Comparative Study of Transvaginal Ultrasound Scoring Systems for Diagnosis of Ovarian Masses

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Abstract: Background: ovarian masses are considered a group of the most common diseases in gynecology. Ovarian tumors, alone, represent two thirds of these cases. **Aim of the work**: A comparitive study of as coring system for diagnosis the nature of ovarian masses comparing the sonographic scoring systems proposed by Alcazar et al. (2003) & Assuit et al. (2012) as apredictors of malignancy in ovarian masses & to comparethe sonographic findings with the histopathological results which being the gold standard for diagnosis. **Patient & method**: Cross section study involved 84 casses presenting with ovarian masses examined by 2D transvaginal ultrasonography to detect morphological criteria of the masses, serum CA125 & CEA levels were measured and compare color doppler of ovarian arteries to histopathological finding. **Results**: Patient with ovarian masses classified into two groups according to histopathological examination of the speimen excised into benign (86.9%) & malignant (13.1%) groups. TVS of malignant ovarian masses. were solid or partially solid, central blood flow, papillary projection <3cm, multiocular thick septum HS (P>0.000) results. RI and PI of the ovarian arteries were highly significantly lower in malignant than benign groups. CEA and CA125 levels were highly significantly higher in malignant group. Comparing our results with Assuit scoring system and Alcazar scoring system for detection of malignant ovarian tumor. **Conclusion**: These scoring systems had the highest sensitivity, positive predictive value and highest diagnostic accuracy in comparison to Ca-125 and CEA. Alcazar morphological scoring system had Sensitivity =100%, Specificity =97.3%, PPV=84.6%, NPV=100% and Assuite scoring system had Sensitivity =100%, Specificity=98.6%, positive predictive value in diagnosis malignant ovarian tumer PPV= 84.6%, negative predictive value NPV=100% accuracy in comparison to Ca-125, CEA, Doppler and ultrasound parameters alone.
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1. Introduction

The diagnosis of ovarian masses is a common clinical problem. Most ovarian masses are due to benign conditions. Determination of a degree of suspicion for malignancy in an ovarian mass is the most critical step after identification of the mass and has a profound effect on patient survival ***(Feerlay et al., 2004).***

A physician who specializes in gynecology will utilize various testing method and examinations to determine if the ovarian mass is cancerous or benign. If an ovarian malignancy is diagnosed, a physician specializing in oncology may be consulted. Medical tests to determine the characteristics of the mass include blood tests, ultrasound and CT scanning. In addition, an MRI may be recommended for further evaluation of the abdominal area. Generally, if these testing methods still do not yield a definitive diagnosis surgery may be required to remove and biopsy the mass ***(Fenchel et al, 2002).***

The differential diagnosis of ovarian masses varies from functional cysts to benign tumors to malignant. Ovarian cancer is the fourth most common cancer in women, with annual incidence rates ranging between 8.5 and 21.5 per 100,000 women in European countries ***(Umma et al., 2006).***

In asymptomatic women, discriminating benign from malignant disease is also important to ensure appropriate management in the setting of malignancy and to avoid unnecessary diagnostic procedures, including surgery, Combining morphology and Dopplert ransvaginal (TVS), which is the most common imaging technique for the discrimination of benign from malignant adnexal masses, achieves pooled sensitivity and specificity of 86% and 91% with many attempts have been made to improve this performance ***(Umma et al., 2006).***

Measurement of serum CA125 and transvagianal ultra sound (TVS), were also proposed but, in validation studies, they did not improve performance above that of Ultrasonography and Doppler alone ***(Fenchel et al., 2002).***

Ultrasound examination for the prediction of malignancy in an ovarian mass has been limited by the lack of accurate scoring systems of such masses. But with the advent of high frequency transvaginal 2D

ultrasonography and high quality color and pulsed wave power Doppler all added to the ability of sonographers to give a proper score to adnexal masses. Therefore, new classifications have emerged for characterization of ovarian masses ***(Alcazar et al., 2001).***

Aim of the Work

To compare 2 transvaginal ultrasound and Doppler scoring systems in diagnosis of the nature of ovarian mass and to correlate the sonographic and Doppler criteria with histopathology of different ovarian masses.

