Academic Journal of Cancer Research 7 (1): 08-18, 2014
ISSN 1995-8943

DOI: 10.5829/idosi.ajcr.2014.7.1.1107

Two Dimensional Ultrasound and Doppler in Assessment of Adnexal Masses in Correlation to Histopathological Analysis

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Abstract: Adnexal masses are considered a group of the most common diseases in gynecology. Ovarian tumors, alone, represent two thirds of these cases. Even though histopathological examination of the adnexal lesion is the gold standard for the final diagnosis or exclusion of malignancy, clinical evaluation, 2D, Doppler studies in addition to tumor markers are reasonably accurate, helpful and non-invasive tools for assessment of adnexal lesions particularly distinguishing benign from malignant ovarian tumors. 2D ultrasound & Doppler are the main diagnostic tools in provisional diagnosis of these adnexal masses. This study included thirty patients with complex adnexal masses, the role of these tools was evaluated in the assessment of their lesions. It was found that, clinical picture alone has the lowest sensitivity to predict malignancy while applying these tools can improve the assessment of adnexal masses and provisionally differentiate between benign and malignant ovarian tumors.

Key words: Adnexal masses · Doppler ultrasound in correlation with Histopathological analysis · Ovarian malignancy · Two dimensional ultrasound

INTRODUCTION

Adnexal masses are considered a group of the most common diseases in gynecology, ovarian tumors, alone, represent two thirds of these cases. Ovarian neoplasms present an increasing challenge to the physician, and ovarian cancer being the most lethal of all gynecological cancers, presents late and responds poorly to treatment [1]. Malignant ovarian tumors are the fourth most common cause of death in women [2]. Approximately 4-24% of adnexal masses in premenopausal women and 39-63% in postmenopausal women are malignant [3]. Because the patient usually complains of abdominal symptoms, she may not have a pelvic examination, and a tumor may be missed. Benign conditions of the reproductive tract, as pelvic inflammatory disease, endometriosis and pedunculated uterine leiomyoma, can simulate ovarian cancer. Non-gynecologic causes of an adnexal mass, such as inflammatory disease or neoplastic colonic mass or even a pelvic kidney can simulate ovarian cancer [4]. A preoperative suggestion of malignancy can guide the gynecologist to refer women with suspected pelvic masses to a trained gynecological oncologist for appropriate therapy and optimized debulking, which is known to improve survival [5]. Doppler US is useful in cases with an apparent solid area or septum, while transabdominal US is helpful for larger masses or those located superiorly or laterally in the pelvis, transvaginal US provides optimal visualization of most adnexal diseases.

In General, US Features that Indicate Malignancy Include:

- Solid component (particularly if there is visible flow in it at Doppler evaluation).
- Thick septa.
- Ascites.
- Doppler criteria that indicate malignancy as increased vascularity.

US demonstration of a solid component within a cystic mass is the most important predictor of malignancy, and conversely, malignancy is very unlikely in the

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absence of a solid component. Terminology to describe the solid component varies and also includes papillary projection, excrescence, vegetation, and nodule. It has been suggested that small solid areas that protrude 3 mm or more from the cyst wall be considered as papillary projections [6]. Wall irregularities due to a collapsing cyst can simulate small solid nodules that may be misconstrued for malignancy [7]. The completely solid adnexal mass is another potential problem. Most commonly, such a mass is due to a pedunculated uterine leiomyoma or an ovarian fibroma.

