues removed during staging laparotomy. Patients were followed up with their histopathology reports. Those patients whose reports could not be traced were excluded from study. All pre-operative information including RMI and histopathology reports were entered in a structured proforma. Data was analyzed on SPSS version 23. RMI score was calculated as follows:

A cutoff of >200 is used to designate as malignant and < 200 is considered as benign. Patients in which the histopathology could not be obtained were excluded.

Results

Mean age of studied patients was 48.78 ± 12.45 years. Out of 92, 36 patients were between 25-40 years of age followed by 29 patients in age group of 56-75 years. (Figure 1) In 53 out of 92 patients RMI was positive for malignancy. Histopathology confirmed malignancy in 49/53 patients (true positives) whereas 4/53 were false positives. Amongst 39 RMI negative patients 32 were true negatives while histopathology report of 7/39 turned out to be malignant (false negative). Sensitivity, specificity, positive predictive value negative predictive value and diagnostic accuracy of RMI were calculated with the help of formulae given below.



Sensitivity: 88%, Specificity: 89%, Positive predictive value: 92%, Negative predictive value: 82%, Diagnostic accuracy: 88%

Parameter	Finding	Points
Menopausal status	Pre-menopausal	1
	Post-menopausal	4
Ultrasound findings suggestive of malignancy	0 or 1	1
	≥ 2	4
	1. Evidence of solid areas (hyper echoic areas in cyst)	
	2. Evidence of metastases (involvement of liver and lung)	
	3. Presence of ascites (fluid in peritoneal cavity)	
	4. Bilateral lesions (involvement of both ovaries)	

Further stratification according to age groups are given in Table III–V. Most of the patients belonged to age group 25-40 years.

Table II: Findings of RMI & Histopathology.

	Positive result on RMI	Negative result on RMI	P-value
Positive on Histopathology	49 (TP)*	07 (FN)***	0.653
Negative on Histopathology	04 (FP)**	32 (TN)****	

Table III: Stratification of Age 25-40 years. (n=36)

	Positive result on RMI	Negative result on RMI	P-Value
Positive on Histopathology	18 (TP)	01 (FN)	0.813
Negative on Histopathology	02 (FP)	15 (TN)	
Sensitivity: 94.74%			
Specificity: 88.24%			
Positive Predictive Value (PPV): 90.0%			
Negative Predictive Value (NPV): 93.75%			
Diagnostic Accuracy: 91.67%			

Table IV: Stratification of Age 41 – 55 years (n=27)

	Positive result on RMI	Negative result on RMI	P-Value
Positive on Histopathology	15 (TP)	02 (FN)	0.780
Negative on Histopathology	01 (FP)	09 (TN)	
Sensitivity: 88.24%			
Specificity: 90.0%			
Positive Predictive Value (PPV): 93.75%			
Negative Predictive Value (NPV): 81.82%			
Diagnostic Accuracy: 88.89%			

Table V: Stratification of Age 56-75 years. (n=29)

	Positive result on RMI	Negative result on RMI	P-Value
Positive on Histopathology	16 (TP)	04 (FN)	0.412
Negative on Histopathology	01 (FP)	08 (TN)	
Sensitivity: 80.0%			
Specificity: 88.89%			
Positive Predictive Value (PPV): 94.12%			
Negative Predictive Value (NPV): 66.67%			
Diagnostic Accuracy: 82.76%			

Discussion

The triage of ovarian masses has always been a tricky process. Benign masses can be managed without being referred to specialized oncology center whereas suspected malignant lesions should be referred to oncologist soon after they present. All we need is a globally accepted screening system that is reliable,

feasible, acceptable by majority of gynecologists and being widely used. Various modalities have been proposed i.e. tumor markers and grey scale ultrasound but these alone may not be very helpful in detecting early stage disease. However, combining these two parameters along with menopausal status gives better picture to predict nature of the ovarian masses.

A study done over a period of 06 years in Denmark including 1159 women with adnexal masses. Results of this study revealed that RMI identified 230 out of 251 ovarian malignancies having sensitivity of 92%. On the other hand, 635 out of 778 benign conditions were correctly diagnosed by RMI showing specificity of 82%, borderline tumors were diagnosed in 74 patients and 56 had other cancers.¹³ Although our study included only 92 patients and was done over 06 months duration but results derived were comparable to above mentioned study, with overall sensitivity and specificity of 88% and 89% respectively.

Suknaya et al (India, 2020) conducted a cross-sectional study which included 120 women. Out of this study population, 72 were postmenopausal and 48 were premenopausal. Ninety women were found to have RMI value of >200 predicting malignant disease, but only 79 were confirmed to have malignancy, 2 had borderline tumors and 9 had benign ovarian disease on histopathology. Out of 30 women whose RMI score was <200, histopathology of 10 cases didn't confirm this diagnosis and were turned out to be malignant in nature. Rest of these were confirmed to be benign disease. Based on above data, sensitivity of RMI was calculated as 89%, specificity 65%, PPV 88% and NPV 67%.¹⁴ The sensitivity in this study was almost same as in our study (89% vs 88%) whereas there was a marked difference in specificity (65% vs 89%). Another study done in 2016 revealed that specificity of RMI can be increased by increasing the threshold level for malignancy using RMI cut-off value of 250.¹⁵

A relatively larger study, done at a tertiary care hospital of Punjab, Pakistan, included a total of 165 patients with somewhat similar age group as in our study (25-70 years). In this study, RMI predicted malignancy in 61(37%) of patients and benign type was predicted in 104 (63%) patients. The histopathology diagnosed malignancy in 64 patients and benign type was diagnosed in 101 patients. Thus the sensitivity, specificity and diagnostic accuracy of RMI was 89%, 96% and 93% respectively. This study further classified the patients in two age groups (<50 years and >50 years

of age). In <50 years' age group, the sensitivity, specificity and diagnostic accuracy were 74%, 100% and 94% respectively. In contrast, in women of age above 50 years, the sensitivity, specificity and diagnostic accuracy were 96%, 87.5% and 92% respectively.¹⁶ According to this study, sensitivity of RMI has increased with advancing age while specificity has declined. Diagnostic accuracy on the other hand remained somewhat constant. Although our study population was somewhat similar to the above-mentioned study but the results were different. Results of our study showed that sensitivity and diagnostic accuracy of RMI dropped with increasing age, specificity on the other hand has remained almost same (near 80%) over this age range of 25-75 years. The reason for this decline in sensitivity may be that, all these ultrasounds were not done by single radiologist, but were done by different radiologists according to their availability.

Study done in 2022 with larger sample size (n=264) as compared to above mentioned studies, divided women in 3 age groups (reproductive, pre-menopausal, postmenopausal). Results from this study revealed that incidence of malignant ovarian tumors was highest in postmenopausal group and lowest in reproductive age group. The overall sensitivity of RMI in this study was 93% while specificity was 83%. It was highly sensitive in women of reproductive age range whereas specificity was maximum in postmenopausal women.¹⁶ These results are similar to that of our study. Therefore, RMI at cut off value of 200 is an effective tool in predicting ovarian malignancies.

Conclusion

This study concluded that risk of malignancy index (RMI), which is an ultrasound-based non-invasive method, helps in predicting malignancy in patients presenting with ovarian masses. It has high diagnostic accuracy and has not only improved our ability of differentiating benign from malignant ovarian masses pre-operatively but also helps the surgeon in proper counselling as well as decision making of the patients.

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