2. Patients and Methods

This cross section study involved 84 cases presenting with ovarian masses referred to the gynecology departments of Kafr El Sheikh General Hospital and Al Zahraa University Hospital in the period between September 2015 to February 2018.

Inclusion criteria

1- Age 15-65 years old

2- Parity 0-7

3- Presence of ovarian swelling or masses symptoms as

a) Bloating distention or crambing
b) Abdominal or low bac discomfort
c) Pelvic pressure or frequent urination
d) Un explained changes in the bowel habits
e) Nausea or vomiting
f) Dysparunia
g) Vaginal bleeding in post menobausal women

Exclusion criteria

- Polycystic ovary snydrom as diagnosed by Rotterdam criteria
- Hydrosalpinx and pyo salpinx

Initial approach:

A verbal consent was obtained from each patient.

History and Examination:

Full history taking for patients to ensure patients meeting the inclusion criteria Pervaginal examination was p erformed to examine the, size, position of the uterus and to check for any ovarian masses.

Ultrasound Scanning technique:

All patients were evaluated by transvaginal 2 Dimensional greyscale ultrasonography, colour Doppler and pulsed wave Doppler the type of machine is (Xario 200 Toshiba PRO-V-GE IL, Japan).

Laboratory assessment of ovarian masses measurement of cancer antigen 125 (Ca-125) and Cancer Embryonic Antigen (CEA).

A cutoff value of CA125 35 µ/ ml was predetermined in our study as previously mentioned by **Van Calster et al. (2007).**

A cutoff value of CEA 5µ IU was predetermined in our study as previously mentioned by **Van Calster et al. (2007).**

Histopathological examination:

In all patients tumors were surgically removed and definitive histopathological diagnosis was obtained.

Then morphological and Doppler evaluation was performed according to the parameters listed in Alcazar score and Assuit Score including.

- Papillary projections presence, cutoff 3mm
- Solid areas presence or absence or pure solid echogenicity
- Vascularity whether central, peripheral or absent
- Doppler parameters including RI, PI and PSV

After morphological assessment was done, Colour Doppler gate was activated to identify vascular colour signals within the tumor (Doppler settings frequency: 5MHz, Gain: o.8, Dynamic range: 20-40 dB, edge: 1, persistence: 2, colour map:5, gate: 2, filter: L1, PRF:0.6kHz).

3. Results

Table (1): Demographic data of all women of the study:

Items (N=100)	**(Mean ±SD)**
Weight In (kg)**:**	75.5 ± 14.2
Height In (cm)**:**	164.7 ± 7.2
Age In (years)**:**	34.1 ± 9.2
Age grouping	**No. (%)**
≤ 20	2 (2%)
21-30	**38 (38.0%)**
31-40	**43 (43.0%)**
41-50	11(11.0%)
>50	6 (6.0%)
Parity: • Nulliparous	14 (14.0%)
• Multipara: ≤ 3	70 **(70.0%)**
>3	16 (16.0%)

4. Discussion

Ovarian cancer is of particular interest to ultrasonographers and oncologists since it is the leading cause of gynecological malignancy mortality in the world, affecting 1 in 56 women and causing about 14,500 deaths in the United States annually. Unfortunately the disease presents very late, which greatly reduces the chances of cure ***(Radosa et al., 2011).***

In the current study we have evaluated the morphological scoring system proposed by Alcazar et al in **2003**. We have studied **84** ovarian masses and scored these masses as per alcazar score. We have assessed the proposed scoring system through comparing the ultrasound and Doppler score given to masses with the final histopathology result and thus we were able to calculate sensitivity, specificity and predictive values of the system.

The demographic data of the study group revealed that that the age of patients ranged from 15 → 65 years. The average age for patients with benign masses was 32.6±10.3, while the average age for patients with malignant masses was (34.1±9.2). The p-value for Age was <0.001 which meant that age alone was significant criterion for predicting malignancy.

