SIGNIFICANCE AND DIAGNOSTIC ACCURACY OF RESISTIVE INDEX IN PREDICTING MALIGNANT OVARIAN MASSES KEEPING HISTOPATHOLOGY AS GOLD STANDARD

Sana Iqbal[1], Anam Safdar[1], Shandana Khan[2]

How to cite this article

Iqbal S, Safdar A, Khan S. Significance and Diagnostic Accuracy of Resistive Index in Predicting Malignant Ovarian Masses Keeping Histopathology as Gold Standard. J Gandhara Med Dent Sci. 2026;13(2):87-91
https://doi.org/10.37762/jgmds.13-2.813

Date of Submission: 25-10-2025
Date Revised: 19-02-2026
Date Acceptance: 08-03-2026

[2]Assistant Professor, HOD, Department of Radiology, Northwest General Hospital and Research Centre, Peshawar

Correspondence

[1]Anam Safdar, Assistant Professor, Department of Radiology, Northwest General Hospital and Research Centre, Peshawar
: +92-332-9840175
: anamsafdar33@gmail.com

ABSTRACT

OBJECTIVE

This study aimed to determine the significance and diagnostic accuracy of the resistive index (RI) in predicting malignancy in ovarian masses, using histopathology as the gold standard.

METHODOLOGY

This prospective study was conducted at the Department of Radiology, Northwest General Hospital and Research Centre, Peshawar, from Jan 1 2024, to Jul 31 2025. A sample size of 159 was calculated using the WHO calculator. Patients were selected through convenience sampling. Trans-abdominal Doppler Ultrasound was performed using a 3.5 MHz transducer on a GE Logic 5 Doppler Ultrasound machine. The Resistive Index (RI) was calculated for each case, and a threshold of 0.6 was used to differentiate benign from malignant lesions. Data analysis was done using SPSS version 25.

RESULTS

The sensitivity of the resistive index in predicting malignancy in ovarian masses was 75.2%, and the specificity was 63.2%. The positive predictive value of the RI was 86.7%, and the negative predictive value was 44.4% when histopathology served as the gold standard. The mean age of patients in our study was 48.3 ± 8.1 years.

CONCLUSION

Doppler ultrasound and the resistive index are pivotal non-invasive tools for predicting malignant risk in ovarian masses, with high diagnostic accuracy. It has not only dramatically improved our ability to differentiate benign from malignant adnexal masses but also helped surgeons with preoperative planning. Effect modifiers like patient body habits and the performing sonologist's expertise. should be included in further studies to determine their effect on the diagnostic accuracy of RI.

KEYWORDS: *Doppler Ultrasound, Resistive Index, Histopathology, Ovarian Carcinoma*

INTRODUCTION

Ovarian cancer is the fifth most common cause of cancer death among women and the second most common gynecological malignancy.[1] The incidence of ovarian cancer has been rising significantly among younger women, likely due to the growing prevalence of obesity, metabolic syndrome, increased estrogen exposure, and lower birth rates.[2] The global incidence and mortality rates of ovarian cancer for 185 countries in 2020 were retrieved from the Global Cancer Observatory (GLOBOCAN) database. In 2020, a total of 313,959 new cases of ovarian cancer were recorded globally, with an ASR (age-standardized rate) incidence of 6.6 per 100,000. In 2020, a total of 207,252 new deaths due to ovarian cancer were reported globally, with an ASR mortality of 4.2 per 100,000.[2] Ovarian cancer has the highest mortality rate of all gynecologic cancers. The delayed onset of clinical symptoms and diagnosis at an advanced stage largely drives the high mortality rate of this disease.[3] The overall survival rate for this disease is below 50%, but it can reach up to 90% when detected at stage I. Unfortunately, only about 15% of cases are diagnosed this early. In contrast, more than 60% of cases are identified at advanced stages (III and IV), where the 5-year survival rate falls to just 28%.[4] For ovarian cancer, screening tests tend to have low specificity, leading to numerous false positives and potentially unnecessary surgical or therapeutic interventions. At the same time, low sensitivity means that many cancers may go undetected. As a result, true screening for ovarian cancer is not currently feasible.[4] The best alternative is achieving an accurate diagnosis at an early stage. For patients at high risk of ovarian cancer, the most employed screening method is yearly testing for serum CA125 and transvaginal ultrasound (TVS). A major problem with CA125 is its lack of specificity: it may be elevated in

