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Original Article

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Adnexal lesions in post-menopausal women: A radiopathological correlation

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Abstract

***Background & Aims*:** Ovarian cancers are increasing in incidence, and an accurate ultrasonographic diagnosis, along with a complete physical examination and history taking, is essential for prompt diagnosis and early reporting.

In this study, we aimed to evaluate the efficacy of ultrasonography (USG) in identifying ovarian lesions using histopathology as the gold standard.

Materials & Methods: This was a retrospective study conducted by evaluating the reports of patients in the menopausal age group who had undergone total hysterectomy or oophorectomy. Histopathological diagnoses were retrieved from the Department of Pathology, and ultrasonographic (USG) reports were obtained from the patients' medical records.

Results: This study included the histopathological and ultrasonographic reports of 239 women, of which 95.4% of cases were benign, while borderline lesions and malignant lesions constituted 3.3% and 1.3%, respectively. USG showed sensitivities of 93.55%, 66.7%, and 33% in identifying benign, borderline, and malignant lesions, respectively. Specificities of 91.67%, 91.84%, and 99.46% were noted in classifying ovarian lesions as benign, borderline, and malignant, respectively.

Conclusion: Ultrasonography (USG) remains an important imaging tool for the early diagnosis of ovarian lesions, and a standardized reporting protocol should be implemented in every institution to increase the accuracy of USG and to reduce the inter-observer variability commonly encountered in ultrasound.

***Keywords*:** Cysts, Ovarian, Ultrasonography, Malignant

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Introduction

Ovarian cancer primarily affects women in the post-menopausal age group, i.e., 55-64 years. An increase in age is associated with an increased incidence as well as lower survival rates and is linked to the advanced stage of the disease at which it presents (1, 2). According to the National Registry Program of India, the projected

incidence of ovarian cancer by the year 2025 is expected to be 49,644 (3, 4).

About 20% of women with pelvic masses present with varying symptoms, the most common being early satiety, abdominal pain, and bloating. A careful evaluation with thorough history taking is essential to guide the clinician in the right direction (5). The final diagnosis of ovarian lesions depends on a complete clinical examination, ultrasonographic evaluation, evaluation of hormone markers, and histopathologic analysis, with the latter serving as the gold standard.

Adnexal lesions can be classified as benign or malignant, with surface epithelial tumors, sex cord stromal cell tumors, and germ cell tumors being the most common malignant tumors of the ovary (6). Previous studies have shown that the most common benign ovarian lesion in post-menopausal women is the benign serous cystadenoma (7). Accurate categorization of adnexal lesions as benign, borderline, or malignant is essential for prompt diagnosis and early treatment. Ultrasonography (USG) is the primary modality for the diagnosis of adnexal lesions (8). Incidental findings of ovarian cysts are common in USG examinations.

USG utilizes the presence of certain morphological features to identify lesions as benign or malignant. The most important of these include the complexity of the lesion, the presence of papillations, and solid echogenic foci, which are features favoring the classification of a lesion as malignant (9). Various scoring systems have been proposed to differentiate between benign and malignant lesions (10), with emphasis on morphologic features as well as evaluation of internal vascularity and Doppler study.

This study aims to analyze the most common adnexal lesions found in women in the post-menopausal age group and to correlate the USG findings with the histopathology reports. We aim to evaluate the accuracy of USG in classifying adnexal lesions as benign, borderline, or malignant.

Materials & Methods

This was a retrospective study conducted at KMCT Medical College in Kerala, India, during the period from January 2021 to December 2022. This study included 239 women aged 45 years or older who had ovarian cysts confirmed on histopathological examination. The exclusion criterion was women aged less than 45 years. Histopathology reports and ultrasonographic reports were retrieved from the medical records, and data were entered in Microsoft Excel. Transabdominal and transvaginal ultrasonography were done using GE Logiq F8 & Samsung HS 70 machines. As the study was done retrospectively from histopathologically diagnosed cases of ovarian lesions, it also included cases that were not detected ultrasonographically. This study had a sample size of 239, and convenience sampling was used.