The majority of epithelial ovarian malignancies has a cystic component and is rarely completely solid [6]. There are sporadic exceptions, but the majority of completely (ie, 100%) solid, solitary adnexal masses are benign in our experience, and other authors have a similar opinion. Ovarian malignancies that are most likely to manifest as solid or nearly completely solid masses include metastases, lymphoma, neoplasms of the sex cord-stromal group and other rare malignancies such as malignant teratomas or dysgerminomas [8]. Septa in a cystic ovarian mass are evidence of a neoplasm [7] and are more likely to indicate malignancy if they are greater than 2–3 mm in thickness or have detectable flow on Doppler US scans. A cystic ovarian mass with septa but without a solid component is likely to be a benign neoplasm, though occasionally may be malignant when there are a very large number of septa. A cystic mass with multiple, smooth, thin septa and no nodularity is suggestive of a mucinous cystadenoma [9]. Ascites, an indirect indicator of malignancy, occurs with peritoneal tumor spread. Ascites may allow peritoneal implants to be seen. Although a small amount of fluid in the cul-de sac is normal in premenopausal women, an increased risk of malignancy has been reported if it measures more than 15 mm in anteroposterior dimension [6]. Meigs syndrome is the occurrence of ascites and pleural effusion in association with a benign ovarian tumor, most frequently an ovarian fibroma. It is uncommon, however, occurring in about 1% of fibromas. Tumor angiogenesis, which is essential for tumor growth, and was first described by Folkman *et al.* [10], constitutes the basis to evaluate ovarian tumors by different types of Doppler ultrasound. There is a general trend toward lower pulsatility index, lower resistive index, and higher velocity in malignant neoplasms as opposed to benign neoplasms. However, because of the substantial overlap of these spectral Doppler parameters in benign and malignant lesions, they have little to no role in the characterization of adnexal masses.

Aim of the Work: The aim of the work is to study the usefulness and value of Ultrasound and Doppler as a method to enhance differentiation between benign and malignant pathologies before surgical intervention in women having adnexal masses. The final histopathological diagnosis based on surgically removed or biopsy specimen will be taken as the gold standard for comparison of the yield and accuracy of Doppler ultrasound.

Patients and Methods: The present study was a prospective study, conducted at the Obstetric and Gynecology Department of Kasr El-Aini Hospital, Cairo University, Cairo, Egypt in the period between 2009 and 2011. The study included 30 patients who had a preliminary diagnosis of an adnexal mass, which was detected clinically and confirmed sonographically to be adnexal masses. The patients were included, regardless the patients' complaint, age or parity, and scheduled for surgical intervention.

The Patients Included in the Study Will Be Subjected to the Following after Obtaining Informed Consent:

Complete History Taking: Detailed personal, present, past, family, obstetric, menstrual and contraceptive history were taking. Risk factors for ovarian cancer include age older than 60 years; early menarche; late menopause; nulliparity; infertility; personal history of breast or colon cancer; and family history of breast, colon, or ovarian cancer. The medical history should include history of tubal ligation or other tubal surgery, PID, or use of an intrauterine device because these are risk factors for ectopic pregnancy.

General Examination: Vital signs, height and body build and other system examination. The cervical, supraclavicular, axillary, and inguinal lymph nodes should be palpated. Chest auscultation should be done to evaluate for pleural effusion.

Abdominal Examination: Inspection, palpation, Percussion and auscultation. A detailed abdominal examination to assess for ascites, masses, tenderness, hepatosplenomegaly, or increased girth.

Pelvic Examination: PV examination, Bimanual and Speculum examination to assess the size, tenderness, location, consistency, and mobility of the uterus and both adnexa. A rectovaginal examination may reveal tenderness or nodularity of the uterosacral ligaments.

Conventional Pelvic 2D Ultrasound Scanning: To determine: Size, site, side: unilateral (either right or left) or bilateral solid or cystic, uni or multilocaular, thickness of the wall of the neoplasm, inner wall irregularities, the presence of thick sepataions, solid component or ascites.

- It was done using aVolusonE-6 machine (GE Health Care USA) with multifrequency trans-abdominal and trans-vaginal volumetric probes, where Patients with pelvic masses larger than 10 cm had in addition a trans-abdominal ultrasound.
- The used probes were set at various frequencies:
  - Transvaginal route, with 4-9 MHz frequency (using an average 6.5 MHz intracavitary probe).
  - Transabdominal route, with 2-6 MHz frequency (using an average 3.5 MHz convex probe).

Pulsed Wave and Color Doppler Ultrasound Examination: Identical fixed pre-installed power Doppler ultrasound settings were used: frequency, 6–9 ('normal') MHz; pulse repetition frequency, 0.6 kHz; gain, -4.0; wall motion filter, 'low 1' (40 Hz).

