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Original Research Article

Comparison of three sonographic morphology indices and evaluation of its accuracy in predicting ovarian malignancy

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ABSTRACT

Background: Identifying whether an adnexal mass is benign or malignant is crucial because it guides surgeons regarding the type of operative intervention needed. The aim of this study was to evaluate the accuracy of three sonographic morphology indices (DePriest, Sassone, and Ueland) and the risk of malignancy index for preoperative triaging of adnexal masses and comparing their effectiveness in predicting ovarian malignancy.
Methods: A prospective cross-sectional study conducted at Paropakar Maternity and Women's Hospital from August 2021 to October 2022 underwent an ultrasound scan 48 hours prior to surgery. The specificity, sensitivity, negative predictive value, positive predictive value, and accuracy of all three morphological indices and the risk of malignancy index were calculated and compared.
Results: Among 107 patients, 69 (52.3%) had benign tumors, 11 (8.55%) were borderline, and 27 (20.8%) were malignant. The most common malignant ovarian tumor was serous cystadenocarcinoma (14 cases), followed by immature teratoma (5 cases) and granulosa cell tumor (4 cases). The sensitivity of the DePriest, Sassone, and Ueland morphology indices, along with the RMI, was 77.7%, 73%, 85%, and 65%, respectively. Their corresponding specificities were 82.3%, 86.25%, 78.75%, and 73.7%. In terms of accuracy, DePriest achieved 81.48%, Sassone 83%, Ueland 80.37%, and RMI only 74%.
Conclusions: Although the Ueland morphology index was the most sensitive in predicting ovarian malignancy, the preoperative diagnostic accuracy was similar across all three morphology indices, while it was notably lower for the risk of malignancy index (RMI).

Keywords: Malignancy index, Morphology index, Ovarian tumor

INTRODUCTION

Globally, ovarian cancer ranks 5th in cancer-related deaths among women.[1] In Nepal, it is the second most common gynecological malignancy, accounting for about 6.5% of all cancers.[2] Diagnosing ovarian cancer early is challenging; most patients present late and in advanced stages, leading to poor prognosis and low overall survival.[3]

Although CA125 is used as the initial tumor marker for epithelial ovarian cancer, it lacks specificity since levels can also increase in benign conditions such as fibroids, endometriosis, pelvic inflammatory disease, benign cysts, menstruation, and in 1% of the general population.[4] Whether alone or combined with serum markers, ultrasound scans have been proven to be the most effective method to distinguish between benign and malignant ovarian masses.[5]

Various sonographic morphologic scoring systems such as Sassone, Depriest, Lerner, Vera, Kawai, Uegland, and Valentin have been proposed to distinguish benign from malignant conditions. These models include several quantitative indexes that relate ovarian tumor morphology to the risk of malignancy.[4-8] However, there are very few studies that have compared the efficacy of these scoring systems to evaluate and identify the most effective one.

This study aimed to evaluate various preoperative morphological features of ovarian tumors identified by ultrasound to see if different morphological index scoring systems can effectively predict ovarian cancer. It also compares three morphology indices- DePriest, Sassone, and the University of Kentucky- to determine which one is the most accurate for predicting malignancy.

METHODS

A prospective cross-sectional study was conducted at Paropakar Maternity and Women's Hospital from August 2021 to October 2022. The sample size was calculated using the formula $n=z^2pq/d^2$, where z=1.96, taken at a 95% confidence interval; p=92, q=100-p =0.08; and d=5 (Maximum tolerable error).[10]

$$n = \frac{1.962 \times 0.92 \times 0.08}{0.05 \times 0.05}$$

n=107

All women with ovarian tumors admitted for elective surgery were included in the study. However, patients undergoing interval cytoreductive surgery, those with confirmed ovarian malignancy from tumor biopsy, and those with coexisting fibroids, pelvic inflammatory disease (PID), or tuberculosis were excluded. Additionally, patients with dermoid cysts were also excluded as they have distinct and easily identifiable typical sonographic features such as echogenic nodules (Rokitansky protuberance), calcifications, fat-fluid levels, and acoustic shadowing, which are pathognomonic and do not require scoring systems for differentiation.

