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Prospective Evaluation of Ovarian Masses with Gray-scale, Colour Doppler and Spectral Doppler Ultrasound – it's Correlation with Pathological Findings

K. R. Bhat, Naveen Chandra Shetty, Vatsala Kamath, Nivedita Adapa

Dept. of Obstetrics & Gynaecology, Justice K. S. Hegde Charitable Hospital, Mangalore and Dept. of Radiology, Kasturba Medical College Mangalore.

Summary

Morphological appearance of ovarian tumors on ultrasound, and their characteristics on colour doppler have helped immensely to detect malignancy.

In the present study comprising 50 patients with ovarian masses, the ultrasonographic morphologic scores were comparatively higher for malignant masses than for benign tumors. Colour doppler showed colour flow signals in malignant tumors, while some of the benign masses also showed this characteristic. Spectral doppler showed low resistance to blood flow with low pulsatility and resistance indices in malignant masses. In the current study, greater accuracy in differentiating malignant from benign tumors was achieved when cut-off scores of 10, 0.5 and 0.8 were set for morphologic score, resistance index and pulsatility index respectively.

Introduction

Ovarian carcinoma is one of the leading causes of death from gynaecological malignancies. Pre-operative evaluation for differentiating ovarian cancer from benign tumours is of prime importance in instituting suitable treatment. Clinical evaluation, tumor markers like CA-125 and FNAC have been used for this purpose. Morphologic assessment of ovarian masses by ultrasound and colour doppler study are exciting new tools in detection of malignancy.

Based on the ultrasonographic assessment of morphology of ovarian tumours Sassone et al in 1991, proposed a scoring system which took into consideration factors like inner wall structure, wall thickness, septae and echogenicity.

The detection of ovarian malignancy by means of colour doppler evaluation of velocity and vessel compliance is based on the hypothesis by Folkman et al (1989) that neoangiogenesis is essential for tumour growth. The newly formed vessels have low impedence and hence low pulsatility index (Gosling & King, 1976) and low resistance index (Pourcelot, 1974).

$$\text{Pulsatility Index} = \frac{\text{Peak Systolic} - \text{Minimum Diastolic}}{\text{Mean}}$$

$$\text{Resistance Index} = \frac{\text{Peak Systolic} - \text{Minimum Diastolic}}{\text{Peak Systolic}}$$

Aims of present study were :

1. To evaluate the relative usefulness of gray scale sonography, colour doppler and spectral doppler in differentiating benign from malignant ovarian tumours, and correlation with histopathological findings.
2. To determine the optimal cut-off points for gray-scale scoring and doppler values.

Materials and Methods

The study was conducted from 1977 to 1998 at

the Dr. TMA Pai Rotary Hospital, and Lady Goshchen Hospital, Mangalore. Fifty patients with ovarian masses detected either clinically or by routine ultrasound were included in the study.

Sonography was performed with Toshiba –SSH – 140 A having a colour doppler system. First a gray scale evaluation was done and a morphologic score was assigned as per the scoring system devised by Sassone et al. (1991). Then the colour doppler was used to survey the entire mass for areas of vascularisation. A range gate was placed at the region of tumour neovascularisation and spectral wave forms were obtained and the pulsatility index and resistance index were calculated. The post-laparotomy histopathologic findings were correlated with pre-operative ultrasound and colour doppler evaluation. The student 't' test and the Fischer exact test were used for statistical analysis.

Results and Analysis

As shown in Table I, of the 50 ovarian masses in the present study, on histopathological examination, 38 masses proved to be benign and 12 malignant. Eight out of the 12 malignant ovarian tumours belonged to the menopausal group which indicates a higher incidence of malignancy in this group.

Table I: Histopathological Distribution of Ovarian Masses

	Benign		Malignant	
	No.	%	No.	%
1. Nature of mass	38	(76%)	12	(24%)
2. Menstrual status of patient:				
Premenopausal	26	(52%)	4	(8%)
Menopausal	12	(24%)	8	(16%)

Table II: Morphologic Scores of the Masses

	Histopathology	
Scores	Benign	Malignant
5	5	
6	16	
7	11	
8	2	
9	2	
10	1	
11	1	
12	4	
13	1	3
14	1	2
15		
16		
17	1	
Total	38	12
Mean Range	6.816 ± 1.772	12.75 ± 1.74
Range	5-14	10-17

Table II shows that the morphological scores of the malignant masses ranged from 10 to 17 with a mean of 12.75±1.764.; the benign masses had scores ranging from 5 to 14 with a mean of 6.816±1.772 (statistically significant $P<0.001$).