To determine blood flow velocity and the resistance to flow by measurement of:

Resistance index (RI)
Pulsatility index (PI):

- ✓ Resistance index (RI) and Pulsatility index (PI) were taken for each mass, Doppler waves application were applied on the most evident and apparent vessels in the masses.
- ✓ Definitions of RI and PI are as follows:

$$\text{Resistance index (RI)} = \frac{\text{S-D}}{\text{S}}$$

$$\text{Pulsatility index (PI)} = \frac{\text{S-D}}{\text{Mean}}$$

The Mass was Predicted, Being Benign or Malignant According to the Following US Evaluation Criteria:

- Tumors without detectable flow were considered benign while tumors with detectable flow were subjected to further analysis to differentiate benign from malignant ones.
- RI & PI are low in most malignant masses, while vascular indices significantly were higher in the solid portion of malignant lesions compared with benign ones.

Histopathological Examination of the Specimen after Operation: All samples will be examined by pathologist Dr: Mohammed F. Darweesh. Histological confirmation of the finding will be done in all patients.

Statistical Analysis Data were statistically described in terms of mean ± standard deviation (± SD), median and range, or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Mann Whitney U test for independent samples. For comparing categorical data, Chi square ($\chi 2$) test was performed. Exact test was used instead when the expected frequency is less than 5. P values less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

RESULTS

The total number of patients studied was 30 patients. Number of masses studied in these patients was 32 masses (due to bilaterality of the masses in some cases), 27 of them were benign masses, while 5 of them were malignant ones (Table1). The different findings detected by various diagnostic methods were as follows:

Findings on Clinical and Histopathologic Basis: The following findings aroused the suspicion of malignancy particularly if several of them were found in the same patient:

- Old age "over 40 years". On the other hand, complex adnexal masses in young age tend to be malignant
- Rapid abdominal enlargement.
- Presence of pain.
- Irregular uterine bleeding especially postmenopausal.
- Bilaterality, solidity or solid areas in cystic adnexal masses.

Findings on Ultrasonographic and Doppler Wave Basis
Findings on 2D Ultrasonographic Application (Table3): All the malignant tumors had suspicious ultrasonographic criteria (either by U/S or Doppler wave application). The benign masses that had suspicious appearance on ultrasound included cases of endometriosis, PID, papillary serous cystadenoma, mucinous cystadenoma and dermoid cysts.

Table 1: Pathological diagnosis of various cases and adnexal masses.

Pathological diagnosis	Frequency	Percent	Valid percent	Cumulative percent
Benign	25	83.3	83.3	83.3
Malignant	5	16.7	16.7	100.0
Total	30	100.0	100.0	--

Table 2: Histopathological nature of adnexal masses.

Histopathology	Frequency	Percent	Valid percent
Cystadenoma	5	16.7	16.7
Follicular cyst	2	6.6	6.6
Inclusion cyst	1	3.3	3.3
Serous cyst	1	3.3	3.3
Tubo-ovarian complex	2	6.6	6.6
Clear cell tumor	1	3.3	3.3
Corpus leutem cyst	2	6.7	6.7
Cystadenocarcinoma	1	3.3	3.3
Dysgerminpma	1	3.3	3.3
Endometrioma	4	13.3	13.3
Fibroma	1	3.3	3.3
Fibrothecoma	1	3.3	3.3
Gangranous twisted cyst	1	3.3	3.3
Granulosa cell tumor	1	3.3	3.3
Krukenberg tumor	1	3.3	3.3
Heamorrhagic cyst	1	3.3	3.3
Liomyoma	1	3.3	3.3
Mature cystic teratoma	3	10.0	10.0
Total	30	100.0	100.0

Table 3: Consistency of the masses in relation to histopathology.

			Histopathology		
Ultrasonographic consistency		Number & Percentage of cases	Benign	Malignant	Total
Consistency-U/S	Cystic	Count	16	0	16
		% within Histopathology	64.0%	0.0%	53.3%
	Cystic with solid component	Count	7	1	8
		% within Histopathology	28.0%	20.0%	26.7%
	Solid	Count	2	4	6
		% within Histopathology	8.0%	80.0%	20.0%
Total	Count	25	5	30	
	% within Histopathology	100.0%	100.0%	100.0%	

Table 4: Vascularity of adnexal masses in relation to histopathology

			Histopathology		
Doppler findings		Number & Percentage of cases	Benign	Malignant	Total
Vascularity	Avascular	Count	12	1	13
		% within Histopathology	48.0%	20.0%	43.3%
	Vascular	Count	13	4	17
		% within Histopathology	52.0%	80.0%	56.7%
Total	Count	25	5	30	
	% within Histopathology	100.0%	100.0%	100.0%	