A detailed history was obtained from each patient, including information on age, parity, demographic profile, and menopausal status. Ultrasound scans were performed using the HS40 Samsung ultrasound machine, capturing detailed findings of the tumor's morphological characteristics, including size, volume, wall structure, septa, and the presence of extratumoral fluid. Ovarian volume was calculated using the ellipsoid formula (length × width × height × 0.523). Preoperative morphological index scoring was then performed using all three systems- DePriest, Ueland, and Sassone.

Table 1: Morphological index scoring using DePriest, Ueland, and Sassone.

DePriest et al[4]						
Score	**0**	**1**	**2**	**3**	**4**	**5**
Volume	<10 cm^3	10-50 cm^3	>50-200 cm^3	>200-500 cm^3	>500 cm^3	
Cyst wall structure	Smooth <3 mm thick	Smooth >3 mm thick	Papillary projective <3 mm	Papillary projective ≥3 mm	Predominantly solid	
Septa structure	No septa	Thin septa <3 mm	Thick septa 3-10 mm	Solid area ≥10 mm	Predominantly solid	
Sassone et al[7]						
Inner wall structure	smooth	Irregular ≤3 mm	Papillaries >3 mm	Not applicable, mostly solid	-	
Wall thickness	Thin ≤3 mm	Thick >3 mm	Not applicable, mostly solid	-	-	
Septa	Non	Thin ≤3 mm	Thick >3 mm	-	-	
Echogenicity	Sonolucent	Low	Low echogenicity with echogenic core	Mixed echogenecity	High echogenecity	
University of Kentucky morphological index by Ueland et al[9]						
Volume (cm^3)	<10	10-50	>50-100	>100-200	>200-500	>500
Wall structure	Smooth, sonolucent	Smooth, difuse, echogenecity	Thickened wall <3 mm fine septa	Papillary projection ≥3 mm	Complex, predominantly solid	Complex, solid and cystic areas with extratumoral fluid

Furthermore, information of CA 125 was also considered and the final histopathological findings were noted.

Statistical analysis

Data was entered and analyzed using SPSS version 23. Two tailed t tests were done. Sensitivity, specificity, negative predictive value, positive predictive value and accuracy of all morphology indexes were calculated. Area under the curve was calculated. Statistical significance was considered when $p \leq 0.05$.

RESULTS

During the study period, 168 patients were scheduled for elective laparotomy, but 61 patients were further excluded after a confirmed diagnosis of dermoid cyst. Ultimately, 106 patients were included in the analysis, with only 23 (21.5%) being menopausal, and 57% had CA125 levels above 35 U/ml. Majority of the patients with ovarian tumor undergoing elective surgery belonged to the age group 31-49 years i.e. 35 (32.7%) followed by 21-30 years (24.2%) and 41-50 years (19.65) as shown in Table 2.

Table 2: Clinico-demographic characteristics of the patients.

Characteristics	N (%)
Age (years)	
<20	2 (0.1)
21-30	26 (24.2)
31-40	35 (32.7)
41-50	21 (19.6)
51-60	9 (8.4)
>60	14 (13)
Menopausal staus	
Yes	23
No	84
Ca 125 level	
<35	46
>35	61

Final histopathology findings showed that 69 (64.4%) of the ovarian tumors were benign, 9 (8.4%) were borderline, and 27 (25.2%) were malignant. The most common benign tumor was endometrioma, with 25 cases (36.25%), followed closely by serous cystadenoma with 24 cases (34.7%). Among the borderline tumors, there were 6 cases of borderline serous tumors and 5 cases of borderline mucinous tumors.

