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ACCURACY OF ULTRASONOGRAPHY IN DIAGNOSIS OF ADNEXAL MASSES IN CORRELATION TO HISTOPATHOLOGICAL EXAMINATION AFTER SURGICAL INTERFERENCE

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ABSTRACT

Pelvic mass lesions are commonly encountered in gynecological practice among women of all ages. The evaluation of adnexal masses includes a thorough history, clinical examination, imaging studies like ultrasonography, computed tomography scan or magnetic resonance imaging and tumor markers. Ultrasound examination is the standard diagnostic test for evaluation of a pelvic mass. Transvaginal sonography (TVS) along with colour doppler gives better results for assessing ovarian morphology and vascularity. Our study evaluated the capacity of ultrasound criteria in women having adnexal masses, before surgical intervention, correlated with histopathological examination. All patients in this study was subjected to complete history taking, general examination, abdominal examination, pelvic and bimanual examinations and pelvic ultrasound scanning. Patients underwent surgical intervention. All specimens were removed and sent for histopathological examination assay. Age of our studied patients ranged from 18 to 60 years with mean 40.05 years. The present study revealed significant difference between tumor types and both patients' parity and menstrual history. Also, there is statistically significant difference between type of tumor among the studied patients and ultrasongraphic features. Solid consistency of adnexial mass predict its malignant nature with sensitivity 74.2%, specificity 90.6%, positive predictive value 78%, negative predictive value 88.7%, and accuracy 85.5%. Presence of papillary projection of adnexal mass predict its malignant nature with sensitivity 91.9%, specificity 56.5%, positive predictive value 48.7%, negative predictive value 94% and accuracy 67.5%. Positive findings on ultrasound predict its malignant nature with sensitivity 91%, specificity 97.8%, positive predictive value 95%, negative predictive value 96.4% and accuracy 96%. Conclusion: Transvaginal ultrasonography is the recommended imaging modality for suspected or incidentally identified pelvic mass.

KEYWORDS: Ovary, adnexa, adnexal masses, ultrasonography, histopathology.

INTRODUCTION

Pelvic mass lesions are commonly encountered in gynecological practice among women of all ages. A pelvic mass may be gynecologic or non-gynecologic in origin and maybe benign or malignant in nature.[1]

It is important for clinicians to be aware of the differential diagnosis of these masses. Assessing the characteristics of the masses especially with regard to the possibility of malignancy is necessary before doing a surgical intervention like laparotomy or laparoscopy.[1,2]

The evaluation of adnexal masses includes a thorough history, clinical examination, imaging studies like ultrasonography, computed tomography scan or magnetic resonance imaging and tumor markers.[1]

Ultrasound examination is the standard diagnostic test for evaluation of a pelvic mass. Ultrasonography can diagnose the possible origin of the mass- whether uterine or adnexal and delineate features suggestive of malignancy.[3]

With the widespread use of ultrasound in pregnancy, adnexal masses are often incidentally found on routine ultrasound examination. Most of these masses regress spontaneously, but some persist, and very few are malignant.[1]

Subjective evaluation of ultrasound images by an experienced ultrasound examiner is an excellent method for discriminating between benign and malignant adnexal masses, and a correct specific histological

diagnosis (e.g. endometrioma, dermoid cyst or hydrosalpinx) can often be provided.[4,5]

Transvaginal sonography (TVS) along with colourdoppler gives better results for assessing ovarian morphology and vascularity.[6]

The IOTA study is the largest study in the literature on ultrasound diagnosis of ovarian pathology. It started years ago in 1999 and included nine European centers. A standardized technique for preoperative classification of adnexal masses was defined by IOTA group. Major highlight of the study were 10 simple ultrasound rules that had high sensitivity and specificity and were applicable to a large number of tumours. On application of one or more M-rules in the absence of a B-rule, or one or more B-rules in the absence of a M-rule, the mass is classified as malignant or benign respectively. If both M-rules and B-rules apply, or if no rule applies, the mass could not be classified.[7]

Table (1): Simple IOTA rules for predicting benign or malignant ovarian tumour.[7]