Data analysis was done using SPSS software version 22.0. Continuous variables with normal distribution were presented with mean, median, and standard deviation. 2x2 contingency tables were used for sensitivity and specificity calculations. A p-value < 0.05 was considered statistically significant.

Results

There were 239 women included in the study. The age of the study population ranged from 45 years to 77 years with a mean age of 51.69 years and a standard deviation of 7.06. Most women were in the age group of 45-50 years comprising 145 women. This constituted up to 60.7 % of the study population. The age distribution of the study population is summarised in Figure 1 and Table 1.

Table 1. Age distribution of the study population

Mean	51.69
Std. Deviation	7.06
Minimum	45
Maximum	77

95% Confidence interval for mean	50.79 - 52.59
Mean ± Std.	51.69 ± 7.06

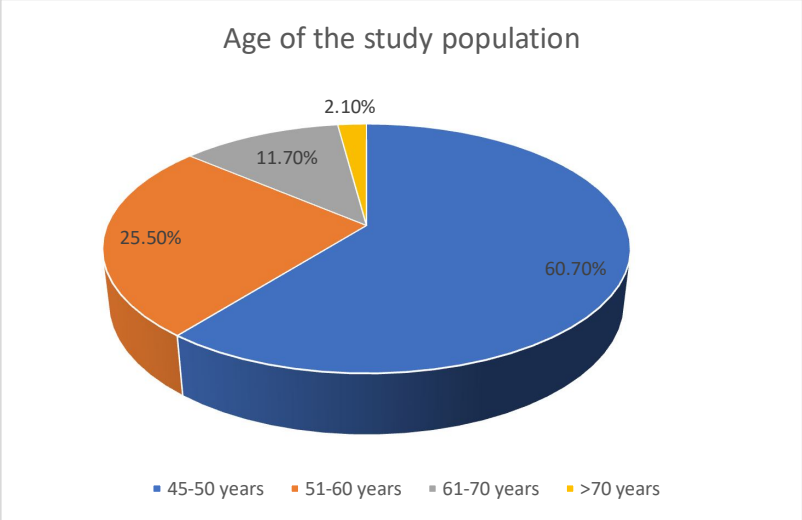

Fig. 1. Age distribution of the study population

Majority of the patients had complaints of post-menopausal bleeding(79.7%), followed by abdominal pain(12.3%), abdominal bloating(5.4%), and fatigue(4.6%). The USG findings of the study population are summarized in Table 2.

Table 2. USG findings of the study population

USG findings	Frequency	%
Benign	127	53.14%
None	41	17.15%
Multiloculated	16	6.69%
Borderline	9	3.77%
Complex cyst	9	3.77%
Dermoid	9	3.77%
Paraovarian cyst	9	3.77%
Endometriosis	8	3.35%
Hemorrhagic septate cyst	5	2.09%
Malignant	4	1.67%
Hydrosalpinx	2	0.84%
Total	239	100%
Invalid	0	0%
Total	239	100%

Out of the 127 cases reported as benign,uniloculated, simple cysts in USG, 93 cases were confirmed to be benign serous cystadenoma, while other diagnoses include benign mucinous cystadenoma, cystadenofibroma, fibroma, fibrothecoma, benign brenner tumour, endometriosis and functional cysts. 16 multiloculated cysts reported on USG were confirmed to be cases of benign serous cystadenoma(6 cases), benign mucinous cystadenoma (5 cases), struma ovarii, benign mature cystic teratoma and cystadenofibroma. 2 cases of simple uniloculated cyst and one multiloculated cyst showed papillations on USG and was confirmed to be papillary serous cystadenoma while one case of uniloculated cyst with papillations was confirmed to be papillary cystadenofibroma. All cases (100%) of papillary projections were accurately reported on ultrasonography.

All 9 cases of mature cystic teratoma were accurately diagnosed by USG(100% accuracy) .6 out of the 8 cases(75%) of endometriosis were confirmed by histopathology as endometriosis. Other 2 cases were reported as corpus luteal cyst and benign serous cystadenoma.