Among the 27 malignant ovarian tumors, the majority were serous carcinoma, accounting for 14 cases (51.8%), followed by 6 cases (22.2%) of immature teratoma, 4 cases (14.8%) of granulosa cell tumor, 2 cases (7.4%) of mucinous carcinoma, and 1 case (3.7%) of clear cell carcinoma (Table 3).

Table 3: Histopathological distribution of the ovarian tumor.

Histopathological type of tumor	N (%)
Benign	
Endometrioma	25
Serous cystadenoma	24
Mucinous cystadenoma	10
Corpus leutal cyst	6
Paratubal cyst	2
Serous cystadenofibroma	2
Total	69 (64.4)
Borderline	
Serous borderline tumor	6
Mucinous borderline tumor	5
Total	9 (8.4)
Malignant	
Serous carcinoma	14
Immature teratoma	6
Granulosa cell tumor	4
Mucinous carcinoma	2
Clear cell carcinoma	1
Total	27 (25.2)

Table 4: Mean score of the morphological index.

	Benign (mean±SD)	Malignant (mean±SD)	P value
DePriest	4±2.36	7.6±2.2	0.000
Sassones	6.5±2.7	9.6±2.8	0.000
Ueland	5±1.9	7.8±1.3	0.000
RMI	383±164	1164±3171	0.01

Mean DePriest morphological index score for prediction of malignant ovarian tumor was 7.6±2.2, Sassones score was 9.6±2.8 and Ueland score was 7.8±1.3, all being statistically significant with the p value of 0.01 (Table 4).

CA 125 alone had a sensitivity of 77.7%, specificity of 48.7%, positive predictive value (PPV) of 33.8%, negative predictive value (NPV) of 86.6%, and an accuracy of 56%.

Compared to others, all three sonographic morphology indices- DePriest, Ueland, and Sassone-performed better. DePriest had a sensitivity of 81%, a specificity of 82.2%, a PPV of 91.7%, an NPV of 60%, and an accuracy of 81.4%. Ueland showed a sensitivity of 85.1%, a specificity of 78.75%, a PPV of 94%, an NPV of 57%, and an accuracy of 80.3%. Sassone had a sensitivity of 73%, a specificity of 86.25%, a PPV of 90%, an NPV of 47%, and an accuracy of 83.01%.

The risk of malignancy index (RMI), a multimodal method combining CA125, ultrasound findings, and menopausal status, was also evaluated for its predictive value in ovarian cancer. It showed a sensitivity of 51.8%, specificity of 73.7%, PPV of 40%, NPV of 82.9%, and an accuracy of 74% (Table 5).

Table 5: Sensitivity, specificity, PPV, NPV and accuracy for prediction of ovarian malignancy.

	Sensitivity	Specificity	PPV	NPV	Accuracy
Ca125	77.7	48.7	33.8	86.6	56
DePrist	81	82.2	60	91.7	81.48
Ueland	85.1	78.75	57	94	80.3
Sassone	73	86.25	47	90	83.01
RMI	51.8	73.7	40	82.94	74

DISCUSSION

Ovarian malignancies present the greatest clinical challenge among all gynecological cancers because of the wide variety of tumors with poorly defined origins, the lack of known premalignant lesions, and variability in disease progression. About 70% of patients with ovarian tumors are diagnosed at advanced stages, mainly due to the absence of effective screening methods and specific clinical symptoms in early stages, when the prognosis is often poor.

For personalized tumor management, a thorough assessment of tumor spread using modern imaging techniques is crucial. Ultrasound remains the primary and most important imaging tool for detecting ovarian cancer. While increasing evidence indicates that ultrasound is a dependable method for staging and monitoring ovarian cancer, it requires an experienced examiner skilled in evaluating both the pelvis and abdomen. Several researchers have suggested various scoring systems to assess and compare the morphological features of tumors.