Rules for predicting a malignant tumour (M-rules)	Rules for predicting a benign tumour (B-rules)
M1 Irregular solid tumour	B1 Unilocular cyst
M2 Presence of ascites	B2 Presence of solid components where the largest solid component is <7 mm in largest diameter;
M3 At least four papillary structures	B3 Presence of acoustic shadows
M4 Irregular multilocular solid tumour with largest diameter ≥100 mm	B4 Smooth multilocular tumour with largest diameter <100 mm
M5 Very strong blood flow (color score 4)	B5 No blood flow (color score 1)

Alcazar et al.[8] have shown that the examiner's subjective impression has good diagnostic performance for characterizing adnexal masses by this modality. However, the diagnostic performance of this method depends on the examiner's expertise. Unfortunately there is a limited number of expert examiners, so the majority of adnexal masses are initially evaluated by non-experts.

In order to improve the diagnostic performance of non-expert examiners, many scoring systems and logistic models have been developed. However, many of these are complex. The International Ovarian Tumor Analysis (IOTA) Group proposed a simpler approach, based on various ultrasound features of the tumor, the so-called 'simple rules' and 'simple descriptors', also called 'easy instant diagnosis'.[9]

Based on these simple approaches, IOTA proposed a clinically oriented three-step strategy. In this strategy, simple descriptors, simple rules and evaluation by an expert examiner are used sequentially in order to classify adnexal masses as benign or malignant.[10]

Table (2): Simple descriptors and simple rules for classifying adnexal masses as benign or malignant, as defined by the International Ovarian Tumor Analysis Group.[10]

Simple descriptors	*Simple rules*
Benign descriptors	Benign features
Unilocular tumor with ground-glass echogenicity in premenopausal woman	Unilocular tumor
Unilocular tumor with mixed echogenicity and acoustic shadows in premenopausal woman	Largest diameter of largest solid component < 7 mm
Unilocular anechoic tumor with regular walls and largest diameter of lesion < 100 mm	Acoustic shadows
Unilocular tumor with regular walls	Smooth multilocular tumor with largest diameter < 100 mm
	No intratumoral blood flow on color or power Doppler
Malignant descriptors	Malignant features
Tumor with ascites and at least moderate color Doppler blood flow in postmenopausal woman	Irregular solid tumor
Woman aged > 50 years and CA-125 > 100 IU/mL	Ascites
	At least four papillary projections
	Irregular multilocular solid tumor with largest diameter ≥ 100 mm
	Very strong intratumoral blood flow on color or power Doppler

Final diagnosis of adnexal masses is only reached at laparotomy or laparoscopy followed by histopathological examination of the resected specimen.[6, 11]

This study was done to evaluate the capacity of ultrasound criteria in women having adnexal masses, before surgical intervention, correlated with histopathological examination.

PATIENTS AND METHODS

A prospective study was conducted at Bab Al-Shaaria Hospital. The study included 200 patients who had a preliminary diagnosis of adnexal mass clinically and sonographically.

Inclusion criteria

1. Women with clinically and sonographically diagnosed adenxal mass.
2. Patients who will undergo surgical intervention.
3. Patients are recruited regardless of age, parity, complaint and BMI.

Exclusion criteria

1. Patients treated with conservative management.
2. Patients known to be pregnant.
3. Patient unfit for surgery as proved GIT malignancy.

Methods

All patients in this study were subjected to the following:

1. Complete history taking: A structured history was obtained using a standardized research protocol regarding name, age, parity, menstrual, obstetric history, use of hormones and ovulation induction agents.

General examination

- Vital signs were routinely measured.
- Chest and heart examination.
- Examination of lymph nodes.

2. Abdominal examination

- Any abdominal wall scars.
- Examination of the liver, spleen, kidneys.
- Ay abdominal or pelvi-abdominal masses regarding their clinical size, mobility consistency and tenderness.
- Presence of ascites.

3. Pelvic and bimanual examination.

4. Routine preoperative investigations: Liver function test, Kidney function test, Serum measurements of CA-125, random blood sugar, coagulation profile, viral markers and count blood cells.