9 cases of paraovarian cysts were reported on USG,out of which 8 were confirmed to be benign serous cystadenomas while one was diagnosed as steroid cell tumour of ovary. 5 cases of hemorrhagic septate cysts were diagnosed on USG. 2 cases were reported as corpus luteal cyst, one case of hemorrhagic follicular cyst, and one case each of endometriosis and atypical endometriosis. USG reported 2 cases of fimbrial cyst, but histopathology reports showed the diagnoses to be benign serous cystadenoma and fimbrial cyst. 9 women were diagnosed to have complex cysts, out of which 3 cases were confirmed as benign serous cystadenoma, 2 were reported as endometriosis and one case each of benign mature cystic teratoma, fibroma, adult granulosa cell tumour and borderline lesion(serous cystadenoma with focal epithelial proliferation). 9 women were diagnosed as having borderline lesions on USG.Out of these 2 cases were confirmed as benign serous cystadenoma and 3 as borderline tumours of serous and mucinous cystadenoma with epithelial proliferation.2 cases were reported as serous carcinoma histopathologically. 1 case of cystic granulosa cell tumour and 1 case of Sertoli Leydig cell tumour were reported. 4 cases were reported as malignant on USG out of which included one case each of serous carcinoma, papillary serous carcinoma, adult granulosa cell tumour and benign serous cystadenoma.

The age of the women presenting with malignant lesions ranged from 45 years to 73 years.The USG findings of the malignant lesions showed multiseptated lesions with hypoechoic to anechoic foci and increased vascularity. Enhancing wall septae and presence of ascites was noted.

The histopathological diagnoses of the adnexal lesions are summarised in Table 3. The most common diagnosis was benign serous cystadenoma constituting 50.63% of the study population. This was followed by follicular cyst, endometriosis, benign mucinous cystadenoma and dermoid cysts. Other diagnoses constituted only a small proportion of the study population.

Table 3. Histopathological diagnoses of the study population

Histopathological diagnosis	Frequency	%
Benign serous cystadenoma	121	50.63%
Functional cyst	34	14.23%
Endometriosis	17	7.11%
Benign mucinous cystadenoma	15	6.28%
Benign mature cystic teratoma	12	5.02%
Parafimbrial cyst	8	3.35%
Fibroma/fibrothecoma	7	2.93%

Histopathological diagnosis	Frequency	%
Papillary serous cystadenoma	3	1.26%
Benign/mucinous cystadenoma with focal epithelial proliferation	4	1.68%
Serous carcinoma	3	1.26%
Adult granulosa cell tumor/cystic granulosa cell tumor	3	1.26%
Serous/papillary serous cystadenofibroma	2	0.84%
Endometrioid cystadenofibroma	1	0.42%
Sertoli leydig cell tumor	1	0.42%
Benign brenner tumor	1	0.42%
Hemorrhagic follicular cyst	1	0.42%
Atypical endometriosis	1	0.42%
Papillary serous carcinoma	1	0.42%
Struma ovarii	1	0.42%
Mucinous cystadenofibroma	1	0.42%
Leydig cell tumor	1	0.42%
Steroid cell tumor	1	0.42%
Total	239	100%
Invalid	0	0%
Total	239	100%

41 cases were reported as normal ovaries on ultrasound, whereas histopathological reports showed benign simple cysts(19 cases) and mucinous cystadenomas(6 cases) ranging from 1.5 to 3.7cm in greatest dimension .Few cases of endometriosis(6 cases), functional cysts(6 cases) and paraovarian cysts(4 cases) sized more than 0.5cm were missed on USG. A comparison of the USG findings and histopathology reports are summarised in Table 4.

Table 4. Comparison of the USG diagnosis and histopathological diagnosis of the study population

		USG diagnosis											
		Benign uniloculated cyst	Dermoid cyst	Endometriosis	Hemorrhagic septate cyst	Paraovarian cyst	Hydrosalpinx	Multiloculated cyst	Complex cyst	Borderline lesion	Malignant lesion	No cyst/lesions detected in ovaries	**Total**
Histo-pathological diagnosis	Benign serous cystadenoma	93 (38.91%)	0	1 (0.42%)	0	8 (3.35%)	1 (0.42%)	5 (2.09%)	3 (1.26%)	2 (0.84%)	0	8 (3.35%)	**121 (50.63%)**