Table III depicts that on colour doppler sonography, all the malignant tumours showed neovascularisation, while some (47.37%) of the benign tumours also had colour signals. This was statistically significant by Fischer exact test.

Table III : Distribution on Basis of Colour Flow

Histopathology	Neovascularisation	
	Absence	Presence
Benign (n=38)	20 (52.63%)	18 (47.37%)
Malignant (n=12)	0	12(100%)

The range of values of the pulsatility index (Table IV) for the benign masses was 0.8 to 1.8 with a mean of 1.339± 0.245. The pulsatility index for the malignant masses was below 0.9 with a mean of 0.575±0.209. This was statistically significant ($P<0.001$).

Table IV
Pulsatility Indices of the Ovarian Masses

Pulsatility	Histopathology	
Index	Benign	Malignant
0.4		1
0.5		
0.6		3
0.7		4
0.8	1	2
0.9	1	2
1.0		
1.1		
1.2	5	
1.3	1	
1.4	4	
1.5	3	
1.6	2	
1.7		
1.8	1	
Total	18	12
Mean	1.339±0.245	0.575±0.209
Range	0.8-1.8	0-0.8

As shown in Table V, the resistance index for the benign masses ranged from 0.4 to 0.9 with a mean 0.644±.0.115. The resistance index of the malignant masses were all below 0.6 with a mean of 0.275 ± 0.148. This difference was statistically significant ($P<0.001$).

Table V
Resistance Indices of the Ovarian Masses

Resistance Index	Histopathology	
	Benign	Malignant
0	1	
0.1	1	
0.2	3	
0.3	1	4
0.4	1	1
0.5	1	2
0.6	9	
0.7	4	
0.8	2	
0.9	1	
Total	18	12
Mean	0.644±0.115	0.275±0.148
Range	0.4 – 0.9	0-0.5

The performance characteristics for morphologic scores, pulsatility index and resistance index is shown in Table VI. Taking 10 rather than 9 as cut-off for morphologic score improved the specificity and positive predictive value. Pulsatility index cut-off of 0.8 had greater ability to identify malignancy having greater specificity and positive predictive value than a value of 0.9. Sensitivity and negative predictive value improved when the resistance index cut-off value was 0.5 rather than 0.4.

Discussion

Ovarian cancer is a 'hidden' malignancy, and hence accurate diagnosis is essential for early detection and appropriate treatment. Ultrasonography and colour doppler study with spectral doppler analysis have helped immensely in identifying ovarian cancer.

The present study confirmed that there was higher incidence of ovarian malignancy in postmenopausal patients. Higher morphologic scores were obtained on ultrasonography in ovarian cancer than in benign tumours. On colour doppler all the malignant masses showed presence of flow, while some of the benign masses also revealed neovascularisation. The general trend of lower pulsatility and resistance indices in malignant ovarian masses was confirmed in the current study.

Cut-off values of 9 for morphologic scores, 1 for pulsatility index, 0.4 for resistance index showed good accuracy in identifying malignancy in studies by Sassone (1991), Fleicher (1991) and Kurjak (1972) respectively. In the present study, greater accuracy in differentiating malignant from benign tumours was achieved when cut-off scores of 10, 0.5 and 0.8 were set for morphologic score, resistance index and pulsatility index respectively.

Thus, gray scale sonography and colour Doppler with spectral analysis are valuable tools in identifying ovarian malignancy.

References

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Table VI
Performance Characteristics of Morphologic Index, Pulsatility Index and Resistance Index.

		Sensitivity	Specificity	PPV	NPV
Morphologic Score	9	100%	89.47%	75%	100%
	10	100%	94.73%	85.71%	100%
Pulsatility Index	0.8	100%	94.44%	92.30%	100%
	0.9	100%	88.88%	85.71%	100%
Resistance Index	0.4	83.33%	94.44%	90.9%	87.47%
	0.5	100%	88.88%	85.71%	100%

PPV – Positive Predictive Value
NPV – Negative Predictive Value