5. Sonography: Transvaginal, combined with total abdominal sonography in some cases of large masses.

Ultrasound examination commented on

- ***Uterus:*** Size, position, endometrial thickness and any focal lesion.
- ***Adnexa:*** looking for any mass(es) with comment on the following points.
- ***Uterus:*** Size, position, endometrial thickness and any focal lesion.
- Presence of free fluid in Douglas pouch.
- Presence of matted loops of intestine.

6. Surgical intervention: Patient underwent surgical intervention and the mean time between ultrasound examination and surgical intervention ranged from 6 to 20 days, all specimens were removed and sent for histopathological examination assay in the Pathology Department in Bab Al-Shaaria Hospital.

7. Intraoperative findings: Site, size, consistency, surface papillae, ascites, lymph nodes, omental deposits, signs of metastases and steps of operation.

8. Histopathological examination of the specimens.

9. Correlations: Correlation between preoperative ultrasound suspected diagnosis, suspected intraoperative diagnosis and definite histopathological report to evaluate the sensitivity and the specificity of ultrasound in evaluation of adnexal mass.

RESULTS

Age of the studied patients ranged from 18 to 60 years with mean 40.05 years. Their BMI also ranged from 18 to 29 kg/m^2 with mean 24.39 kg/m^2. More than half of them were multipara (table 3).

Sixty nine percent of the studied patients had malignant tumors confirmed by HPE (figure 1).

There is significant difference between tumor types and both patients' parity and menstrual history. Being nullipara and premenopausal had higher occurrence of benign tumor (table 4).

There is statistically significant difference between type of tumor among the studied patients and ultrasongraphic features. Solid mass, ill-defined margin, papillary projections and ascites are significantly higher in malignant tumor (table 5).

There is statistically significant difference between type of tumor among the studied patients and Doppler ultrasongraphic features. Presence of neovasularity, central vessels, systolic velocity ≥15 cm/S. PI >1 and RI<0.4 are higher in benign tumor (table 6).

If the mass was solid with ill-defined border, it can be malignant with sensitivity 51.9%, specificity 88.9%, positive predictive value 97.1%, negative predictive value 81.7%, positive likelihood ratio 17.9, negative likelihood ratio 0.5 and accuracy 93% (table 7).

If the mass was solid with ill-defined border, it can be malignant with sensitivity 46.8%, specificity 98.6%, positive predictive value 98.6%, negative predictive value 90.5%, positive likelihood ratio 33.43, negative likelihood ratio 0.54 and accuracy 82.5% (table 8).

Positive Doppler findings predict its malignant nature (three of Doppler characteristics; new vessels, central vessels, velocity>15 cm/S or Pulstality index >1) with sensitivity 71%, specificity 88.4%, positive predictive value 73.3%, negative predictive value 87.1%, positive likelihood ratio 6.23, negative likelihood ratio 0.33 and accuracy 88% (table 9).

Table (3): Distribution of the studied patient according to age and menstrual history.

	N=200	%
Age:		
Mean ± SD	40.05 ± 12.24	
Range	18 - 60	
BMI:		
Mean ± SD	24.39 ± 3.14	
Range	18 - 29	
Menstrual history:		
Premenopausal	100	50
Postmenopausal	100	50
Parity:		
Nullipara	64	32
Primipara	31	15.5
Multipara	105	52.5

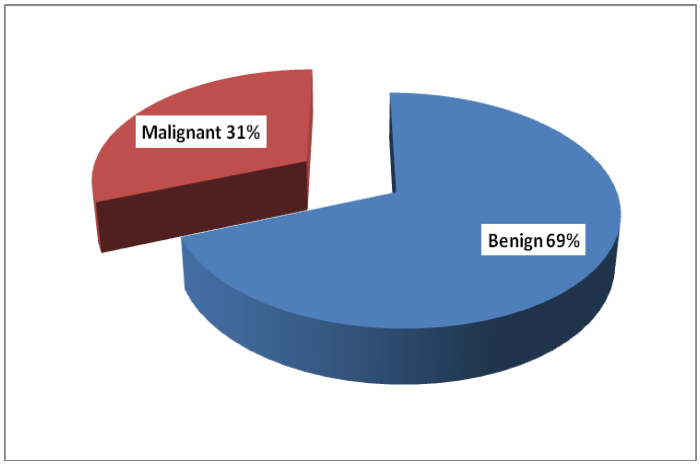

Figure (1): Pie chart showing distribution of the studied patients according to HPE.

