Original Research Article

Role of USG and CT scan in evaluating ovarian lesions

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Abstract

Introduction: Ultrasound helps by detecting lesions, give idea about its internal structure and also give opportunity to evaluate other abdominal organs. However evaluation by CT scan can give additional information, which can modify the course of treatment and prognosis of patient.

Materials and methods: Study comprise of 84 patients who were evaluated with ultrasonography and CT scan of abdomen and pelvis. Ovarian pathologies were categorized with benign, malignant and metastasis and compared with histopathological diagnosis or conservative treatment follow up.

Results: 84 patients were evaluated; CT scan and sonography are excellent noninvasive modality to differentiate ovarian masses from benign and malignant lesions and both imaging techniques seem to be comparable in differentiation of malignant from benign ovarian tumors. CT scan was more sensitive than ultrasonography, but sonography is more specific than CT scan in diagnosis of malignant lesions. Ultrasonography has high positive predictive value as compare to CT scan to diagnose malignant lesions.

Conclusion: Ultrasound by virtue of non-invasiveness, lack of radiation hazard and by ability to demonstrate structural changes in organ is investigation of choice in ovarian pathology and it can easily detect solid to cystic lesions and characterize the size, shape and extent of lesion. Computerized Tomography is particularly useful to know the enhancement pattern of the lesion, density and extent and staging of malignancies.

Key words

USG, CT scan, Ovary, Lesions.

Introduction

The ovary is the third most common site of primary malignancy in female genital tract after cervix and endometrium accounting for 30% of all cancers of female genital tract Ovaries are paired organs measuring 4 x 2.5 x 1.5 cm each in dimension situated one on each side of uterus close to lateral pelvic wall [1].

Ovaries are subjected to monthly endocrine and traumatic insult during ovulatory cycle and prime site for tumor genesis. The primary and secondary carcinomas of ovary are frequent with variety of pathologic pattern, which is seen in all age and ethnic groups [2]. Fifty percent's of ovarian tumor are benign tumors, of malignant 90% are epithelial and remaining 10% are those resulting from metastasis [4]. But mortality rate exceeds the combined mortality of both endometrium and cervical neoplasm [3].

Ultrasound plays an important role in evaluation of ovarian pathology. In present years, ultrasonography is widely accepted as first line radiological investigation for ovarian pathology. It is non-invasive, cheap, quick, free of radiation hazards, comfortable for patients, easy to re-perform and very accurate in hands of skilled operator. With color Doppler it is possible to evaluate vascularity of lesion. Spectral Doppler waveform characteristics (e.g., resistive index, pulsatility index) correlate well with malignancy but generally add little information to morphologic considerations. Ultrasonographic contrast media helps in determination of exact extent of lesion and vascularity of lesion.

CT scan is the preferred technique in the pretreatment evaluation of ovarian lesions, it is very pathology and staging of malignant lesion. It can detect actual density of lesion. Other investigations like MRI, radionuclide scanning, etc. are also helpful in ovarian pathology.

There is very little data available for correlation studies between ultrasonography and computed tomography of ovarian lesions. This study was conducted with a view to find out the diagnostic value of ultrasonography and computed tomography and its correlation with histopathological diagnosis.

Aims and objectives

The aims of study were:

- To detect and evaluate benign and malignant ovarian lesions.
- To correlate between radiological (USG and CT scan) and histopathogical findings in malignant lesions.

Materials and methods

Study Sample: The present prospective study aimed at following up 84 suspected cases of ovarian lesions presenting at radiology department of Dhiraj hospital, by using HD9 Ultrasonography machines and 16 Slice Siemens and Toshiba Xpress GX CT scan machines.

Source: In addition to Baroda city and its suburbs, a large cross section of population comes to Dhiraj Hospital from the state of Madhya Pradesh and Maharashtra.

Inclusion criteria

- Only those patients willing to participate in the study were included.
- Patients referred to the radiology department for ovarian lesions investigation, and found to have positive findings, were included in this study
- All accidentally diagnosed cases of ovarian lesions were also be included in this study.

Exclusion criteria

- Patients presenting to radiology department not willing for examination or written consent, were excluded from this study.

Methods

Clinical: All 84 patients were subjected to a detailed clinical history and examination as outlined in Proforma.