	USG diagnosis												
	Benign unilocculated cyst	Dermoid cyst	Endometriosis	Hemorrhagic septate cyst	Paraovarian cyst	Hydrosalpinx	Multiloculated cyst	Complex cyst	Borderline lesion	Malignant lesion	No cyst/lesions detected in ovaries	Total
Benign mucinous cystadenoma	6 (2.51%)	0	0	0	0	0	6 (2.51%)	0	0	1 (0.42%)	2 (0.84%)	**15 (6.28%)**
Papillary serous cystadenoma	2 (0.84%)	0	0	0	0	0	1 (0.42%)	0	0	0	0	**3 (1.26%)**
Serous cystadeno-fibroma	1 (0.42%)	0	0	0	0	0	0	0	0	0	0	**1 (0.42%)**
Papillary serous cystadeno-fibroma	1 (0.42%)	0	0	0	0	0	0	0	0	0	0	**1 (0.42%)**
Endometrioid cystadeno-fibroma	1 (0.42%)	0	0	0	0	0	0	0	0	0	0	**1 (0.42%)**
Mucinous cystadeno-fibroma	0	0	0	0	0	0	1 (0.42%)	0	0	0	0	**1 (0.42%)**
Fibroma	1 (0.42%)	0	0	0	0	0	0	1 (0.42%)	0	0	1 (0.42%)	**3 (1.26%)**
Fibrothecoma	4 (1.67%)	0	0	0	0	0	0	0	0	0	0	**4 (1.67%)**

	USG diagnosis												
	Benign unilocculated cyst	Dermoid cyst	Endometriosis	Hemorrhagic septate cyst	Paraovarian cyst	Hydrosalpinx	Multiloculated cyst	Complex cyst	Borderline lesion	Malignant lesion	No cyst/lesions detected in ovaries	Total
Endometriosis	5 (2.09%)	0	6 (2.51%)	1 (0.42%)	0	0	0	2 (0.84%)	0	0	3 (1.26%)	**17 (7.11%)**
Follicular cyst	9 (3.77%)	0	0	0	0	0	0	0	0	0	19 (7.95%)	**28 (11.72%)**
Corpus luteal cyst	3 (1.26%)	0	1 (0.42%)	2 (0.84%)	0	0	0	0	0	0	0	**6 (2.51%)**
Benign mature cystic teratoma	0	9 (3.77 %)	0	0	0	0	2 (0.84%)	1 (0.42%)	0	0	0	**12**
Benign brenner tumor	1 (0.42%)	0	0	0	0	0	0	0	0	0	0	**1 (0.42%)**
Hemorrhagic follicular cyst	0	0	0	1 (0.42%)	0	0	0	0	0	0	0	**1 (0.42%)**
Struma ovarii	0	0	0	0	0	0	1 (0.42%)	0	0	0	0	**1 (0.42%)**
Parafimbrial cyst	0	0	0	0	0	1 (0.42%)	0	0	0	0	6 (2.51%)	**7 (2.93%)**

USG diagnosis														
	Benign uniloculated cyst	Dermoid cyst	Endometriosis	Hemorrhagic septate cyst	Paraovarian cyst	Hydrosalpinx	Multiloculated cyst	Complex cyst	Borderline lesion	Malignant lesion	No cyst/lesions detected in ovaries	Total
Paratubal cyst	0	0	0	0	0	0	0	0	0	0	1 (0.42%)	**1 (0.42%)**
Atypical endometriosis	0	0	0	1 (0.42%)	0	0	0	0	0	0	0	**1 (0.42%)**
Serous cystadenoma with focal epithelial proliferation	0	0	0	0	0	0	0	1 (0.42%)	2 (0.84%)	0	0	**3 (1.26%)**
Mucinous cystadenoma with focal epithelial proliferation	0	0	0	0	0	0	0	0	1 (0.42%)	0	0	**1 (0.42%)**
Steroid cell tumor	0	0	0	0	1 (0.42%)	0	0	0	0	0	0	**1 (0.42%)**
Leydig cell tumor	0	0	0	0	0	0	0	0	0	0	1 (0.42%)	**1 (0.42%)**
Sertoli leydig cell tumor	0	0	0	0	0	0	0	0	1 (0.42%)	0	0	**1 (0.42%)**