Table (4): Comparison between tumor type regarding parity and menstrual history.

Variables	Tumor type		Test	
	Benign N=138 (%)	Malignant N=62 (%)	X^2	p
Parity:				
Nullipara	37 (26.8)	27 (43.5)	10.434	0.005*
Primipara	18 (13)	13 (21)		
Multipara	83 (60.2)	22 (35.5)		
Menstrual history:				
Premenopausal	80 (58)	20 (32.2)	11.314	<0.001**
Menopausal	58 (42)	42 (67.8)		

*p<0.05 is statistically significant.

Table (5): Comparison between type of tumor among the studied patients and ultrasonographic features.

Ultrasonographic features	Tumor type		Test	
	Benign	Malignant	X^2	p
	N=138 (%)	N=62 (%)		
Consistency:				
Cystic	125 (90.6)	16 (25.8)	86.302	<0.001**
Solid	13 (9.4)	46 (74.2)		
Margin:				
Well defined	118 (85.5)	20 (32.3)	56.71	<0.001**
Ill defined	20 (14.5)	42 (67.7)		
Septation:				
Thin septa	78 (56.5)	5 (8.1)	41.377	<0.001**
Papillary projection	60 (43.5)	57 (91.9)		
Ascites:				
No	105 (76.1)	5 (8.1)	79.98	<0.001**
Yes	33 (23.9)	57 (91.9)		

**p≤0.001 is statistically highly significant.

Table (6): Comparison between tumor type of the studied patients regarding Doppler finding.

Ultrasonographic features	Tumor type		Test	
	Benign	Malignant	X^2	p
	N=138 (%)	N=62 (%)		
Neovascularity:				
No	82 (59.4)	4 (6.5)	Fisher	<0.001**
Yes	56 (40.6)	58 (93.5)		
Vascularity:				
Peripheral	103 (74.6)	14 (22.6)	47.752	<0.001**
Central	35 (25.4)	48 (77.4)		
Systolic velocity:				
<15 cm/S	119 (86.2)	7 (11.3)	103.07	<0.001**
≥15 cm/S	19 (13.8)	55 (88.7)		
Pulsatality index:				
<0.8	20 (14.5)	57 (91.9)	110.85	<0.001**
0.8-1	29 (21)	5 (8.1)		
>1	89 (64.5)	0 (0)		

**p≤0.001 is statistically highly significant.

Table (7): Performance of being solid, ill-defined mass features of adnexal mass in diagnosis of malignant nature.

Solid and ill-defined border	Sensitivity	Specificity	PPV	NPV	+LR	-LR	Accuracy
Positive ¥	51.9	97.1	88.9	81.7	17.9	0.5	93

¥ Positive if both of them denote malignancy.

Table (8): Performance of being solid, ill-defined mass features of adnexial mass in diagnosis of malignant nature.

Solid, ill-defined border and papillary projection	Sensitivity	Specificity	PPV	NPV	+LR	-LR	Accuracy
Positive ¥	46.8	98.6	93.5	80.5	33.43	0.54	82.5

¥ Positive if all of them denote malignancy.
**p≤0.001 is statistically highly significant.

Table (9): Performance of Doppler ultrasonographic features of adnexial mass in diagnosis of malignant nature.

	Sensitivity	Specificity	PPV	NPV	+LR	-LR	Accuracy
Positive ¥	71	88.4	73.3	87.1	6.23	0.33	88

¥ Positive if three of the above criteria suggest malignancy.