Investigations routine blood investigations were documented in all patients:

- Complete hemogram, which include Hb, total and differential count, Erythrocyte sedimentation rate.
- Renal function test include blood urea and creatinine.
- Random blood sugar estimation; fasting blood sugar and 2 hours post prandial if required.
- Test for HIV and Hepatitis if required.

Radiological Investigation

- All of them were subjected to transabdominal sonography with full bladder technique with 3.5MHz and if required transvaginal sonography after voiding with 6.5 MHz Contrast enhanced CT scan of abdomen and pelvis with 16-slice Siemens machine and Toshiba express GX CT Scan machine.

Results

The present study was carried out at department of Radio diagnosis and imaging at SBKS Medical College and Dhiraj Hospital Piparia from May 2016 to April 2018. In our study ultrasonography and CT scan evaluated a total of 96 patients with clinically suspected ovarian pathology. All patients underwent gynaecology examination prior to referral for sonography.

The findings obtained by ultrasound were compared with those of CT scan to determine the accuracy of modality in diagnosis of ovarian pathologies and degree of echo texture detail provided by each method. Out of 96 patients who were referred to us, 4 were pregnant females and 8 were known postoperative case of ovarian malignancies, so excluded from study. A total 84 patients were examined and comparison done with Radiological and histopathological diagnosis. Demographic profile was as per **Table – 1**. The study comprised of 84 females, between age groups of 0 - 80 years.

Table - 1: Demographic profile.

Sr. No	Age group (years)	Total	%
1	0-10	2	2.3%
2	11-20	3	3.5%
3	21-30	24	28.5%
4	31-40	22	26.1%
5	41-50	14	16.6%
6	51-60	8	9.5%
7	61-70	8	9.5%
8	>70	3	3.5%
Total	84	84	100%

The peak incidence was observed in the age group of 21 – 30 years, which comprised 24 (28.5%) of patients. Ovarian lesions were observed least frequently in paediatric 5 cases (0 – 20 years) and 11 cases in geriatric age group (> 60 years) patients (**Table – 1**).

Table - 2: Disease profile in various age groups.

	0-20	21-40	41-60	>60	Total
Benign tumor	1	29	8	0	38
Malignant	4	16	14	9	43
Metastasis	0	1	0	2	3
Total	5	46	22	11	84

Table - 3: Final radiological diagnosis of benign lesions.

Types of conditions	No. of cases	%
Hemorrhagic cyst	9	23.6%
Tuboovarian abscess	6	15.7%
Mucinous cystadenoma	6	15.7%
Mature cystic teratoma	5	5.9%
Simple cyst	4	10.5%
Pcod	3	13.1%
Serous cystadenoma	3	13.1%
Brenner tumour	1	2.6%
Endometrioma	1	2.6%

A further classification of the age distribution based on major pathologies was done. There was total of 38 benign lesions, 43 malignant and 3 metastatic lesions noted. Benign lesions of ovary were noted to be more common in the age group

below 40 years making 30 out of 51 cases. The cases were clustered in 21-40 year with 29 out of 51 cases.

Table - 4: Final radiological diagnosis of malignant lesions.

Types of conditions	No. of cases	%
Immature cystic teratoma	6	13%
Serous cystadenocarcinoma	21	45.6%
Mucinous cystadenocarcinoma	12	26%
Endometroid carcinoma	2	4.3%
Mixed epithelial tumour	1	2.1%
Pseudomyxoma peritonii	1	2.1%
Fibroma	1	2.1%
Ovarian metastasis	3	6.5%

Table - 5: Clinical presentation.

Complaints	No. of patients	%
Pain	42	50
Mass	30	35.7
Back ache	30	35.7
Wt. Loss	28	33.3
Menstrual irregularity	34	40.4
Dysmenorrhoea	28	33.3
Infertility	11	13

Table - 6: Site.

Types of conditions	Left	Right	Bilateral	Total
Benign tumor	19	8	11	38
Malignant	10	19	14	43
Metastasis	-	-	3	3
Total	29	27	28	84

Table - 7: Association between CA 125 and ovarian tumors.

