Original Article

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Radiology Section

Ovarian Masses: Hitting the Oncological Dart with Ultrasound and CT - A Comparative Study in a Remote Northeast Indian Town

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ABSTRACT

Introduction: Ovarian cancer is the second most common gynecological malignancy in Indian women after cervical carcinoma. It is a giant killer with the worst prognosis amongst all gynecological malignancies, primarily due to late diagnosis. Therefore, radiological evaluation of ovarian masses is pivotal in making early diagnosis and lesion characterization thereby determining the therapeutic approach.

Aim: To assess the individual and relative role of Ultrasonography (USG) and Computed Tomography (CT) in evaluation of benignity and malignancy of ovarian masses with pathological correlation.

Materials and Methods: After approval from Institutional Ethical Committee, a prospective study was conducted in the Department of Radiology, Assam Medical College and Hospital, Dibrugarh, India for duration of 1 year from June 2013 to May 2014. Total 52 patients with clinically suspected ovarian masses were evaluated by USG and CT. Pathological evaluation was taken as gold standard. Sensitivity, specificity and diagnostic accuracy of both modalities in determining benignity and malignancy were calculated. Kappa value was used for assessing inter modality agreement on various parameters. Final results were compared by Chi-square test.

Results: USG showed 76.43% sensitivity, 83.33% specificity and 78.85 accuracy. CT showed 91.17% sensitivity, 77.77% specificity and 86.53% accuracy. Two tailed p-value for USG and CT calculated by Chi-square test was 0.1133; marking a statistically insignificant association.

Conclusion: USG should be the primary modality to evaluate a suspected ovarian mass pertaining to its high specificity in delineating benign from malignant masses, a high morphological sensitivity for the lesion and the lack of radiation. In a suspicious lesion, CT is advised as second modality due to its high sensitivity for malignancy and its associated features.

Keywords: Epithelial tumour, Germ cell tumour, Gynaecological imaging, Serous cystadenocarcinoma

INTRODUCTION

Adnexal lesions especially ovarian masses are a common presentation amongst women of all age groups and all social strata. Pertaining to their wide spectrum of diagnostic variation, they often perplex both the physician and the radiologist. While the docile benign ovarian lesions may be treated conservatively, the aggressive neoplastic lesions often require radical surgical and associated oncological treatment.

Ovarian cancer is a silent killer as it is conspicuous by its late diagnosis and low 5 years survival rate of 45%. It is second only to cervical cancer in gynecological malignancies in India and has a worldwide prevalence [1,2].

Therefore, radiological evaluation of ovarian masses is pivotal in making early diagnosis and lesion characterization, distinguishing between benign and malignant masses thereby determining the therapeutic approach. Various diagnostic modalities such as USG, CT and now MRI have come to the rescue of the diagnostician for solving these dilemmas [3].

USG is typically the first study to be requested in patients with clinical findings that may suggest ovarian mass. The advantages of a USG are its wide availability, low cost and accuracy for morphological characterization. However, a considerable percentage of the ovarian masses may be considered as indeterminate on USG [4].

It is for such lesions that cross-sectional imaging techniques are pivotal. MRI can provide precise anatomical localization

and meticulous lesion characterization; thereby significantly narrowing down the differential diagnosis. However, in a country like India, especially in the remote locations, availability and cost effectiveness are major issues that are preventing MRI to be the second line modality after USG for evaluating ovarian masses. CT on the other hand has wide availability, relative cost effectiveness, rapidity and provides a larger field of view allowing comprehensive evaluation of the abdomen [5,6].

This study aims at assessing the individual and relative role of USG and CT-scan in evaluation of ovarian masses to identify the superior diagnostic modality in determining the benignity and malignancy of ovarian masses. Histopathological Examination (HPE) or cytological evaluation were taken as gold standard for comparison.

MATERIALS AND METHODS

After due Institutional Ethical Committee clearance, a one year prospective comparative study was done at Department of Radio-Diagnosis, Assam Medical College & Hospital, Dibrugarh, Assam, India.