	USG diagnosis											
	Benign uniloculated cyst	Dermoid cyst	Endometriosis	Hemorrhagic septate cyst	Paraovarian cyst	Hydrosalpinx	Multiloculated cyst	Complex cyst	Borderline lesion	Malignant lesion	No cyst/lesions detected in ovaries	**Total**
Adult granulosa cell tumor	0	0	0	0	0	0	0	1 (0.42%)	0	1 (0.42%)	0	**2 (0.84%)**
Cystic granulosa cell tumor	0	0	0	0	0	0	0	0	1 (0.42%)	0	0	**1 (0.42%)**
Serous carcinoma	0	0	0	0	0	0	0	0	2 (0.84%)	1 (0.42%)	0	**3 (1.26%)**
Papillary serous carcinoma	0	0	0	0	0	0	0	0	0	1 (0.42%)	0	**1 (0.42%)**
Total	**127 (53.14%)**	**9 (3.77 %)**	**8 (3.35%)**	**5 (2.09%)**	**9 (3.77%)**	**2 (0.84%)**	**16 (6.69%)**	**9 (3.77%)**	**9 (3.77%)**	**4 (1.67%)**	**41 (17.15%)**	**239 (100%)**

Table 5 shows a comparison of USG and Histopathology in categorizing the lesions as benign, borderline and malignant. USG reported a total of 176 cases while histopathologically confirmed benign cases were 187. USG identified 18 lesions as borderline and 4 lesions as malignant, while histopathology showed3 borderline lesions and 9 malignant lesions.

Table 5. Comparison of USG and histopathology in classifying the lesions of the study population

		Histopathology			
		benign	borderline	malignant	**Total**
USG	benign	174	1	1	**176**
	borderline	11	2	5	**18**
	malignant	1	0	3	**4**

	Histopathology			
	benign	borderline	malignant	**Total**
Total	**187**	**3**	**9**	**198**

USG shows a 93.55% sensitivity and 91.67% specificity in classifying benign ovarian lesions as shown in Table 6. USG shows 66.67% sensitivity and 91.84% specificity in identifying borderline lesions and showed a low sensitivity(33%) and specificity(99.46%) in identifying malignant lesions with an accuracy of 96.39%.

Table 6. Statistical analysis of the efficacy of USG in diagnosis of benign,borderline and malignant lesions

	Benign lesions		**Borderline lesions**		**Malignant lesions**	
Statistics	**Value**	**95% CI**	**Value**	**95% CI**	**Value**	**95% CI**
Sensitivity	93.55%	89.00% to 96.62%	66.67%	9.43% to 99.16%	33.33%	7.49% to 70.07%
Specificity	91.67%	73.00% to 98.97%	91.84%	87.08% to 95.26%	99.46%	97.03% to 99.99%
Positive Likelihood Ratio	11.23	2.98 to 42.34	8.17	3.23 to 20.65	61.67	7.10 to 535.83
Negative Likelihood Ratio	0.07	0.04 to 0.12	0.36	0.07 to 1.80	0.67	0.42 to 1.06
Disease prevalence	88.57%	83.47% to 92.54%	1.51%	0.31% to 4.34%	4.64%	2.14% to 8.62%
Positive Predictive Value (*)	98.86%	95.85% to 99.70%	11.11%	4.71% to 24.02%	75.00%	25.67% to 96.31%
Negative Predictive Value (*)	64.71%	51.14% to 76.25%	99.45%	97.32% to 99.89%	96.84%	95.08% to 97.99%
Accuracy (*)	93.33%	89.07% to 96.31%	91.46%	86.67% to 94.94%	96.39%	92.71% to 98.54%

*Values are calculated using the prevalence noted

The present study showed a predominance of benign lesions(95.4%) ,followed by malignant lesions(3.3%) and lastly borderline lesions(1.3%) .