	CA 125
Ovarian malignancy	38 (82%)
Benign lesions	7 (18%)

Malignant lesions were noted in much older patients with 23 out of 33 cases seen in patients more than 40 years of age. The cases were clustered in > 60 year with 11 out of the 11 making of the cases. The oldest patient was 78 years of age while the youngest was 9 years of age. Metastases to ovary were noted in 3 cases and affecting older age groups (**Table – 2**).

In this study, 38 of the 84 lesions were benign and 43 were malignant. Of these benign lesions, hemorrhagic cyst was most common benign lesion presenting 9 (23.6%) of cases. The second most common lesion was mucinous cystadenoma 6 (15.7%) of cases (**Table – 3**).

The most common malignant tumours in this study were serous cystadenocarcinoma (45.6%) and mucinous cystadenocarcinoma (26%).Other malignant lesions included were immature cystic teratoma, ovarian metastasis, endometroid carcinoma, mixed epithelial tumours and pseudomyxoma peritonii (**Table – 4**). Clinical presentation was as per **Table – 5**. Site was as per **Table – 6**.

In our study, out of 46 malignant lesions, 38 (82%) shows raised CA-125 levels. Out of 38 benign lesions 7 (18%) showed raised CA-125 levels. In 4 cases of Tubo-ovarian abscess and 1 cases of endometriosis, raised levels of CA 125 detected (**Table – 7**).

Out of 38 patients with benign tumours, 37 patients were correctly diagnosed on ultrasonography, while 36 (95.8%) were correctly diagnosed when CT done. Out of total 43 patients with malignant tumours, 38 (88%) patients were correctly diagnosed on ultrasonography, while 43 (100%) patients were correctly diagnosed when CT was done (**Table – 8**).

Malignant lesions were predominantly hypo echoic. In 27 malignant lesions wall thickness was more than 3 mm. Internal septations and solid component were prominent features of malignancy. There was wall irregularity seen in 41.6% of cases of malignancies. Ascites and pleural effusion were also associated with ovarian malignancies (**Table – 9**).

On CT scan peritoneal deposits were seen in majority of malignant lesions. Fat and

calcification is prominent feature of teratomas. Brenner tumour shows bilateral calcification. Ascites and pleural effusion is also associated with malignancies (**Table – 10**).

The disease prevalence of malignant lesions in my study population was 55.95% on ultrasonography and 54.76% on CT Scan (**Table – 11**).

Table - 8: Comparison of pathological diagnosis and us findings.

Pathological diagnosis	No. of lesions	Correctly diagnosed at US	Correctly diagnosed at CT
Benign	38	37(97.4%)	36(95.8%)
Malignant	43	38(88%)	43(100%)
Metastasis	3	2(66.6%)	3(100%)
Total	84	77(91.6%)	82(97.6%)

Table - 9: Predominant findings on USG.

	ECHO			Wall thickness		Septations	Inner wall structures		Ascites
Types of conditions	**Hyper**	**hypo**	**mixed**	**(>3mm)**	**(<3mm)**		**smooth**	**irregular**	
Benign tumor	3	17	22	1	20	25	28	3	5
Malignant	8	20	16	27	3	35	6	35	20

Table - 10: Predominant findings on CT scan.

Types of condition	Benign	Malignant
Peritoneal deposits	0	28
Calcification	10	2
Ascitis	4	25
Enhancement	10	35
Metastasis	0	24

Table - 11: Comparative values of USG and CT scan in ovarian lesions.

	Ultrasonography	CT scan
Sensitivity	85.11 %	97.83 %
Specificity	94.59 %	92.11 %
Positive Predictive Value	95.24 %	93.75 %
Negative Predictive Value	83.33 %	97.22 %
Positive Likelihood Ratio	15.74	12.39
Negative Likelihood Ratio	0.16	0.02
Disease prevalence	55.95 %	54.76 %

Table – 12: Sensitivity and specificity of multidetector computed tomography in differentiating benign from malignant adnexal masses.

Author	Sensitivity (%)	Specificity (%)
Kinkel, et al.	81	87
Tsili, et al.	90	88
Liu, et al.	87	100
Our study	97	92

In evaluation of ovarian lesions, CT Scan (97.8%) was more sensitive than ultrasonography (85.1%), but sonography (94.5%) was more specific than CT Scan (92.1%) in diagnosis of malignant lesions. Ultrasonography (95.2%) has high positive predictive value as compare to CT Scan (93.7%) to diagnose malignant lesions. But negative predictive value of CT Scan (97.2%) was higher than ultrasonography (83.3%) to rule out malignant lesions.