Table (2): Ultrasound picture of the studied group

Histopathology / **US picture**	**Benign N=73 No (%)**	**Malignant N=11 No (%)**	**Test of significance**	**p- value**
Consistency: Cystic Solid Partially solid	70 (95.9%) 2 (2.7%) 1 (1.4%)	2 (18.2%) 4 (36.4%) 5 (45.5%)	$X^2 = 47.875$	**0.000***
Blood flow: None Peripheral Central	19 (26%) 51 (69.9%) 3 (4.1%)	0 (0%) 2 (18.2%) 9 (81.8 %)	$X^2 = 47.318$	**0.000***
Papillary projection: Absent Less than 3 More than 3	63 (86.3%) 8 (11%) 2(2.7%)	4 (36.4 %) 1(9.1%) 6 (54.5%)	$X^2 = 29.959$	**0.000***
Septum: Absent Thin Thick	50 (68.5%) 14 (19.2%) 9 (12.3%)	3 (27.3%) 2 (18.2%) 6(54.5%)	$X^2 = 12.120$	**0.002***
Locularity: Unilocular Multilocular	63 (86.3%) 10 (17.7%)	3 (27.3%) 8 (72.7%)	$X^2 = 19.784$	**0.000***

Table (3): Laboratory investigation of the studied group

Histopathology / **Tumor marker**	**Benign N=73 No (%)**	**Malignant N=11 No (%)**	**Test of significance**	**p- value**
CA125 Normal (<35 u/ml) Abnormal	36 (49.3%) 37 (50.7%)	0 (0%) 11 (100%)	$X^2 = 9.493$	**0.002***
CEA Normal (< 5u/ml) Abnormal	72 (98.6%) 1 (1.4%)	7 (63.6%) 4(36.4%)	$X^2 = 20.91$	**0.000***

Table (4): Doppler criteria of the studied group

Histopathology / **Doppler imaging**	**Benign N=73 No (%)**	**Malignant N=11 No (%)**	**Test of significance**	**p- value**
RI Normal (> 0.4) Abnormal (<0.4)	56 (76.7%) 17 (23.3%)	0 (0%) 11 (100%)	$X^2 = 12.5$	**0.000***
PI Normal (>1) Abnormal (<1)	38 (52.1%) 35 (47.9%)	0 (0%) 11 (100%)	$X^2 = 10.4$	**0.001***

Table (5): Assessment of of our results according to Assuit scoring system:

Histopathology / Assuit score	Malignant N=11	Benign N=73	Total
Positive	11	1	12
Negative	0	72	72
Total	11	73	84

Table (6): Assessment of of our results according to Alcazar scoring system

Histopathology / Alcazar score	Malignant N=11	Benign N=73	Total
High risk	11	2	13
Low risk	0	71	71
Total	11	73	84

Table (7): Sensitivity and specificity, PPV, NPV of Assuit scoring system and Alcazar scoring system in assessment of our results

	Sensitivity%	Specificity%	PPV%	NPV%
Assuit scoring system	100%	98.6%	84.6%	100%
Alcazar scoring system	100%	97.3%	84.6%	100%

In the present study, benign cases 9 (19.2%), malignant 6(54.5%) of masses (24 masses) had thick wall (≥3mm) while benign cases 14(19.2%), malignant cases 2(18.2%) of masses (19 masses) had thin wall (<3mm). The P-value was 0.002 which meant that Wall thickness was insignificant in our study and Wall thickness has not been frankly included by Alcazar and colleagues in their initial scoring system in 2003. ***(Alcazar et al., 2009).***

Thick Papillary projections ≥ 3mm and papillary projections in general, were present in benign cases 2 (2.7%), malignant 6 (54.5%). Three were papillary serous cystadenocarcinoma while 2 were papillary mucinous cystadenocarcinoma. The p value was < 0.000. The presence of papillary projections was a significant criterion in our study in differentiating benign from malignant masses.