Tables 5: Parameters used in assisting the adnexal masses in relation to histopathology

Histopathology	Statistical parameter	Age	Gravidity	Parity	Max. Diameter	Doppler RI	Doppler PI
Benign	Mean	40.84	4.44	3.08	10.85	0.5823	2.116
	N	25	25	25	25	13	13
	SD*	10.530	2.785	1.730	4.684	0.31862	0.5313
	Minimum	26	0	0	4	0.22	1.4
	Maximum	74	10	7	23	1.00	3.0
	Median	40.00	4.00	3.00	9.00	0.4800	2.200
Malignant	Mean	40.80	3.40	2.80	12.10	0.3225	3.988
	N	5	5	5	5	4	4
	SD	14.584	2.074	1.924	3.435	0.24581	4.6284
	Minimum	25	2	1	8	0.10	1.1
	Maximum	54	7	6	16	0.67	10.9
	Median	48.00	3.00	2.00	12.00	0.2600	1.980
Total	Mean	40.83	4.27	3.03	11.06	0.5212	2.556
	N	30	30	30	30	17	17
	SD	11.005	2.677	1.732	4.474	0.31682	2.2131
	Minimum	25	0	0	4	0.10	1.1
	Maximum	74	10	7	23	1.00	10.9
	Median	40.00	4.00	3.00	9.00	0.3500	2.100

*SD = standard deviation

	Test statistics					
Statistical test	Age	Gravidity	Parity	Max. Diameter	Doppler RI	Doppler PI
Mann-Whitney U	60.500	40.500	51.000	45.000	10.500	24.000
Wilcoxon W	385.500	55.500	66.000	370.000	20.500	34.000
Z	-0.111	-1.244	-0.651	-0.980	-1.758	-0.227
p value	0.911	0.214	0.515	0.327	0.079	0.820

Findings on Pulsed Wave and Color Doppler Application: Pulsed wave Doppler application for various masses was done and Doppler indices, RI and PI, were calculated for each mass, results were available as shown in (Table 4)**.** RI and PI values were calculated in patients with benign masses, where the mean values were 0.58 and 2.12 respectively, while in malignant adnexal masses the mean RI and PI values were 0.32 and 3.99 respectively. And in whole population the mean RI and PI values were 0.52 and 2.56, respectively.

Findings on Comparing Various Past Diagnostic Tools in Prediction of Malignancy in Adnexal Masses to Various Parameters in the Studied Population in Relation to Standard Histopathologic Diagnosis: Data presented in Table 5 shows the parameters used in assisting the adnexal masses in relation to histopathology diagnosis.

DISCUSSION

Ovarian cancer is the second most common female reproductive cancer, preceded only by the cancer of the uterine corpus, more women die from ovarian cancers, as it corresponds to the highest mortality rate in developed countries. As a result, many patients undergo major surgery because of the fear of missing an ovarian cancer. On the contrary, many women with advanced ovarian cancer undergo insufficient primary surgeries at local hospitals, and the suboptimal intervention affects prognosis and increases patient morbidity [11]. Malignant ovarian tumors are diagnosed at an advanced stage in 75% of cases and are associated with the highest mortality figures of all gynecological cancers [12]. In our work, we support the hypothesis that ultrasonographic evaluation and Doppler U/S might help to improve preoperative differentiation between benign and malignant ovarian tumors. In the present study, the mean age of studied cases was 40.83, the maximum age was 74 and the minimum was 25. The mean gravidity and parity fur all cases were 4.27 and 3.03 respectively. Seven of thirty patients were postmenopausal and 23 were premenopausal.

In the study population, the main symptoms of presentation were as follows, 60.0% of patients complained of pelvic pain (18 from 30 cases), 27% complained of abdominal swelling (eight patients), 13.30% of the cases complained of abnormal uterine bleeding (four patients) and 7% were complained of other symptoms as infertility or were accidently discovered.