DISCUSSION

Adnexal masses are one of the most common reasons for gynecologic admission. The safety of diagnosis of adnexal masses by two-dimensional ultrasonography has been sufficiently demonstrated.[12]

According to **American Cancer Society**[13] women are commonly diagnosed with stage III/IV disease, for which 5-year survival rates are around 27% and 16%, respectively compared with the 5-year survival of over 90% in patients with stage I ovarian cancer. This has led to efforts over the past two decades to develop early detection strategies using serum CA125 and ultrasound.

A physical examination, including a pelvic examination, and ultrasound imaging are essential for diagnosis. CT scanning is preferred to assess the extent of the tumor in the abdominopelvic cavity. Bimanual pelvic examination and serum CA-125 levels have failed to allow consistent detection of ovarian malignancy.[14]

In an IOTA study that included 1066 women who underwent TVS for an ovarian mass, experienced ultrasound examiners were able to make a conclusive diagnosis using subjective assessment of dermoid cysts, endometriomas and hydrosalpinges in most cases.[15]

Our study was done to evaluate the capacity of ultrasound criteria in women having adnexal masses, before surgical intervention, correlated with histopathological examination. All patients in this study was subjected to complete history taking, general examination (including blood pressure, pulse and temperature), abdominal examination, pelvic and bimanual examinations and pelvic ultrasound scanning. Patient underwent surgical intervention. All specimens were removed and sent for histopathological examination assay.

Age of the studied patients ranged from 18 to 60 years with mean 40.05 years. Their BMI also ranged from 18 to 29 kg/m^2 with mean 24.39 kg/m^2. More than half of them were multipara. Seventy five percent of the studied patients complained of abdominal pain, while 63.5% of them presented with abdominal swelling.

Sayasneh et al.[16] assessed the diagnostic performance of subjective assessment by ultrasound examiners in predicting the specific histology of adnexal masses. The mean age of the patients was 47 years and 194 (62%) of those included were premenopausal.

In the present study, we found that Thirty-one percent of the studied patients had malignant tumors confirmed by HPE. **Sayasneh et al.**[16] found that the prevalence of malignancy was 31% (96/313), including 66 primary ovarian cancers (30 Stage I, five Stage II and 31 Stage III or IV), 19 BOTs and 11 metastatic tumors.

Badkur and Caputa[17] showed that benign adnexal masses constitute 80.96% and malignant masses constitute 19.4% of all adnexal masses. **Piovano et al.**[18] showed that prevalence of malignancy was 21%.

In our study, the most common lesion found was endometrioma (17%) followed by mature teratoma (12.5%) and serous cystadenocarcnioma (12.5%). These results agreed with the result of **Sayasneh et al.**[16] **that** showed that endometrioma (55%) is the most common benign cases while serous cystadenicarcinoma (12.1%) is the most common in malignant ones. **Goyal and Agarwal**[19] stated that the most common benign lesion were inflammatory lesions and cystadenoma while 50% of malignant lesions were serous carcinoma.

In the present study, there is statistically non-significant difference between tumor type among the studied patients and patient age. **Cancer Research UK**[20] stated that around 80% of cases of ovarian cancer mainly occur above the age of 50.

Badkur and Caputa[17] **and Goyal and Agarwal**[19] showed that there is a significant linear trend of increasing age and higher chances of malignancy. There were considerably higher proportion of malignancy among women more than 40 years of age. This is on contrary with the study done by **Hartman et al.**[21] that concluded that the mean age of the benign and malignant group was not significantly different (P=0.07).

In this study, there is statistically non-significant difference between tumor type among the studied patients and BMI. Also, BMI has no significant difference in the study done by **Hartman et al.**[21]

The present study revealed significant difference between tumor types and both patients' parity and menstrual history. Being nullipara and premenopausal had higher occurrence of malignant tumor.

Badkur and Caputa[17] showed that maximum number of masses occurs of women of lower parity, but there is significant correlation among parity of higher order and malignancy.

In the present study, there is statistically significant difference between type of tumor among the studied patients and ultrasongraphic features. Solid mass, ill-defined margin, papillary projections and ascites are significantly higher in malignant tumor. Presence of neovasularity, central vessels, systolic velocity ≥15 cm/S. PI >1 and RI<0.4 are higher in malignant tumor.