Discussion

Adnexal lesions in postmenopausal women pose a significant clinical challenge due to their varied presentation and potential for malignancy. According to previous studies, there is an increased incidence of ovarian tumors in the age group of 60-80 years (11). In this study, the mean age of the study population was 51.69 years. A study conducted by Jacobs et al showed a mean age of 56 years (12), while a study conducted by Marcels FP et al showed a mean age of (42.01 ± 15.06) in the occurrence of benign tumors and a mean age of (54.67 ± 13.84) for ovarian cancer (13). In this study, the malignant tumors were diagnosed in women with the youngest age being 45 years and the oldest patient being aged 73 years.

Radio pathological correlation plays a crucial role in accurately diagnosing and managing these lesions. The lesions are classified as benign, borderline, or malignant based on their morphological characteristics. Our study showed a predominance of benign lesions, which constituted 95.4% of the study population. Out of these, the most common benign lesion was benign serous

cystadenoma, constituting 50.63% of the study population. A study conducted by He P et al showed a predominance of benign tumors comprising 64.8% of the study population. Among these, serous cystadenomas constituted the most common lesion (14). This is in concordance with studies conducted by Mondal et al (15) and Rajavigneshwari N et al. (16), while Soumini G et al (17) showed a predominance of mucinous cystadenomas.

Among malignant lesions, serous carcinomas were predominant in the present study, constituting 44.4% of all malignant cases. This is in concordance with a study conducted by Gangane et al. (18).

In our study, the presence of papillary projections was noted in borderline lesions, while malignant lesions showed multiseptate lesions with hypoechoic to anechoic foci. Similarly, the study conducted by He P et al showed that papillary projections and multiple loculations were more commonly seen in borderline lesions, while the presence of ascites was frequently seen in Stage I and Stage II ovarian cancer (14). A study conducted by Khalaf et al also showed that the presence of large tumor volume, non-hyperechoic solid components, papillations, thick wall, and internal septae were in favor of malignancy (19). Studies done by Brown et al. (20), Herrmann et al. (21), Valentin et al. (22), demonstrated that the presence of non-hyperechoic solid components is strongly associated with malignancy, while Khurana et al. (23) reported that papillary projections were a predictor of malignancy.

Studies conducted by Granberg et al (24) and Timmerman et al. (25) showed that the presence of thick septation was the significant predictor for ovarian cancer.

In this study, we noted a 93.55%, 66.67%, and 33.33% sensitivity in identifying benign, borderline, and malignant lesions, respectively. A 91.67%, 91.84%, and 99.46% specificity was noted in identifying benign, borderline, and malignant lesions, respectively. Overall diagnostic accuracy ranged from 91.46%-96.39%. Previous studies have shown that transvaginal ultrasound has a sensitivity of 90% and a specificity ranging from 51-97% for identification of malignant lesions (26,27). A study conducted by Rabail Hameer et al showed 82.68% sensitivity, 73.68% specificity, and 81.11% overall diagnostic accuracy of ultrasound in cases of malignancy, taking histopathology as the gold standard (28).

Studies have shown that the use of gray-scale ultrasonography combined with Doppler studies and CA-125 values shows a higher success rate in detection of malignancy (29,30).

Women in the menopausal age group are at a higher risk of developing ovarian malignancy. Ultrasonographic findings of large cyst size, thick internal septae, hypo- to anechoic foci, and papillations should be highlighted, and suspicion of malignancy should be raised. Evaluation of hormone markers can also guide the clinician in early diagnosis and prompt treatment.

Conclusion

Although there have been massive advances in the field of imaging, ultrasonography remains the most important and cost-effective imaging tool for diagnosis of ovarian lesions. A standardized reporting protocol has to be implemented in every institution so as to increase the sensitivity of USG in detection of borderline/malignant lesions. Further imaging with CT or MRI has to be done if ovaries are not properly visualized or if there is suspicion of extension of malignancy beyond the ovaries and for accurate staging.

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Ethical approval

This study was approved by the Institutional Ethics Committee of KMCT Medical College (IEC No.IECKMCT/27/2024-29.02.2024) and was performed in accordance with the principles of the Declaration of Helsinki.Due to the retrospective nature of the study, the need for informed consent was waived.

Data Availability

The raw data supporting the conclusions of this article are available from the authors upon reasonable request.