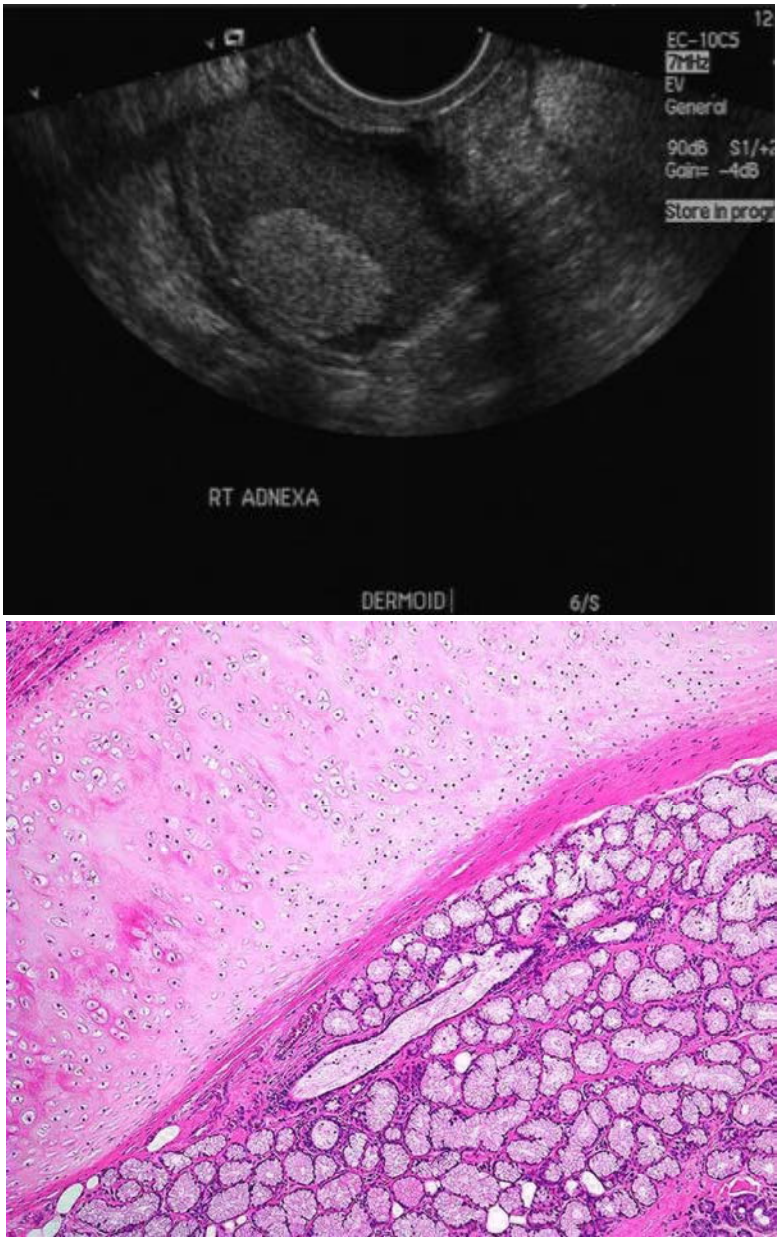

Fig. 1: 2D US of an adnexal mass proved to be mature cystic teratoma by histopathology

Twisted tumors resulted in intermittent sharp pain accompanied with vomiting followed by constant pain. Hemorrhage into cysts and low grade infection gave rise to chronic pain. Some of patients (9 from 30 cases) described an abdominal enlargement accompanied with pressure (gastrointestinal or urinary) symptoms and they were related to the tumor size, all occurred with size >12 cm (abdominal or pelvi-abdominal masses). In the present study, 13.30% of the cases complained of abnormal uterine bleeding as menorrhagea and metrorrhagea. Postmenopausal bleeding occurred in only one patient. The main tools we used in this thesis were applying different ultrasound and Doppler modalities on 30 patients diagnosed clinically to have adnexal masses.

The U/S characteristics of these masses were as follow, 28 of 30 masses were unilateral and only two were bilateral. The consistency of the masses was 53.3% cystic, 26.7% solid with cystic component and 20% solid. These masses were either unilocular (17 from 30) or multilocular (13 masses).The inner wall of the masses was regular in 50% of masses. The septa were found in 14 masses, seven of them were found to be thick septations.