other cancers, such as lung or pancreas, as well as many benign conditions such as pelvic inflammatory disease and inflammatory bowel disease etc.[5] Using CA125 levels to triage patients before proceeding to transvaginal sonography (TVS), rather than performing both tests simultaneously, results in better outcomes with fewer false positives. Ultrasound is the primary choice for evaluating pelvic masses due to its easy availability, cost-effectiveness, and lack of ionizing radiation.[3,5] The International Ovarian Tumor Analysis (IOTA) classifies a tumor as benign, malignant, or indeterminate.[6] This classification consists of two sets of descriptors: Benign (B) features: unilocular cyst, smooth multilocular tumor, solid component <7 mm in diameter, the presence of acoustic shadows and no detectable Doppler signal and Malignant (M) features: irregular solid tumor, irregular multilocular mass >10 cm in diameter, ≥4 papillary structures, ascites and high Doppler signal. An adnexal mass is classified as malignant if at least one M-feature and no B-features are present, and vice versa. Color Doppler imaging combined with pulsed Doppler spectral analysis enhances the assessment of ovarian masses by evaluating blood flow within tumor tissue. The neovascularization in tumors typically lacks a muscular layer and exhibits low impedance with high-velocity flow, resulting in a low resistive index.[7] Therefore, benign and malignant tumors can be differentially diagnosed by RI.[8] 82.5 % of malignant tumors had RI less than 0.6, in contrast to only 6.81 % of benign tumors in a study conducted in India.[9] In another study, 4 (11%) benign tumors with vascularity had an RI of <0.6, compared to 100% of malignant tumors with an RI of <0.6.[10] According to a study, the sensitivity and specificity of various cut-off values of RI were calculated. A cut-off value of RI <0.6 had sensitivities of 82.1%, specificities of 100%, and positive and negative predictive values of 72.2%, respectively.[10] These findings suggest a notable difference in the distribution of Resistive Index values between benign and malignant neovascular ovarian tumors.[7] This study aims to highlight the diagnostic accuracy of color Doppler resistive index in the detection of malignant ovarian masses. The gold standard for the diagnosis of ovarian malignancy is histopathology. We stress again that ultrasound‘s importance is to provide the gynecologist with a simple tool to triage patients with an ovarian mass. This study aims to evaluate the diagnostic accuracy of Doppler resistive index in distinguishing malignant from benign ovarian masses, with histopathology as the gold standard.

METHODOLOGY

This prospective study was conducted in the Radiology Department, Northwest General Hospital, and Research Centre, Peshawar, from Jan 1 2024, to 31st july 2025. Ethical approval for this study was obtained from the Ethical Committee of Northwest General Hospital prior to the commencement of data collection on 01-01-2024 (IRB 0239). Written informed consent was obtained from all patients before their inclusion in the study. Participants were informed about the purpose, procedures, potential benefits, and risks of the study, as well as their right to withdraw at any time without affecting their medical care. Participants' confidentiality and privacy were strictly maintained throughout the study. Personal identifiers were removed, and all data were coded and analyzed anonymously. In this study, we included 159 patients using convenience sampling. Females with an age range of 18-64 years and having symptoms of pelvic pain, abdominal bloating, weight loss, and/or positive family history were included. Females with an age of less than 18 years, cysts less than 2.5cm, and with obvious benign lesions like corpus luteal cysts, and incomplete imaging or clinical data were excluded. The exclusion criteria were strictly adhered to to control for confounders and prevent bias in the study results. Informed written consent was taken from the patients. Doppler abdominopelvic ultrasound was performed by senior sonologists who were blinded to the clinical and surgical outcomes. In cases of ambiguity, another sonologist was consulted to provide an additional opinion and resolve the discrepancy. After assessing the morphology, color flow Doppler was activated. Flow was considered present when it appeared centrally, and absent when no signal was detected or when blood flow was only peripheral. Once a central vessel was identified by the color Doppler US, the spectral Doppler parameter "resistive index (RI)" was automatically calculated. The lowest RI was used for analysis if more than one vessel was within the lesion. A threshold resistive index of 0.6 was used to differentiate benign from malignant lesions. Masses were characterized as probably benign or possibly malignant based on their sonographic appearance. The perioperative findings and histopathology reports of the patients were traced. The data was entered into a devised form. Data analysis was done using SPSS version 25.