Septations were present in 72.09% of masses, (31 masses in total). 27.38% of these masses (23 masses) were benign while 9.52 % (8 masses) were malignant as proven by histopathology. Septations were absent in 63.09% of masses (masses in total). 59.52% (50 masses) were proven to be benign while 3.57% (3 masses) were proven to be malignant by histopathology. The presence or absence of septations is what rendered a mass either multilocular or unilocular respectively. In our study, the P-value was 0.002* for this criterion which means that, presence or absence of septations was insignificant in prediction of the nature of the mass, in fact this agrees with the results of the study published in 2009, which showed that the presence or absence of septations was a nonsignificant criterion in influencing his scoring system ***(Alcazar et al., 2009).***

This also agrees with the results published in 2006 who found that whether the mass was septated or not, was generally insignificant in predicting the nature of the mass and The p-values in that study was 0.703 ***(Singh et al., 2006).***

In the present study central vascularity was detected by colour Doppler in benign cases 3(4.1%), malignant cases 9(81.8%) of masses (9masses), all 9 masses (100 %) were proven to be malignant by histopathology. 63.09% of masses (53masses) had peripheral vascularity shown on colour Doppler. In begnin cases 51 (69.9%), malignant cases 2 (18.2%) masses out of the 53 have been proved to be benign while 2mass (18.2/% of masses) was proven to be malignant by histopathology. The P-value was <0.000, which meant that central vascularity acted as a significant criterion in differentiating benign from malignant masses.

Marret et al. (2002) concluded that central blood flow location was one of the independent predictors of malignancy. Also the absence of color flow in the different echogenic portions as in the dermoid plugs, clots contained in hemorrhagic cysts and in endometriomas, is helpful in identifying benign nature ***Alcazar et al. (2003)*** has shown that the presence of central vascularity could be used as an independent factor for prediction of malignancy and could be included in morphological scoring systems. **Singh et al., 2006**, has shown that the presence of central vascularity is an independent predictor of the presence of malignancy and has shown that the P-value was < 0.001.

These cutoff values for RI, PI in our study were set at “0.45”, “1” and respectively. The mean values

for benign masses were as follows of RI is normal (>0.4) 56masses (76.7%) and abnormal (<0.4) 17masses (23.3%) or malignant masses normal (>0.4) 0mass (0%), abnormal (<0.4) 11masses (100.0%). The mean value of PI for benign masses was (0.000) for malignant masses as shown in table The mean While PI in benign cases is normal >1 38masses (52.1%), abnormal (<1) 35masses (47.9%). In malignant cases is normal (>1) 0mass (0%), abnormal (<1) 11masses (100%). Unfortunately, there is too much conflicting information in literature regarding the cut-off values of Doppler vascular indices for the differentiation between benign and malignant ovarian tumors ***(Alcazar et al., 2003).***

Buy et al. (1996) and Roman et al. (1997), revealed a cut off value of 0.4 for RI, all with low sensitivity ranging from 18% to 24% but with a high specificity ranging from 90% to 98% in their studies. Using the same cut off value, ***Emoto et al., (2000)*** reported a sensitivity of 95 % for cutoff value of 0.4 for RI ***Ebrashy and Ezzat (2000),*** found that a cutoff for RI of 0.45 to be of 86% sensitivity. ***Marret et al., (2002)*** reported a cut off value of 0.53 for RI will have a sensitivity of 93%.

Alcazar has specified the cutoff values for RI "0.45", PI "1" and We were able to prove that that at the previously stated cutoff values, the scoring system has a diagnostic accuracy of 95 %, a sensitivity of 100%, specificity of 97.3%, PPV of 84.6%, NPV of 100%.

In the present study Observation of the CA-125 revealed that the mean level in benign cases was 36 (49.3%) in normal (<35) and 37 (50.7%) in abnormal level. In malignant cases, 0 (0%) in normal, 11 (100%) in abnormal the P value was <0.002. This meant that Ca125 levels were significant in differentiating benign from malignant masses. A study in 2007 mentioned that, CA-125 has long been a very popular tumor marker for ovarian tumors especially epithelial tumors ***(Van Calster et al., 2007).***

Mury et al., 2011evaluated the predictive role of CA-125 in cases with adnexal masses. In this study the values of CA-125 have been measured pre and postoperatively for 231 patients and the levels were compared to the final pathology report. This study has shown that CA-125 has a sensitivity of 83.4%, specificity of 86.2%, and positive predictive value of 89.3% and negative predictive value of 91.3 %.

We were able to conclude that Alcazar scoring system And Assuit scoring model had:

- Highest sensitivity in comparison to Ca125, Doppler and ultrasound parameters
- Lower NPV than RI and PI alone
- Highest ppv and diagnostic accuracy

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