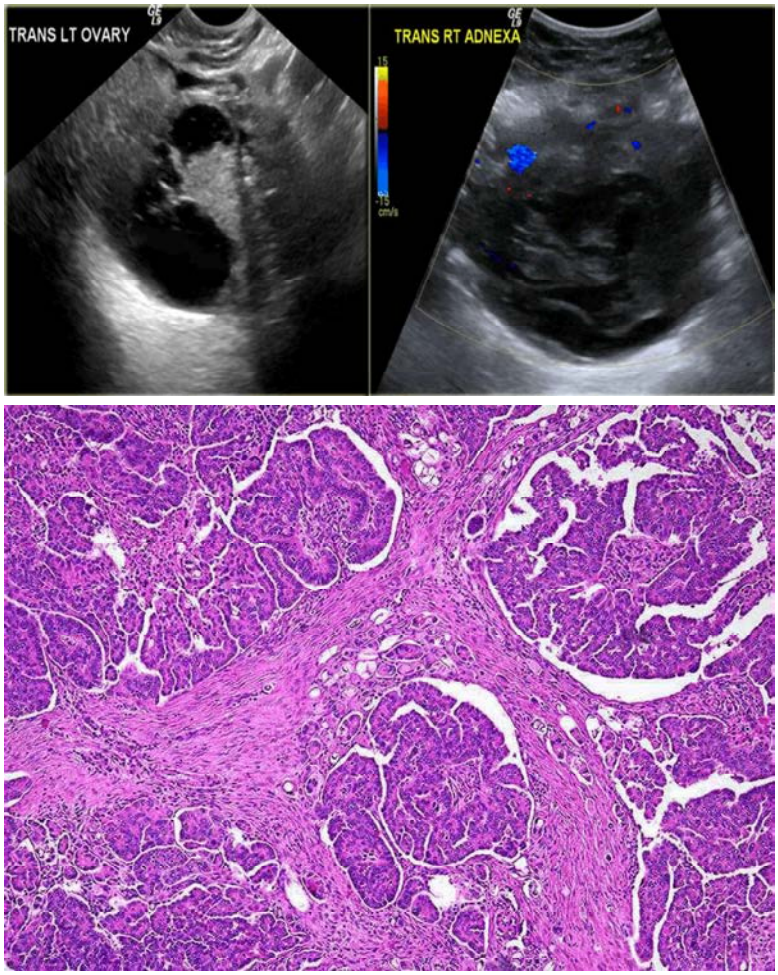

Fig. 2: Ultrasound shows a complex solid-cystic mass in the left ovary and another complex solid-cystic mass in the right ovary. The mass found to be of low vascularity by Doppler U/S and proved to be serous ovarian cystadenocarcinoma by histopathology

Ascites was found in seven cases, in three of these cases was massive (reaching hepatorenal pouch). Application of Doppler waves on these adnexal masses revealed that 17 of masses were vascular and 13 of masses were a vascular. Ultrasonographic subjective impression (regarding malignancy) was detected for each mass, depending on the previous 2D gray-scale U/S characteristics and vascular pattern by Doppler waves. Histopathological analysis of the surgically excised masses revealed that 25 of these masses were benign and 5 were malignant. The most common benign tumor in this study was cystadenoma (5 cases). The second most common is endometrioma (4 cases). Other common masses were mature cystic teratoma, tubo-ovarian complex and follicular cysts**.** In this study, by correlation of all previous tools and findings with the histopathological analysis we found that:

- Clinical evaluation including various clinical parameters had a low sensitivity as regard the differentiation between benign and malignant ovarian tumors, a finding that was previously concluded by Roman *et al*. [13]. Tenderness was encountered in some uncomplicated benign masses, in all complicated benign masses and also in some malignant tumors. This finding agreed with who found that benign tumors became tender probably due to the tense nature of their contents. On the other hand, infiltration of the capsule by malignant cells may account for tenderness in malignant tumors.
- The mean age of benign cases was 40.84 years and that of malignant cases was 40.80 years. Age alone was not sensitive for predicting malignancy according to the results of this

study, having a "p value" of 0.911 (non-significant). Malignant masses were found in older group than benign masses.