RESULTS

The study was conducted on 159 women presenting with clinical features suspicious of an ovarian mass. The mean age of women was 48.3 $\pm$ 8.1 years. Patients were divided into three age groups (Table 1). The majority of malignant adnexal masses were noted in old age. High-resolution Doppler ultrasound was performed, and a cut-off of 0.6 was used to predict malignancy in an ovarian lesion. RI <0.6 was labelled as possibly malignant, R1>0.6 was labelled as probably

benign (Table 2). The histopathology reports were traced. Results are shown in Table 3. The sensitivity of RI on Doppler was found to be 75.2% and, specifically, 63.2%. The positive predictive value of the RI on Doppler was 86.7%, and the negative predictive value was 44.4% (Table 4).

Table 1: Age-Wise Distribution of the Sample (n = 159)

		Frequency	%age
Age Groups (years)	Up to 35.00	16	10.1
	35.01 to 50.00	77	48.4
	50.01 & above	66	41.5

Table 2: Malignant Ovarian Mass on Doppler U/S Using RI (n=159)

		Frequency	%age
Ovarian mass classification using RI on Doppler	Possibly Malignant	105	66.0
	Probably benign	54	34.0

Table 3: Classification of Ovarian Mass on Histopathology (n=159)

		Frequency	%age
Ovarian mass on histopathology	Malignant	121	76.1
	Benign	38	23.9

Table 4: RI On Doppler & Histopathology 2 X2 Table (n = 159)

		Malignant Ovarian Mass on Histopathology	
		Positive	Negative
Malignant ovarian mass on RI	Positive	91 (TP)	14 (FP)
	Negative	30 (FN)	24 (TN)

Note: Sensitivity: TP/TP + FN = 75.2%, Specificity: TN/TN + FP = 63.2%, Positive Predictive Value: TP/TP + FP = 86.7%, Negative Predictive Value: TN/TN + FN = 44.4%.

DISCUSSION

Ovarian cancer (OC) ranks as the seventh most common cancer among women and remains the deadliest gynecologic malignancy. It poses a major global health concern, with over 324,000 new cases and more than 200,000 deaths reported each year.[11] OC is characterized by late-stage diagnosis, a poor prognosis, and 5-year survival rates ranging from 93% (early stage) to 20% (advanced stage).[11] Despite progress in genomics and proteomics, effective early-stage diagnostic tools and population-wide screening strategies remain elusive, contributing to high mortality rates. Current diagnostic modalities, including imaging techniques (transvaginal ultrasound, computed/positron emission tomography, and magnetic resonance imaging) and biomarkers (CA-125 and human epididymis protein 4) offer varying degrees of sensitivity and specificity and have limited efficacy in detecting early-stage OC.[11] Approximately 66% of patients are diagnosed at advanced stages, "FIGO" stage III or IV, which have a 5-year survival rate of 41% and 20%, respectively. Conversely, the 5-year survival rates for stages I and II are approximately 93% and 74%, respectively. Therefore, early-stage detection and treatment of OC are vital.[11,12] Ultrasonography is typically the first-line imaging modality for assessing adnexal masses because of its high sensitivity in detecting and confirming ovarian masses, distinguishing them from uterine masses, and ruling out other pathologies. The addition of color Doppler imaging with pulsed Doppler spectral analysis further enhances the characterization of ovarian masses by evaluating blood flow within tumor tissue.[4] The theoretical basis lies in the observation that newly formed tumor vessels resulting from angiogenesis differ from normal vessels in terms of cellular composition, basement membrane structure, and permeability. Consequently, these differences lead to altered hemodynamic properties within the vessels. Resistive index is an ultrasound parameter used to assess vascular system resistance. Calculated as RI = peak systole- end diastole/peak systole, the RI evaluates arterial waveforms in which the reverse flow component is absent. The value may be determined from just two well-defined spots in the spectral display, and it is not sensitive to changes in beam or vessel angle.[7] Study showed that a cut-off value of RI <0.6 had a sensitivity, specificity, positive predictive value, and negative predictive value of 82.1%, 100%, 100%, and 72.2%, respectively.[10] In another study, the results showed that using a cut-off resistance index value of 0.6, the sensitivity and specificity of color Doppler in the detection of malignant tumors were 82% and 72%, respectively.[13] A notable difference was found in the Resistive Index values between benign and malignant ovarian tumors. Among the benign tumors (n=12), none had an RI <0.4. Three tumors (25.0%) fell within the RI range of 0.4-0.6, and most benign tumors (9, 75.0%) had an RI >0.6. A considerable proportion of malignant tumors (35.0%) exhibited an RI <0.4, indicating a lower resistance pattern.[7] Yet another study showed that considering the RI value of 0.64 as the cut-off point, the sensitivity and specificity were 95.1% and 90.3%, respectively.[14] In our study, the sensitivity of RI on Doppler was found to be 75.2% and the specificity 63.2%. The positive predictive value of the RI on Doppler was 86.7%, and the negative predictive value was 44.4%. These findings highlight the importance of using color Doppler imaging and hemodynamic parameters to differentiate between benign and malignant ovarian tumors. The detection of neovascularity, together with spectral Doppler indices

