Original Research

Integration of a Comprehensive Ultrasound Assessment in the Prognostic Modeling of benign and Malignant Ovarian Tumors

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Abstract

Ovarian tumors can be challenging to diagnose and treat, especially in areas with limited access to advanced medical care. During routine prenatal ultrasounds, abnormal growths in the ovaries can be unexpectedly discovered. In clinical practice, it is essential to accurately differentiate between benign and malignant ovarian tumors in order to develop appropriate treatment plans. Ultrasound imaging has become the preferred diagnostic tool. The aim of this article is to examine the ultrasound characteristics of ovarian and adnexal growths and to explore how these characteristics, along with other clinical factors, can aid in predicting the likelihood of ovarian cancer.

Key words: Ovarian tumours, Ca-125, sonography, scoring system, benign, malignant

Introduction

Ovarian tumours pose a significant health burden worldwide, representing a variety of benign and malignant neoplasms with varying clinical presentation and prognosis in areas such as Uzbekistan where improved medical resources may has been limited, ovarian tumour diagnosis and management present unique challenges. Despite advances in diagnostic techniques, including biomarker testing, accurate differentiation between benign and malignant cervical tumours remains paramount for effective treatment planning and prognostic prediction, The incidence of Ovarian cancer in Uzbekistan is noteworthy, with a reported rate of 4.9 per 100,000 women [(1)]. Alarmingly, nearly 20% of cervical cancer cases occur before the age of 40, and early detection strategies are needed [(2)]. Although 5-year survival rates range from 50% to 90% for early disease (stage 1 and 2), late disease (stage 3 and 4) and a significantly lower survival rate of 21% advanced disease is associated with poor outcomes[(3)]. In this context, it is urgent to improve the detection of ovarian tumors, particularly in resource-poor settings. A comprehensive ultrasound assessment, in combination with clinical and laboratory factors, has the potential to be a cost-effective way of improving disease diagnosis accuracy and guiding clinical decisions using advanced imaging techniques, integrating biomarker data. This will give clinicians a deeper understanding of ovarian tumor characteristics, ensuring optimized treatment strategies and optimal outcomes for

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patients. In addition, our research aims to investigate the usefulness of ultrasound imaging and laboratory features in differentiating between ovarian tumors. We study the specific ultrasound features associated with benign and malignant ovarian neoplasms to evaluate the diagnostic accuracy of screening algorithms that incorporate ultrasound results, as well as the role of biomarkers such as CA-125 in diagnosing malignant tumors using a multidimensional approach that integrates imaging, biomarker analysis, and in-house clinical evaluation. CA-125 (cancer antigen 125) is a high-molecular-weight glycoprotein that serves as a biomarker for ovarian cancer. Elevated levels of CA-125 are found in approximately 80% of women with epithelial ovarian cancer, making it a critical tool in the diagnostic arsenal for this malignancy [4]. Despite its utility, CA-125 is not exclusively elevated in ovarian cancer and can be seen in other conditions such as endometriosis, pelvic inflammatory disease, and even normal menstruation, which complicates its specificity [5].For improved diagnostic accuracy, CA-125 is often used in combination with other diagnostic modalities, such as ultrasound imaging. When used alongside transvaginal ultrasound, CA-125 can help stratify patients into different risk categories, thus guiding further diagnostic and therapeutic procedures [6]. Studies have demonstrated that integrating CA-125 levels with ultrasound findings significantly increases the sensitivity and specificity of ovarian cancer diagnosis [4]. In resource-limited settings like Uzbekistan, the utilization of CA-125 in combination with ultrasound could offer a cost-effective means to enhance early detection of ovarian cancer. This strategy is vital given the high incidence of late-stage presentation and the associated poor prognosis. By adopting a comprehensive approach that includes CA-125 testing, healthcare providers can better differentiate between benign and malignant ovarian tumors, optimize treatment plans, and improve patient outcomes [5]. Future advancements may include the development of more specific biomarkers and the incorporation of novel imaging techniques, further refining the diagnostic process [4]. In conclusion, while CA-125 alone cannot definitively diagnose ovarian cancer, its integration with ultrasound and other clinical evaluations forms a robust framework for early detection and management. This approach is essential, especially in areas with limited medical resources, to improve diagnostic accuracy, treatment efficacy, and patient survival rates [6]. We aim to contribute to improving cervical cancer screening techniques, ultimately in Uzbekistan and other countries, to improve patient care and outcomes.

Materials and Methods

This study is based on a comprehensive examination of 90 women with prior consent of patients who had histologically confirmed ovarian neoplasms. Of these women, 39 had benign tumors and 51 had malignant ones. Clinical, laboratory and instrumental examinations included ultrasound examination of the ovaries using the Toshiba Aplio 500 PRO ultrasound machine, histological and immunological analyses conducted at the Republican Specialized Oncological Scientific Centre of Uzbekistan.