- Postmenopausal women accounted for about 23.3 of patients in the present study, and the incidence of malignancy in these women was found to be 60%**.** Twenty one of these masses were encountered in patients in the reproductive years. The incidence of malignancy in premenopausal patients (2 of 5 patients) was found to be 40.0%. According to various studies, most ovarian tumors 80% to 85% are benign and two-thirds of these occur in women in reproductive years. The chance that an ovarian tumor is malignant in a patient younger than 40 years of age is about 7% [4]. Approximately 4-24% of adnexal masses in premenopausal women and 39-63% in postmenopausal women are malignant [14].
- The mean value of gravidity and parity for total population were 4.27 and 3.03 respectively with non significant "P values"; 0.214 and 0.515 respectively, in correlation to pathology.
- The unilateral adnexal masses were 93.3% of the cases, while 6.7% of the cases had bilateral adnexal masses. The bilateral masses were founded in two cases; cystadenoma and hemorrhagic cyst.
- Most of benign masses were found to be cystic 64.0%. Four of malignant masses were found to be solid 80.0% and one case is cystic with solid component.
- The unilocular masses were 16 in benign masses and one for cases with malignant masses while multilocular masses were found in nine of the benign and four in the malignant masses.

Kupesic [15] generally used ultrasound for discriminating the benign from malignant lesions, also to determine the histological type of tumors. Criteria for this distinguish includes: Size of the tumor number of loculi, presence of septation, inward papillary excrescence from outer rim of the mass, overall echodensity, and Doppler pulsatility index. If all the other ultrasound parameters are reassuring; however, a unilocular lesion without internal echo or papillary excrescences is highly unlikely to be malignant regardless of the size or age of patient.

- Thick septation were found in 60% of malignant cases and only in 16% of benign cases.
- Inner wall was regular in 15 benign masses while it was irregular in all malignant masses.
- The mean largest dimension in cm by (U/S) for benign masses (25 cases) was 10.85 and for malignant masses was 12.10 with "P values" in correlation to pathology being 0.327 (non-significant values)
- Ascites was found in 80% of malignant cases and 12.0% of benign masses respectively. The cases with no ascites were 23 cases, one was malignant and the rest were benign.
- Vascular indices were calculated for each masses; RI and PI, revealing a high diagnostic value in predicting malignancy in various adnexal masses. The mean values of RI and PI in various masses were; 0.58 and 2.12 for benign masses respectively, 0.32 and 3.99 for malignant masses**.** The "*p*-value" for RI and PI were0.079 and 0.820 respectively, being of insignificant value in predicting malignancy of adnexal masses**.** Cases of endometriosis in the study (4 cases), three of them attained a vascular pattern (the occult blood inside the cysts does not contain blood vessels), and one of cases was vascular with RI and PI are 0.48 and 1.39 respectively, although the unilateral endometriotic cysts have no criterion of malignancy.

In our work, we support the hypothesis that ultrasonographic evaluation of tumor angiogenesis might help to improve differentiation between benign and malignant ovarian tumors detected in screening trials, as stated by Carmeliet *et al.* [16]. In the present study, pulsed wave Doppler and color Doppler applications correctly diagnosed false positive cases of clinical evaluation, US lonely. This was by detecting peripheral flow with low Doppler indices and high vascular indices. So, combination of various diagnostic modalities with Doppler wave application increases their specificity and diagnostic accuracy. This proves that the Doppler wave application should be used as a complementary tool in the diagnosis of ovarian tumors. Folkman *et al*. [10] described the importance of angiogenesis for tumor growth. In general, both indices tended to be lower in malignant masses than in benign masses [17, 18]. Guerriero *et al*. [19] concluded that at least one of the two Doppler techniques, pulsed wave or color Doppler, should be used in conjunction with gray-scale imaging in order to decrease the false positive rate of gray-scale imaging used alone. Buy *et al*. [20] and Roman *et al*. [13] put the increasing evidence that both indices demonstrate considerable overlap between malignant and benign ovarian masses and so they limited the usefulness of pulsed Doppler ultrasound in differentiating these lesions.