Positive likelihood ratio of Ultrasonography was 15.74 as compare to CT Scan (12.39), means that if ultrasonography detects malignancy there will be 15.7 times more chances of having malignancy as compare to 12.3 times on CT Scan.

Discussion

Ovarian cancer is one of the most common gynaecological malignancies in India and worldwide [5, 6]. However, it has the highest mortality among all gynaecologic malignancies. The major reason for the poor prognosis is that, at the time of diagnosis, approximately 75% of patients have diseases that are at an advanced stage [7]. The early detection of ovarian carcinoma continues to be a formidable challenge and an elusive task. The risk of a woman developing ovarian cancer is 1 in 71 [8]. Adnexal masses can be benign or malignant and the benign masses greatly outnumber malignant ones [9]. In our study 45% of patients had benign lesion and 55% had malignant lesion. This discrepancy was mainly due to selection bias. When an ovarian mass is detected, there are two major issues: to determine whether it is benign or malignant and then if it is malignant, to look for the extent of disease [10, 11]. Precise characterization of an Adnexal lesion is important, Because of the obvious significant differences in prognoses between early and advanced cancers, early detection with accurate staging is of paramount importance [12]. However, we understand that surgery has a role in definite diagnosis and the further characterization of masses. Until the last decade, exploratory laparotomy was used for the diagnosis and staging of Adnexal masses, however, modern imaging techniques particularly ultrasonography (US), computed tomography (CT), and magnetic resonance (MR) imaging have indispensable role in the diagnosing and staging of ovarian carcinoma. If the nature of the mass is adequately determined on the image, then it saves the patient unnecessary surgery and it helps in further planning [13, 14]. Age is a major factor in determining the likelihood of cancer, with age-adjusted rates increasing as age advances. Multiparity and early age at first birth lower the risk and personal or family histories of breast or ovarian cancer increase the risk [15].

In our study, benign lesions of ovary were noted to be more common in the age group below 40 years and malignant lesions were noted in much older patients more than 40 years of age.

In a study by Kinkel, et al., Prevalence of ovarian cancer was 8.75% in premenopausal women and 32.40% in postmenopausal women with an ovarian mass [16].

Although tumour markers like CA-125, AFP, and HCG are indicative of ovarian cancer and germ cell tumours respectively, careful consideration inspite of the components of the masses and evidence of malignant spread are useful from a management aspect [17, 18]. Although widely used as part of the assessment of ovarian pathology, the results of the IOTA study suggest that measurements of serum CA 125 have a limited role in characterizing ovarian pathology, especially in premenopausal women. Incorporating serum CA 125 measurements into logistic regression models has no significant impact on performance of the model for women of any age [19]. In our study CA-125 was significant in 82% of malignant patients and in 18% of benign lesion. Bimanual pelvic examination and serum CA-125 levels have failed to allow consistent detection of ovarian malignancy. Owing to the sensitivities of these techniques is often below 50% [20].

Certain radiologic findings predominate for each type of tumor; knowledge of these key features of ovarian tumors may allow a specific diagnosis or substantial narrowing of differential diagnosis [21-23]. The image appearance of ovarian tumors ranges from cystic to solid masses. Although tumors have similar clinical and radiological findings, predominant or specific key features are present in each type of ovarian tumor [24-26]. Ultrasound is the first line modality to evaluate adnexal pathologies, to differentiate between benign and malignant lesions.

The greater use of transvaginal ultrasound scanning in everyday practice for the investigation of different gynaecological symptoms and conditions leads to an increasing number of ovarian cysts and other tumors that come to the attention of gynaecologists. The risk of ovarian cancer in these cysts is low, but much unnecessary anxiety can be caused and unnecessary intervention undertaken if a wrong diagnosis is made [27]. Ultrasound characteristics can be used to diagnose the classic-appearing non neoplastic entities, benign neoplasms and malignancies. The large size of an ovarian mass, with the other characteristics being equal, has been found to be a significant factor in predicting ovarian cancer. An early study in postmenopausal women found that tumors exceeding 10 cm were significantly more likely to be associated with malignancy [28]. This finding has been confirmed in several other studies; when single or multiple measurements were performed separately or as part of a multi parametric analysis, larger masses were significantly associated with an increased likelihood of ovarian cancer [29].