such as RI values, can help characterize and distinguish these lesions. Although opinions vary regarding optimal cut-off values, there is consensus that neovascularization is a fundamental feature of malignant transformation, and recognizing it may allow detection of the earliest stages of ovarian oncogenesis. In the future, research should be directed at comparing the new color e-flow abdominopelvic Doppler ultrasound with other modalities, especially three-dimensional color Doppler, for detecting ovarian malignancy. Because of the low incidence of ovarian cancer, one can initiate this ovarian malignancy screening program in the high-risk population so that the efficacy of this method can be evaluated. Advanced imaging modalities, such as MRI, should be used when US results are indeterminate or equivocal.[15]

CONCLUSIONS

Resistive index in abdominopelvic Doppler imaging is the non-invasive modality of choice, with high diagnostic accuracy in differentiating benign and malignant adnexal masses; however, it is not an alternative to CT or MRI. It has significantly enhanced preoperative differentiation and supports surgeons in making informed clinical decisions. This review underscores the urgent need for ongoing research and innovation to improve early detection, reduce mortality, and optimize patient outcomes in ovarian cancer. Advancements in personalized medicine, the integration of emerging technologies, and the development of targeted global initiatives and collaborative efforts are essential to address disparities in access to care and to promote cost-effective, scalable screening strategies as key approaches to combat ovarian cancer.

LIMITATIONS

Conducting the study at a single center limits its generalizability. Effect modifiers such as patient body habitus, the expertise of the performing sonologist, etc., should be included in future studies to determine their effect on the diagnostic accuracy of RI.