Conflicts of interest

There are no conflicts of interest.

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References

1. Gangane NM, Patil BU, Ghongade PV. Ovarian cancer: A report from population-based cancer registry at central rural India. Journal of Cancer Research and Therapeutics 19(Suppl 2):S857-S862. DOI: 10.4103/jcrt.jcrt_1426_22. https://doi.org/10.4103/jcrt.jcrt_1426_22
2. Rajavigneshwari N, Kotasthane DS, Koteeswaran G. Clinicopathological spectrum of ovarian tumours in a tertiary care hospital. J Evol Med Dent Sci 2017 May 4;6(36):2948-52. https://doi.org/10.14260/Jemds/2017/635
3. Mathur P, Sathishkumar K, Chaturvedi M, Das P, Sudarshan KL, Vinodh N, John A, Narasimhan S, Roselind FS. Cancer statistics, 2020: report from national cancer registry programme. India JCO Global Oncol 6:1063-75. https://doi.org/10.1200/GO.20.00122.
4. Sathishkumar K, Chaturvedi M, Das P, Stephen S, Mathur P. Cancer incidence estimates for 2022 & projection for 2025: result from national cancer registry programme. Indian J Med Res. 2022. https://doi.org/10.4103/ijmr.ijmr_1821_22.
5. Wheeler V, Umstead B, Chadwick C. Adnexal Masses: Diagnosis and Management. Am Fam Physician 108(6):580-587, 2023. PMID: 38215419.
6. Chen VW, Ruiz B, Killeen JL, Coté TR, Wu XC, Correa CN. Pathology and classification of ovarian tumors. Cancer 97:2631-2642, 2003. https://doi.org/10.1002/cncr.11345
7. Mondal SK, Banyopadhayay R, Nag DR, Roychowdhury S, Mondal PK, Sinha SK. Histologic pattern, bilaterality and clinical evaluation of 957 ovarian neoplasms: a10 year study in a tertiary hospital of eastern India. J Cancer Res Ther 7(4):433-7, 2011. https://doi.org/10.4103/0973-1482.92011
8. Radhamani S, Akhila MV. Evaluation of Adnexal Masses-Correlation of clinical, sonological and histopathological findings in adnexal masses. Int J Sci Stud 4(11):88-92, 2017.
9. Javadi S, Ganeshan DM, Qayyum A, Iyer RB, Bhosale P. Ovarian cancer, the revised FIGO staging system, and the role of imaging. Am J Roentgenol 206(6):1351-60, 2016. https://doi.org/10.2214/AJR.15.15199
10. Khurana I, Satia MN. Preoperative evaluation of ovarian masses with color Doppler and its correlation with pathological finding. Int J Reprod Contracept Obstet Gynecol 5(7):2084-2092, 2016. https://doi.org/10.18203/2320-1770.ijrcog20161895
11. Ovadia J, Goldman GA. Ovarian masses in postmenopausal women. Int J Gynaecol 39(1):35-9, 1992. https://doi.org/10.1016/0020-7292(92)90777-G
12. Jacobs I, Prys Davies A, Bridges J, Stabile I, Fay T, Lower A, Grudzinskas JG, Oram D. Prevalence screening for ovarian cancer in postmenopausal women by CA 125 measurement and ultrasonography. BMJ 306:1030-1034, 1993. https://doi.org/10.1136/bmj.306.6884.1030
13. Paes MF, Daltoé RD, Madeira KP et al. A retrospective analysis of clinicopathological and prognostic characteristics of ovarian tumors in the State of Espírito Santo, Brazil. J Ovarian Res 4:14, 2011. https://doi.org/10.1186/1757-2215-4-14.
14. He P, Wang JJ, Duan W, Song C, Yang Y, Wu QQ. Estimating the risk of malignancy of adnexal masses: validation of the ADNEX model in the hands of nonexpert ultrasonographers in a gynaecological oncology centre in China. J Ovarian Res 14(1):169, 2021. https://doi.org/10.1186/s13048-021-00922-w
15. Mondal SK, Banyopadhayay R, Nag DR, Roychowdhury S, Mondal PK, Sinha SK. Histologic pattern, bilaterality and clinical evaluation of 957 ovarian neoplasms: a10 year study in a tertiary hospital of eastern India. J Cancer Res Ther 7(4):433-7, 2011. https://doi.org/10.4103/0973-1482.92011
16. Rajavigneshwari N et al. Clinicopathological spectrum of ovarian tumours in a tertiary care hospital. Journal of

evolution of Medical and Dental Sciences 6(36):2948, 2017. https://doi.org/10.14260/Jemds/2017/635