The results of a study carried out by Fleischer *et al*. [17] showed a statistically significant difference between vascularity in benign lesions, which tended to be peripheral and that in malignant lesions which tended to be central. Cohen *et al*. [21] published a study on 71 women with a known complex pelvic mass who were referred for a preoperative ultrasound evaluation with both TVUS and power Doppler. They correctly identified all 14 ovarian malignancies (2 FIGO stage I, 2 stage II, 7 stage III, and 3 metastatic colon) by both TVUS and power Doppler imaging having sensitivity of 100%. This seems to be an important finding, because Bell *et al*. had established that an increase in cancer detection at stage I from 25% to 50-75% might result in about 20-40% reduction in ovarian cancer mortality at five years [22]. Patients with a frozen-section diagnosis of malignancy at laparoscopy can undergo immediate laparotomy with tumor debulking and surgical staging, if a gynecologic oncologist is on stand-by. This reduced medical costs a lot [23].

It was mentioned in literature that pattern recognition by an experienced sonologist is an excellent method for discriminating between benign and malignant adnexal masses and should probably be regarded as the standard method for preoperative classification of adnexal masses [24]. However, the ability to discriminate between benign and malignant adnexal masses using Vascular pattern recognition increases with increasing experience, and in daily clinical practice, it is impossible to ask an expert's opinion on every adnexal mass [25]. Valentin [26] recommended to refer cases with adnexal tumors to experts (known as level III ultrasonography) to distinguish between benign and malignant adnexal tumors, with an expected accuracy of 95%. But also he conducted a study on the use of pattern recognition for discrimination between benign and malignant adnexal masses by non-expert ultrasound operators, where results reached a sensitivity and specificity with regard to malignancy of 86% and 80%, respectively**.** Yazbek *et al*. [27] stated the importance of the quality of Ultrasonography machine and its resolution, in addition to the experienced operator, in the management of patients with suspected ovarian cancer in a tertiary gynecologic center and how it results in a significant decrease in the number of major staging procedures and a shorter patient hospital stay.

It is obvious that subjective US impression needs to develop ways of teaching less experienced operators how to interpret ultrasound images. Moreover, each course aiming at improving the ultrasound skills of the participants probably needs to include hands-on training as well. Before using a model or a scoring system, proper training is likely to be of paramount importance if diagnostic performance is to be optimized. It may be difficult to determine preoperatively the nature (benign or malignant) of adnexal tumors. However, an accurate diagnosis is essential to provide optimal treatment, as the rupture of a Stage I ovarian cancer during surgery may worsen the prognosis [28]**.** Because of the low incidence of ovarian cancer in clinical practice, reported to be approximately one case per 2,500 women per year, it has been estimated that a screening test with 100% sensitivity and 99.6% specificity is needed to achieve a positive predictive value of 100%, i.e. to limit the number of unnecessary surgical procedures to nil for each detected case of ovarian cancer [29].

CONCLUSION

From the previous discussion we can conclude that: even though histopathological examination of the adnexal lesion is the gold standard for diagnosis or exclusion of malignancy, 2D U/S in addition to Doppler are reasonably accurate, helpful and non-invasive tool for assessing adnexal lesions. Study of the results of clinical evaluation showed that old age, menopausal status, abnormal uterine bleeding especially postmenopausal, bilaterality of the adnexal masses and mixed consistency of the tumor, should be considered for the possibility of malignancy. The role of clinical evaluation in the diagnosis of early malignancy is of limited value and so the need for other diagnostic tools is mandatory in many cases. Ultrasonography has a high diagnostic value in diagnosing the nature of ovarian masses. The use of different modalities of ultrasound and Doppler wave technology can precisely help in predicting malignancy in various adnexal masses. The risk of malignancy index is a useful tool in the preoperative evaluation of adnexal masses. This index is a simple score system which can be applied directly to clinical practice and might be of value in referring patients with suspected advanced neoplasia to a specialised cancer centre for optimal debulking which is known to improve survival. Our results show also that analysis of the vascular architecture and calculation of Doppler and vascular indices for adnexal masses are useful tools in excluding the possibility of malignancy with a high specificity. Their diagnostic accuracy in the prediction of ovarian malignancy improves considerably when used in conjunction with ultrasound morphological criteria. To sum up our results, Adding Doppler to 2-D

U/S morphological criteria had increased its sensitivity in the prediction of ovarian malignancy. But still further studies are needed to corporate its findings. It is obvious that subjective US impression needs to develop ways of teaching less experienced operators how to interpret ultrasound images. As before using a model, a scoring system or an ultrasound technique, proper training is likely to be of paramount importance if diagnostic performance is to be optimized.

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