Multiple studies have explored the use of ultrasound screening in populations of women with varying degrees of risk for ovarian cancer in an effort to improve outcomes in women with an early diagnosis of ovarian cancer [30]. US performed with transabdominal and endovaginal techniques have demonstrated accuracies of up to 80% in evaluation of ovarian masses. The sensitivity of morphologic analysis with ultrasound in predicting malignancy in ovarian tumors has been shown to be 85%–97%, whereas its specificity ranges from 56%–95% [31-33]. Our results are comparable to previously published international literature [34, 35]. In other study ultrasonography had sensitivity (85.1%) and specificity (94.5%) in diagnosis of malignant lesions.

Sassone, et al. [36] proposed a morphologic scoring system using endovaginal US to characterize ovarian lesions and demonstrated a sensitivity of 100% and a specificity of 83% in distinguishing benign from malignant ovarian lesions. The sensitivity of morphologic analysis with US in predicting malignancy in ovarian tumors has been shown to be 85%–97%, whereas its specificity ranges from 56% to 95%.

Emphasizing morphologic characteristics of the adnexal masses, in so called pattern recognition, features like presence of mixed consistency or multi locular components, septa or excrescence could differentiate benign from malignant neoplasms [37]. This pattern recognition of adnexal masses reach a sensitivity of 86% and specificity of 80% when is performed by non-expert ultrasound examiner, and when performed by experienced one it has sensitivity of 90% and specificity of 93% [38]. In our study, predominantly hypo echoic, wall thickness was more than 3 mm, internal septations, solid component; wall irregularity; Ascites and pleural effusion were associated with ovarian malignancies.

Such sonographic features include the cystic and solid tumor compositions as well as the presence and type of septations and papillations. An important goal of the analysis of ovarian and adnexal masses is an attempt to identify nonneoplastic entities, such as functional cysts, tubal and inflammatory diseases, or endometriosis.

Joseph Yazbek, et al. concluded that, the sensitivity and specificity of ultrasonography was 2 of 5 (40%; [95% CI 6·5–84·6]) and 10 of 10

(100%), respectively, done by less experienced operators and 7 of 8 (88%) and 27 of 28 (96%), respectively, in the experts operators [39].

Ultrasound characteristics can be used to categorize ovarian and adnexal masses, and pattern recognition can accurately diagnose some of the classic-appearing non-neoplastic entities, benign neoplasms, and malignancies.

Often, however, the sonographic appearance of an ovarian mass is not pathognomonic. It is in these indeterminate cases that an assignment of a relative risk of malignancy is beneficial for patient care. Features that have been found to contribute to malignancy risk include clinical issues such as age and cancer history, morphology and size of the mass and Doppler parameters. Thus, a multi parametric model for risk assessment is appropriate and more accurate in distinguishing between benign and malignant ovarian masses; however, the optimal model has yet to be developed. The ultimate approach to prospectively predicting ovarian malignancy by ultrasound should include a universal consensus of the clinical and sonographic risk parameters among radiologists and gynaecologists and gynaecologic oncologists with a multi parametric model that has an organized, coordinated template that is generally used, easily applied, and offers clear interpretations of relative risk.[(30)]Recently, building on the concept of pattern recognition, scoring systems were developed to more accurately discriminate between benign and malignant neoplasms [31]. One study [32] incorporated the patient's age, ovarian volume, Doppler velocimetry and vessel location, and echogenic predominance of the mass (suggestive of a dermoid) with the morphology scale of Sassone, et al. [36] to compute the ovarian tumor index, a calculated probability of malignancy based on the weighting of each of the listed parameters. The ovarian tumor index was found to be discriminating for predicting ovarian malignancy in the clinical scenario of a suspected adnexal mass, with a receiver operating characteristic (ROC) of 0.91. In April 2009, results of the prevalence screen of the United Kingdom Collaborative Trial of Ovarian Cancer Screening was published [40] this study was the largest randomized controlled trial of ovarian cancer to date, randomly assigned more than 200,000 postmenopausal women to one of three screening arms: no screening (control group because this is the current standard of care), ultrasound screening only, and annual multi technique screening with transvaginal ultrasound and a serum CA-125 assay.