Shah et al.[22] found that their data were slightly more specific and less sensitive with RI <0.4 and more sensitive and less specific with PI <1. Hence, to optimize sensitivity and specificity, they proposed PI <1 and RI <0.6, which should be taken as cutoff.

In our study, if the mass was solid with ill-defined border, it can be malignant with sensitivity 51.9%, specificity 88.9%, positive predictive value 97.1%, negative predictive value 81.7%, positive likelihood ratio 17.9, negative likelihood ratio 0.5 and accuracy 93%.

If the mass was solid with ill-defined border and papillary projections, it can be malignant with sensitivity 46.8%, specificity 98.6%, positive predictive value 98.6%, negative predictive value 90.5%, positive likelihood ratio 33.43, negative likelihood ratio 0.54 and accuracy 82.5%.

Goyal and Agarwal[19] stated that ultrasonic signs on morphological assesments of malignant masses include multilocular or multiple cyst, septa or walls, nodules and solid components. **Choi et al.**[23] also proposed algorithm for differential diagnosis of complex solid and multicystic lesions on the basis of imaging features.

Regarding to 2D US, **Kardage et al.**[24] showed sensitivity of 76.4%, specificity of 89% in differentiating benign and malignant adnexal mass.

In results of **Sayasneh et al.**[16] examiners were able to charachtarize adnexal pathology as benign or malignant with sensitivity of 90% and specificity of 92%. Specificity was high irrespective of the type of mass (range, 91–100%), whilst sensitivity varied substantially. Comparison of the sensitivity for diagnosis of a specific pathology using subjective assessment by medical doctors and by sonographers was not feasible due to the small number of cases in each histological subgroup. Sensitivity was highest in the diagnosis of simple cysts (100%), hydrosalpinges (100%), mature teratomas (88%), endometriomas (75%), ovarian fibromas (88%), and tubo-ovarian abscess/infections (88%). When functional and hemorrhagic cysts were categorized together, sensitivity was still low, at 47%, whilst specificity was 99%. In diagnosing malignant histology, sensitivities were higher for serous cystadenocarcinomas (82%) when compared to those for serous BOTs (56%), mucinous BOTs (25%) and other malignancies including rare primary and metastatic tumors (5%), for which the number of false-negative results was relatively higher.

Goyal and Agarwal[19] results were close to our study showing sensitivity 94.44% but detect lower specificity 48.15%. **Badkur and Caputa**[17] disagreed with our study that concluded that ultrasound is invaluable technique in determining the nature of adnexal masses but the gold standard remains the surgery and histopathological findings.

Alcazar et al.[8] found an overall agreement of 75% between ultrasound and histological diagnosis when performed by experienced examiners. Endometriomas may be confused with other tumors because of variation in the ultrasound features of this pathology. Many endometriomas have a 'typical' unilocular appearance with ground glass contents; however, many show irregularities or solid areas26.

Sayasneh et al.[16] concluded that subjective assessment was good for the detection of simple cysts, endometriomas, mature teratomas, hydrosalpinges, fibroma, tubo-ovarian abscess and serous cystadenocarcinomas.

Sehgal. N.[25] explored the role of color Doppler studies in characterization of ovarian masses. They demonstrated a significant increase in the sensitivity, specificity, PPV, and NPV in establishing the preoperative diagnosis of ovarian masses in terms of benign and malignant nature, when color and spectral Doppler was used in combination with USG as compared to grayscale USG alone.

CONCLUSION

Histopathological examination of speciemen obtained from laparotomy or fine needle aspiration cytology of adnexal masses is the gold standard for diagnosis or exclusion of malignancy.

Extremes of age, menopausal status, mixed consistency of the tumor, and the presence of ascites must be considered for the possibility of malignancy. The role of clinical examination 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 adnexal masses but malignancy is difficult to be excluded. Transvaginal ultrasonography is the recommended imaging modality for suspected or incidentally identified pelvic mass. The ultrasound can be taken as the gold standard for diagnosis of adenexal mass in correlation with histopathology. Therefore, the ultrasound can be taken as the gold standard for diagnosis of adenexal mass in correlation with histopathology.

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