17. Soumini G et al. Int J Reprod Contracept Obstet Gynecol 4(4):982-989, 2015.
18. Gangane NM, Patil BU, Ghongade PV. Ovarian cancer: A report from population-based cancer registry at central rural India. Journal of Cancer Research and Therapeutics 19(Suppl 2):S857-S862. DOI: 10.4103/jcrt.jcrt_1426_22.
19. Khalaf LMR, Desoky HHM, Seifeldein GS et al. Sonographic and Doppler predictors of malignancy in ovarian lesions. Egypt J Radiol Nucl Med 51:44, 2020. https://doi.org/10.1186/s43055-020-00172-8.
20. Brown DL, Doubilet PM, Miller FH, Frates MC, Laing FC, DiSalvo DN et al. Benign and malignant ovarian masses: selection of the most discriminating gray-scale and Doppler sonographic features. Radiol 208(1):103-110, 1998. https://doi.org/10.1148/radiology.208.1.9646799
21. Herrmann JU, Locher GWGA. Sonographic patterns of ovarian tumors: prediction of malignancy. Obstet Gynecol 69(5):777-781, 1987.
22. Valentin L, Sladkevicius PMK. Limited contribution of Doppler velocimetry to the differential diagnosis of extrauterine pelvic tumors. Obstet Gynecol 83(3):425-433, 1994.
23. Khurana I, Satia MN. Preoperative evaluation of ovarian masses with color Doppler and its correlation with pathological finding. Int J Reprod Contracept Obstet Gynecol 5(7):2084-2092, 2016. https://doi.org/10.18203/2320-1770.ijrcog20161895
24. Granberg S, Wikland MJI. Macroscopic characterization of ovarian tumors and the relation to the histological diagnosis: criteria to be used for ultrasound evaluation. Gynecol Oncol 35(2):139-144, 1989. https://doi.org/10.1016/0090-8258(89)90031-0
25. Timmerman D, Van Calster B, Testa AC et al. Ovarian cancer prediction in adnexal masses using ultrasound-based logistic regression models: a temporal and external validation study by the IOTA group. Ultrasound Obs Gynecol 36:226, 2010. https://doi.org/10.1002/uog.7636
26. Expert Panel on Women's Imaging, Atri M, Alabousi A, et al. ACR Appropriateness Criteria® Clinically Suspected Adnexal Mass, No Acute Symptoms. J Am Coll Radiol 16:S77-93, 2019. https://doi.org/10.1016/j.jacr.2019.02.011
27. Timmerman D, Valentin L, Bourne TH, et al. Terms, definitions and measurements to describe the sonographic features of adnexal tumors: a consensus opinion from the International Ovarian Tumor Analysis (IOTA) Group. Ultrasound Obstet Gynecol 16:500-5, 2000. https://doi.org/10.1046/j.1469-0705.2000.00287.x
28. Rabail H, Shafaq A, Abid H, Sualeha U, Radha, Ekta et al. Diagnostic Accuracy Of Ultrasound In Differentiating Ovarian Neoplasm, By Taking Histopathology As Gold Standard. Journal Of Population Therapeutics And Clinical Pharmacology 31(1):334-344, 2024. Doi: 10.53555/Jptcp.V31i1.4001.
29. Varras M. Benefits and limitations of ultrasonographic evaluation of uterine adnexal lesions in early detection of ovarian cancer. Clin Exp Obstet Gynecol 31:85-98, 2004.
30. Kurjak A, Predanic M. New scoring system for prediction of ovarian malignancy based on transvaginal color Doppler sonography. J Ultrasound Med 11:631-638, 1992. https://doi.org/10.7863/jum.1992.11.12.631