In this study, we assessed the effectiveness of various sonographic morphology indices in predicting ovarian malignancy in 168 patients. Of these, 61 patients diagnosed with dermoid cysts were excluded, leaving a final group of 107 patients. Our findings showed that 52.3% of the tumors were benign, 8.55% were borderline, and 20.8% were malignant.

Most patients undergoing elective surgery for ovarian tumors were aged 31-40 years, representing 35 cases (32.7%). This was followed by the 21-30 years (24.2%) and 41-50 years (19.65%) age groups. These findings are similar to those of Jha et al, who reported the highest incidence in the 31-40 age group with 43 cases (26.7%) in their 2008 study.[11]

Histopathological findings in our study showed that 69 (64.4%) of the ovarian tumors were benign, 9 (8.4%) were borderline, and 27 (25.2%) were malignant. Similarly, a study by Pilli et al found that 212 (75.2%) of ovarian tumors were benign, 8 (2.8%) were borderline, and 62 (21.9%) were malignant.[12] Jha et al reported similar results, with 135 (83.9%) of ovarian tumors being benign and 26 (16.1%) malignant.[11]

In the present study, the mean DePriest morphological index score for predicting malignant ovarian tumors was 7.6±2.2, while for benign tumors, it was 4±2.36, showing statistically significant results with a p value of 0.01. These findings agree with the study by Sokkary, where the mean DePriest morphological index score was 8.27±1.77 for malignant tumors and 4.38±1.61 for benign tumors.[13]

The sensitivity of the DePriest, Ueland, and Sassone indices in our study was 81%, 85.1%, and 73%, respectively, which aligns with the study by Klangsin et al, where DePriest and Sassone indices had sensitivities of 89.1% and 75%, respectively.[8] Interestingly, our study found the Ueland morphological scoring system to be the most sensitive for predicting ovarian cancer, contrasting with Klangsin et al's findings, which identified the DePriest system as the most sensitive.[9]

The specificity of the DePriest, Ueland, and Sassone indices in our study was 82.2%, 78.75%, and 86.25%, respectively, which matches the findings of Klangsin et al, where the specificity of DePriest and Sassone indices was 73.2% and 79.3%, respectively.[8]

Additionally, the risk of malignancy index (RMI), a multivariate method that combines CA 125, ultrasound findings, and menopausal status, was assessed for its predictive ability. In our study, the RMI showed a sensitivity of 51.8%, specificity of 73.7%, PPV of 40%, NPV of 82.9%, and an overall accuracy of 74%. However, a study by Dora et al reported that using a cut-off value of 236, the RMI achieved significantly higher results, with a sensitivity of 72.5%, specificity of 98.2%, PPV of 98.1%, NPV of 74.7%, and a diagnostic accuracy of 84.13% in differentiating malignant from benign pelvic masses.[14]

The findings of our study have important clinical implications. Accurate prediction of ovarian malignancy can enable timely intervention and better management of ovarian cancer. The high specificity of the Sassone index helps determine if surgical evaluation is needed, which can reduce unnecessary surgeries. Likewise, the higher sensitivity of the Ueland index can improve early detection of ovarian malignancies, leading to more effective treatment and better patient outcomes.

Although our study provides valuable insights, several limitations should be acknowledged. As a single-center study, there is a potential for bias, and differences in

operator experience might have also affected the results. A multicenter study with a larger sample size and a more diverse population would yield more robust and generalizable findings.

CONCLUSION

This study indicated that ultrasound-based morphological indices are valuable tools for preoperative triage of adnexal masses. While the Ueland index showed the highest sensitivity in detecting ovarian malignancy, the DePriest, Sassone, and Ueland indices had similar overall diagnostic accuracy and outperformed the risk of malignancy index (RMI). The lower accuracy of RMI highlights its limited usefulness when used alone. Overall, standardized sonographic morphological assessment offers dependable guidance for surgical decision-making and referrals, especially in settings where accurate preoperative risk assessment is crucial.

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