The results obtained and the discussion. Histological examination revealed: 30 (58.8%) adenocarcinomas among patients with malignant neoplasms,

15 (29.4%) papillary cystadenocarcinomas, 2 (3.9%) dysgerminomas , 2 (3.9%)

granulocellular tumors and 2 (3.9%) metastases. Among benign

neoplasms : 2 (5.1%) papillary cystadenomas, 16 (41.0%) serous cystadenomas,

1 (2.56%) mucinous cystadenoma, 4 (10.25%) corpus luteum cysts, 3 (7.6%) dermoidcysts, 12 (30.7%) endometrioid cysts, and, in 1 case (2.56%) tecoma.

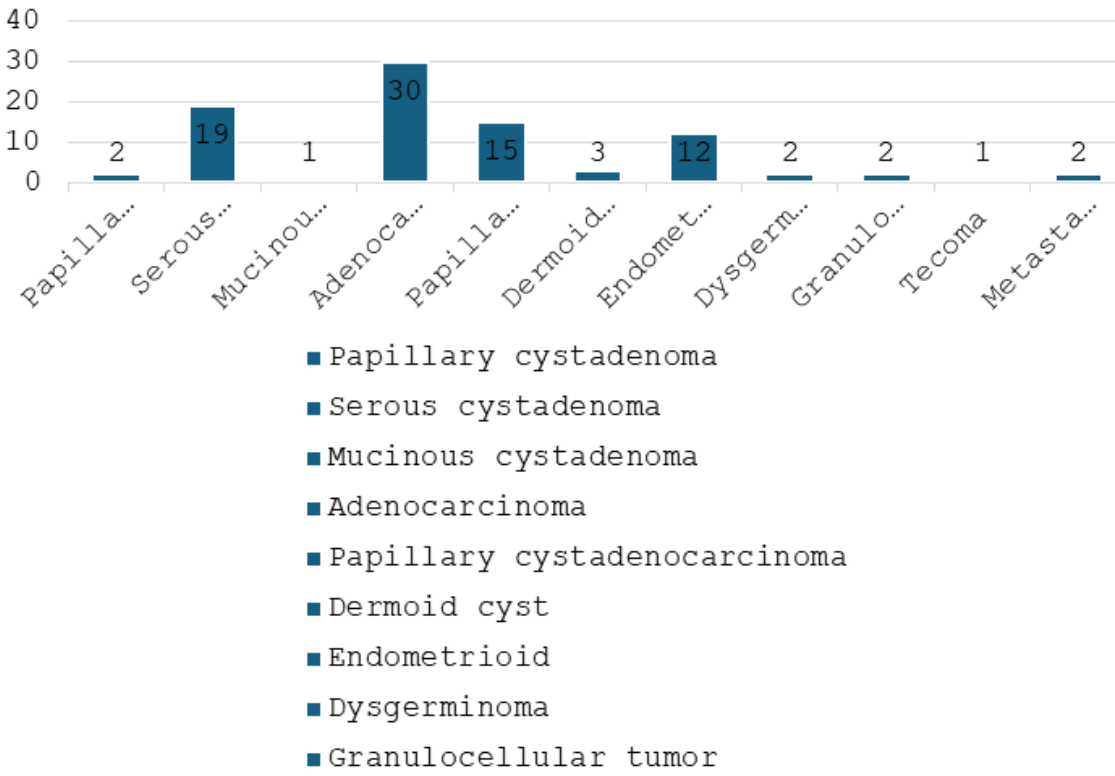

Figure 1. Distribution of tumours ovaries by Histotype (n=90)

The analysis of ultrasound and laboratory parameters was carried out in the study group, the average age of which was 31.7 ±7.3 in women with benign neoplasms and 54.4 ±14.1 with malignant neoplasms. When assessing the tumor process in the ovaries, the following criteria were evaluated: the type of structure, the size of the formations, the presence of partitions in the structure of the formation, the assessment of the capsule structure tumors, namely the presence of papillary growths, the presence of blood flow in the formation. The indicators of blood flow velocity, pulsation index and blood flow resistance index in the tumor are considered separately.

The size of the uterine appendages in the patients varied in a relatively significant range, the volume of ovarian tumors in the group of patients with a benign nature of the formation was 47.1±14.4 mm and in the group of patients with malignant tumors 386.6±87.8 mm.

