

Assessment of ovarian tumors using transvaginal color Doppler ultrasonography

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Summary

In our study we used transvaginal color Doppler ultrasonography in a token of 127 women presenting with unilateral ovarian tumor. The characteristics of the tumors were analyzed, the presence of vascularization was checked and the resistance index (RI) was calculated. Consequently, based on a concrete scoring system, we attempted to discriminate these tumors as benign or malignant. It was proven that 24 of 127 ovarian tumors were malignant. Transvaginal color Doppler correctly identified 21 of the 24 malignant tumors, as well as 94 of the 103 benign tumors. In nine other cases we had false-positive results. The sensitivity and the specificity of the method was 87.5% and 91.2%, while the positive and negative predictive values were 70% and 96.9%, respectively.

Key words: Ovarian tumors; Ultrasound; Color Doppler.

Introduction

Ultrasound has been proven to be a sensitive method for distinguishing morphologic characteristics of pelvic organs and in particular ovaries [1, 2]. Color Doppler is a modern ultrasound diagnostic procedure, which is based on hemodynamics inside the organs. This diagnostic modality has gained a lot of importance because it gives information about morphology and blood flow, making the differentiation possible of vessels of high impedance usually found in benign tumors from those of low impedance and high velocity which are typically seen in malignancies.

Enlargement of the ovary detected by pelvic bimanual examination usually results in referral of the patient for sonographic evaluation. Transvaginal ultrasound is capable of differentiating cystic from solid masses and categorizing cystic masses by visualization of internal morphological characteristics. Further improvement has been made with the introduction of color and pulsed Doppler. Arrangement of pre-existing blood vessels inside and around the tumor, branching type of the tumoral microcirculation, and analysis of Doppler patterns are the parameters for differentiation of benign from malignant neoplasms. Sonographic diagnosis of an ovarian mass with transvaginal color Doppler ultrasonography has remained a challenge. Although many studies have shown a high accuracy in the evaluation of ovarian lesions [3, 4], there are others that have reported poor results [5, 6].

The aim of this study was to evaluate the accuracy of transvaginal ultrasonography in combination with color Doppler in the detection of ovarian cancer and the differential diagnosis of ovarian tumors.

Materials and Methods

The present study included 127 women with ovarian tumors, based either on the clinical examination or a previous ultrasound scan, who were referred to the Fetal Medicine and Gynecological Ultrasound Unit of our hospital over the last two years. Ultrasonographic examination with color Doppler ultrasound was performed with an Ultramark-9 HDI (Advanced Technology Laboratories, Bothell, WA, USA) ultrasound machine using a 6.5-MHz transvaginal transducer. All women had unilateral ovarian masses. Ninety-three were premenopausal or perimenopausal and the remaining 34 were postmenopausal. In order to decrease the false positive results, the premenopausal women that were found to be in the secretory phase of their menstrual cycle were excluded from the study. Moreover, women who presented simple ovarian cysts smaller or equal to 30 mm were also excluded. All patients underwent surgery within a few days following the scan. The examination was performed by an experienced operator and the results were available to the clinicians.

The ultrasound criteria used for the differential diagnosis of the ovarian tumors were: the parietal structure, ultrasound shadowing, presence of a diaphragmatics, echogenicity, presence of compact elements or free peritoneal fluid. A minimum of three waveforms were obtained from feeding vessels of the tumor. The resistance index (RI) was used ($RI = \frac{\text{systolic peak} - \text{diastolic peak}}{\text{systolic peak}}$) with the lowest measurement taken as representative of the most suspicious pathologic characteristic. These criteria are presented in Table 1. A total score greater than or equal to 5 was associated with a high risk for ovarian malignancy.

Following surgery a comparison of the ultrasonographic and histopathological findings was made. Malignant ovarian tumors were classified according to the International Federation of Obstetrics and Gynecology (FIGO).

Results

Histologic examination showed that 24 of 127 ovarian tumors were malignant. The pathological findings are presented in Table 2. The patients' age ranged from 17 to

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Table 1. — Sonographic and color Doppler criteria for diagnosis of ovarian malignancy.