Both screening techniques performed well. The annual multi technique screening strategy had a significantly better specificity (99.8%) than did the ultrasound screening only strategy (98.2%), resulting in fewer repeat tests and less surgery. The sensitivity forthe detection of primary epithelial cancers of the ovaries and fallopian tubes was better with the annual multi technique screening (89.4%) than with the ultrasound screening only (84.9%) method, but the difference was not statistically significant. Over diagnosis of borderline ovarian cancers was more of a problem using the ultrasound only method than with the multi technique method?

Doppler examination was once thought to be the key in distinguishing between benign and malignant masses because the vascular characteristics within a malignant neoplasm often differ from those of a benign neoplasm. Malignancies often exhibit their increased flow signals not only at the periphery of the mass, as seen with benign lesions, but also in the central regions of the mass, including within septations and solid tumor areas [40]. Studies of contrasted-CT and MRI have shown accuracies of almost 80% in diagnosis of cancer [14]. A meta-analysis by Kinkel, et al. described that CT shows sensitivity and specificity of 81% and 87% respectively when used for indeterminate masses seen on ultrasound [35].

As per **Table - 12**, Liu, et al. reported that PET/CT scanner shows a sensitivity of 87% and specificity of 100% for differentiating benign from malignant ovarian cancers [35]. Tsili, et al.

also described in their study that MDCT can categorize adnexal masses into benign and malignant in up to 93% and 89% of the cases [34]. Our study reported a sensitivity and specificity of 97% and 91%, respectively. A meta-analysis by Jingzhe Liu, et al reported CT scan sensitivity 89% and specificity of 84% [12]. In a recent meta-analysis, Kinkel, et al. [16] showed that in women with an indeterminate ovarian mass at gray-scale US, MRI is superior to CT or combined gray-scale and Doppler US in differentiation of malignant from benign ovarian tumors. In the present study, we found that CT scan was not superior than sonography significantly. Some discusses must be addressed for this disparity. First, Kinkel's meta-analysis was used to evaluate the performance of combined grayscale and Doppler US, CT, and non-enhanced or contrast material-enhanced MR imaging after initial gray-scale US with indeterminate results. So Kinkel, et al. included only the studies with indeterminate ovarian mass. In our study differentiation of malignant from benign ovarian tumors was by using sonography and CT scan. Another is, results of Kinkel's study also supported that the selection of study cohort had significant effect on the performance of image modality. But in another meta-analysis by Jingzhe Liu et al reported that sensitivity and specificity estimates of all imaging modalities were comparable: 89%, 84% for US, 85%, 86% for CT, and 89%,86% for MR imaging (P = 0.12). It is well demonstrated that US is superior in predicting benign status, however it is less accurate when used to predict malignancy, especially the early carcinoma. Therefore, a greater prevalence of ovarian cancer in the study cohort would likely have a negative effect on diagnostic efficiency for US. It is also likely the prevalence of ovarian cancer affected diagnostic accuracy of CT scan. Unfortunately, the small number of data sets of sonography and CT scan prevented us to study the effect of these variables [12].

Our study shows high accuracy (>90%), however, there were two false positive and one false negative result. Lesions characterized as have false negative imaging characteristics similar to benign lesions, i.e., less than 4 cm in size, smooth walls without thick septations, making evaluation of these tumors difficult. Similarly, regarding false positive results, these lesions have characteristics of malignant lesions, i.e., solid lesions with necrosis, infiltration to adjacent organs and the presence of ascites. These features make it difficult to recognize on images, resulting in false positive and negative results. Other possibilities include interpretation error or not using reformatted images properly. Our study has a few limitations besides the small number of patients in study group sample and only those patients who were referred to CT scan were included, which introduces bias.

Conclusion

Ultrasound by virtue of non-invasiveness, lack of radiation hazard and by ability to demonstrate structural changes in organ is investigation of choice in ovarian pathology and it can easily detect solid to cystic lesions and characterize the size, shape and extent of lesion. Computerized Tomography is particularly useful to know the enhancement pattern of the lesion, density and extent and staging of malignancies.

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