The presence of ascites in the pelvis was assessed for each type of tumor according to morphological classification. For benign tumors, a small amount of free fluid in the pelvis was observed in 3 patients (7.6%), in patients with malignant neoplasms – in 25 (49.0%);

The analysis of the types of echostructure of pelvic formations made it possible to identify echographic types of ovarian tumors associated to a lesser or greater extent with malignancy. Significant differential dopplerometric indicators of benign and malignant formations: the index of resistance in benign tumors was 0.80, in ovarian cancer – 0.36 ($p < 0.05$), whereas the data of the pulsation index were not diagnostically significant, the indicators of the pulsation index for

benign tumors amounted to 1.01, and for ovarian cancer -0.79 ($p > 0.05$). During the study, the following characteristic ultrasound patterns were identified for benign ovarian tumors: (A) Single-chamber cysts with or without a solid component, (B) smoothness of multichamber cysts with a septum thickness of <3 mm, (A) low vascularization, (C) echogenicity of "frosted glass" formation, (D) the presence of an acoustic shadow. [Image 1]

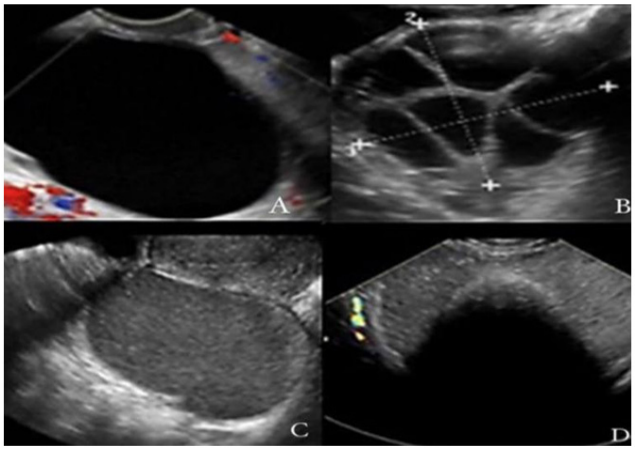

Image 1. Showing Sonographic patterns of benign formations.

The following ultrasound indicators were specific for malignant tumors: (A) heterogeneity of solid formation, (C) presence of papillary growths >3 mm thick, multicameral cysts with a solid component with a septum thickness >3 mm, (C) presence of ascites, (D)high vascularization, where the index resistance levels below 0.3-0.4 [Image 2]. The presented data demonstrated a significant difference in the image parameters of benign and malignant ovarian tumors. However, despite the clarity of the ultrasound signs, practically.

It remains important to find a single integral ultrasonographic criterion for discriminating between benign and malignant ovarian tumors. For this purpose, one of the previously proposed scoring systems for echographic images was used to determine the threshold value of discrimination between benign and malignant ovarian tumors (Sassone et al. 1991).

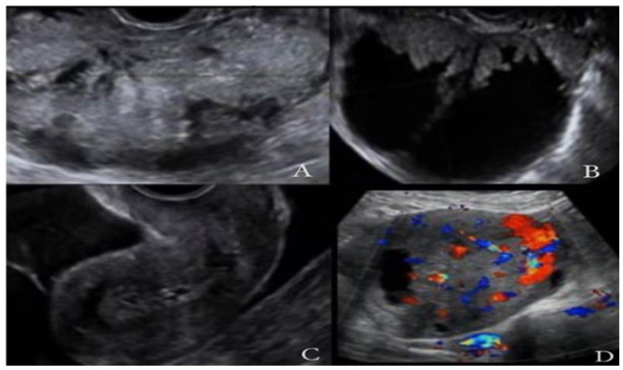

Image 2. Showing Sonographic patterns of Malignant formations.

The Sassone point system, which is not widespread, is simple and based on scoring of only four indicators on grayscale images ovaries: structure of the inner wall, wall thickness, septal thickness and echogenicity. At the same time, the authors established the high sensitivity and specificity of the method in differentiating benign and malignant tumors - 100% and 83%, respectively. The Sassone scoring system is simple and is based on the scoring of only four indicators on grayscale images of the ovaries: internal wall structure, wall thickness, septal thickness and echogenicity. [Table 1]

Table 1. Represent Scoring system of Echo signs

Structure of the inner wall	Wall thickness	Septum's	Echogenicity	Score
Smooth-walled	Less than ≤ 3 mm	Absent	Anechoic	1
Unevenness<3mm	More than >3 mm	Thinner≤ 3mm	Hypoechoic	2
Papillarity > 3mm	Not applicable	Thicker >3 mm	Hypoechoic with hyperechoic inclusion	3
Not applicable			Heteroechoic	4
			Hyperechoic	5

Semi-quantitative analysis of greyscale ultrasound data using the Sassone scale has shown a high prognostic potential for differentiating between benign and malignant ovarian tumors. The area under the receiver operating characteristic (ROC) curve for the total score of ultrasound signs was 0.905. This indicates that the combination of ultrasound signs has a sensitivity of 92% for differentiating malignant tumors from benign ones and a specificity of 84%. The Sassone scale was not effective for predicting the histological grade of ovarian cancer, but a logistic regression analysis demonstrated the potential for predicting the degree of tumor differentiation based on a combination of ultrasound signs. The AUROC for this analysis was 0.928.

Conclusion

Based on the above information, it can be concluded that the echographic scoring system for ovarian neoplasms provides a simple and highly informative method for differentiating between malignant and benign formations. Further experience accumulation seems promising for improving the accuracy of the logistic model used for discriminating between highly differentiated ovarian cancers and moderate to low-grade forms, based on ultrasound sign.

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