	Criteria	Score
Wall structure	• smooth/irregularities \leq 3mm	0
	• papillarities $>$ 3 mm	2
Shadowing	• present	0
	• absent	1
Septa	• absent / thin \leq 3 mm	0
	• thick $>$ 3 mm	1
Solid parts	• absent	0
	• present	2
Echogenicity	• monolucent/low-level echo	0
	• mixed or high	2
Peritoneal fluid	• absent	0
	• present	1
Tumoral blood flow	• RI $>$ 0.42	0
	• RI \leq 0.42	2

The cut-off score \geq 5 is associated with a high risk of ovarian malignancy.

Table 2. — Histopathological diagnosis of ovarian tumors.

Benign ovarian tumors (n = 103)	Number
Simple ovarian cyst	34
Endometrioma	29
Serous cystadenoma	17
Dermoid cyst	11
Fibroma-thecoma	4
Corpus luteum cyst	3
Paraovarian cyst	3
Tuboovarian complex	2
Malignant ovarian tumors	Number
Serous cystadenocarcinoma	15
Mucinous cystadenocarcinoma	7
Squamous cell carcinoma	1
Dysgerminoma	1

73 years with a mean age of 46.6 years. The mean age of the women with benign tumors was 42.4 years and of those with malignant tumors 53.7 years. Transvaginal color Doppler ultrasound correctly identified 21 of the 24 malignant tumors, as well as 94 of the 103 benign tumors. On the contrary it presented nine cases of false-positive results. Sensitivity and specificity of the color Doppler transvaginal ultrasound were 87.5% and 91.2%, respectively. Positive and negative predictive values of the method were 70% and 96.9%, respectively. The mean and SD of the RI values in the malignant tumor group (0.31 ± 0.4) was statistically lower than that of the benign tumor group (0.57 ± 0.9), ($p < 0.05$).

Discussion

Our results indicate that transvaginal ultrasonography in conjunction with color Doppler can be used for the assessment and differentiation of ovarian tumors with a reasonably high degree of reliability. The addition of color Doppler to the sonographic appearance of a mass provides more information regarding the possibility of malignancy. However, it is extremely important to detect

a few blood vessels (not only one), because the majority of tumors have different areas of vascularization. The analysis of the waveform with the lowest RI value is of clinical significance.

Characterization of the ovaries through transvaginal ultrasound appears to be feasible [7, 8]. In an attempt to characterize ovarian masses different scoring systems have been used, based mainly on the morphological characteristics of the mass (size and thickness of the septae, amount of echogenicity, solid material within the mass, consistency and definition of the borders of the mass, and existence of free peritoneal fluid) [2, 9]. The introduction of the color and pulsed Doppler device has improved the potency of assessment of ovarian tumors and provided a more complete distinction of ovarian tumors into benign and malignant ones [10]. This is feasible due to the recognition of the rapidly developing capillary blood vessels. Moreover, measurement of the RI constitutes a reliable criterion in the diagnosis of the ovarian tumors. General characteristics of a benign ovarian tumors are the absence of newly formed blood vessels, existence of a regular vessel ramification of arteries and the arterioles, as well as a resistance index higher than 0.42 [11, 12].

Transvaginal color Doppler ultrasonography is capable of providing further information about ovarian tumors with compact elements and simple morphological characteristics [4, 13]. New technological achievements are required in order to have the sensitivity and the specificity required for the differential diagnosis of ovarian tumors [14, 15]. Conclusively, the combined use of transvaginal ultrasound and color Doppler offers improved differentiation of benign from malignant ovarian tumors. However, the three malignancies that were lost with this method in our study suggest that there is still room for improvement in the sonographic assessment of these lesions.

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There will be 5 "themes" for sessions at the meeting:

1. State of the art sessions - plenary and parallel. To define current practice in each key area by disease site. Invited expert lectures of 20 minutes.
2. Frontiers in gynaecological cancer sessions - parallel. Talks on key areas of progress in gynaecological cancer. Invited expert lectures.
3. Meet the expert sessions - parallel, early each morning. Four different topics with 2 or 3 invited speakers at each session.
4. Interactive sessions of case presentations/discussions and debates/small group discussions on a range of topics. Small groups, parallel sessions in 6 rooms with 2-4 case presentations on different topics. Invited experts will choose the cases.
5. Free communication sessions for presentation of submitted abstracts - 4 sessions. Two plenary sessions for the best abstract submitted. The other two will be parallel to the number of rooms, depending on the number of abstract received. In addition, there will be 2 parallel poster sessions.

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