CONFLICT OF INTEREST: None

FUNDING SOURCES: None

REFERENCES

1. Khalaf LM, Desoky HH, Seifeldein GS, Salah A, Amine MA, Hussien MT. Sonographic and Doppler predictors of malignancy in ovarian lesions. Egypt J Radiol Nucl Med. 2020;51(1):44.https://doi.org/10.1186/s43055-020-00203-2. PMID: 32190261.
2. Huang J, Chan WC, Ngai CH, Lok V, Zhang L, Lucero-Prisno DE III, et al. Worldwide burden, risk factors, and temporal trends of ovarian cancer: A global study. Cancers (Basel). 2022;14(9):2230. https://doi.org/10.3390/cancers14092230. PMID: 35564645; PMCID: PMC9103243.
3. Liberto JM, Chen SY, Shih IM, Wang TH, Wang TL, Pisanic TR. Current and emerging methods for ovarian cancer screening and diagnostics: A comprehensive review. Cancers (Basel). 2022;14(12):2885. https://doi.org/10.3390/cancers14122885. PMID: 35740455; PMCID: PMC9225201.
4. Abramowicz JS, Condous G, Timmerman D. Ovarian mass—differentiating benign from malignant: Why the International Ovarian Tumour Analysis rules should be implemented in Australasia. Australas J Ultrasound Med. 2018;21(3):121-125. https://doi.org/10.1002/ajum.12092 PMID: 30459943; PMCID: PMC6223954.
5. Yu Z, Sun Y. Evaluating pretreatment serum CA-125 levels as prognostic biomarkers in endometrial cancer: A comprehensive meta-analysis. Front Oncol. 2024;14:1442814. https://doi.org/10.3389/fonc.2024.1442814.
6. Sujata P, Mishra SP, Kurra J, Kar D, Bhuyan R. Preoperative risk assessment of adnexal masses using simple rules from the International Ovarian Tumor Analysis group. Ann Rom Soc Cell Biol. 2021;25(2):1340-1351.
7. Dhir YR, Roy A, Maji S, Karim R. Sonological accuracy in defining benign and malignant ovarian neoplasms with colour Doppler and histopathological correlation. Int J Acad Med Pharm. 2023;5(3):2308-2311.
8. Kodali S, Sundari LD, Shah D. Correlation of clinical, Doppler study and histopathological features of ovarian tumors. J South Asian Feder Obstet Gynaecol. 2022;14:257-260. https://doi.org/10.5005/jp-journals-10006-2057.
9. Shah D, Shah S, Parikh J, Bhatt CJ, Vaishnav K, Bala DV. Doppler ultrasound: A reliable predictor of ovarian malignancy. J Obstet Gynaecol India. 2013;63(3):186-189. https://doi.org/10.1007/s13224-012-0255-8 PMID: 24426372; PMCID: PMC3893995.
10. Mahale N, Kumar N, Mahale A, Ullal S, Fernandes M, Prabhu S. Validity of ultrasound with color Doppler to differentiate between benign and malignant ovarian tumours. Obstet Gynecol Sci. 2024;67(2):227-234. https://doi.org/10.5468/ogs.23167 PMID: 38395074; PMCID: PMC10901352.
11. Hong MK, Ding DC. Early diagnosis of ovarian cancer: Advances, challenges, and future directions. Diagnostics (Basel). 2025;15(4):406. https://doi.org/10.3390/diagnostics15040406.
12. Torre LA, Trabert B, DeSantis CE, Miller KD, Samimi G, Runowicz CD, et al. Ovarian cancer statistics, 2018. CA Cancer J Clin. 2018;68(4):284-296. https://doi.org/10.3322/caac.21456 PMID: 29809280.
13. Nighat S, Tariq A, Iqbal N, Nadeem J, Imran H, Ishaque S. Accuracy of ultrasonography and color Doppler in the diagnosis of ovarian masses and correlation with histopathology. Pak J Med Dent. 2025;14(4).
14. Miao K, Zhao N, Lv Q, He X, Xu M, Dong X, et al. Prediction of benign and malignant ovarian tumors using ResNet34 on ultrasound images. J Obstet Gynaecol Res. 2023;49(12):2910-2917. https://doi.org/10.1111/jog.15849PMID: 37754803.
15. Abd Elrahman EO, Hemida R, Ghanem AA, Shams-Eldin N, Mohamed AA. Doppler ultrasound versus pelvic magnetic resonance imaging in diagnosis of ovarian mass in teenagers: A prospective study. Egypt J Hosp Med. 2023;92(1):5508-5518.
16. Sujana K, Pranathi L, Jyothi S. To evaluate the efficacy of ultrasonography and colour Doppler in the diagnosis and characterization of gynaecological pelvic masses. J Popul Ther Clin Pharmacol. 2024.
17. Ahmed HE. The usefulness of ultrasound diagnosis of suspicious ovarian masses based on the O-RADS classification system. Al-Azhar Int Med J. 2021;2(10):1-6.

18. Rastogi A, Singh B, Rigveda R. Ultrasound and colour Doppler in ovarian masses and correlation with CA-125. Eur J Cardiovasc Med. 2025;15(7).

AUTHORS CONTRIBUTION

Sana Iqbal - *Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Supervision; Final Approval*

Anam Safdar - *Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Supervision; Final Approval*

Shandana Khan - *Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Supervision; Final Approval*

The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.