Patient Selection

The study comprised of 52 patients of age group >18 years having symptoms related to ovarian masses.

Patients of age 0 to 18 years, midline uterine mass lesions on USG, clinically and sonographically proven cases of ectopic pregnancy, sonographically validated benign cystic ovarian lesions such as functional cysts in patients of reproductive age group and patients with known Iodinated contrast allergy were excluded from the study.

Protocol

USG Protocol: Study was done on Siemens ACUSON Antares 5 Ultrasound System. Transabdominal USG was done by 3.5-5 MHz curvilinear probe, Transvaginal USG was done by 8-12 MHz endoluminal probe wherever found necessary and the patient consented.

CT Protocol: Study was done on Siemens Somatom Spirit Dual Slice CT. After being NPO for 6-8 hours, patients were given dilute oral contrast agent (20% Urograffin) 45 minutes before the study. After informed consent, Initial plain CT was followed by contrast scan by injecting 2ml/kg body weight Iodinated low Osmolar non-ionic monomer. Scanning was done from top of diaphragm till symphysis pubis. Scanning parameters were spiral mode with slice thickness of 6mm and collimation 6 x 2.5 mm, pitch: 1.4; kVp: 130; mAs: 80. Appropriate post processing and Image reconstruction was done.

Assessment: The imaging results were analyzed for lesion origin, size, morphological characters and features of metastatic disease. Final result was marked as-benign or malignant.

In USG the lesions with larger sizes, intralesional solid component, multilocularity, wall thickness of >3 mm, papillary projections and presence of associated features of metastatic disease such as ascites, omental deposits and lymphadenopathy were considered to indicate malignancy [7,8].

In CT a lesion of larger size, solid-cystic mass, wall irregularity, presence of enhancing solid component or septae, papillary projections and features of metastatic disease were considered to indicate malignancy [9].

Lesions having ≥ 3 indicators of malignancy were considered malignant.

Radiological diagnosis was confirmed either by HPE or FNAC, which were considered as the gold standard.

STATISTICAL ANALYSIS

The results of USG and CT in depicting benignity and malignancy were compared with the pathological results by calculating sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy for both modalities.

Cohen's kappa coefficient and Chi-square test were used to demark intermodality agreement and differences respectively. All calculations were done by using Microsoft Excel 2010 and MedCalc Software.

RESULTS

Demographics: We evaluated 52 patients from 18 to 62 years of age with Mean age of 41.94 years. Most patients presented in the 4th decade [Table/Fig-1].

Menstrual History: Post menopausal patients predominated the study with 51.92% prevalence. Total 34 patients were proven to have malignant lesions out of which 23 (67.64%) were post menopausal. Whereas, 14 (77.77%) out of the 18 patients with benign lesions were premenopausal.

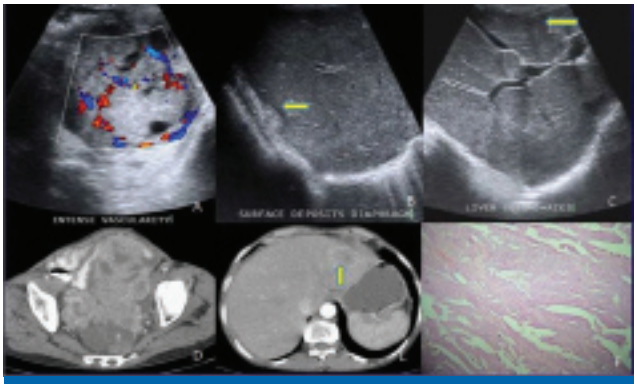
Clinical Presentation: Pain abdomen was the most common presenting feature in 86.54% cases followed by swelling of abdomen, seen in 73.08% cases.

Lesion Type: Epithelial tumours, benign and malignant formed 60% of our study group while malignant epithelial tumours formed 67.64% of malignant cases. Benign cystic teratoma was the most common benign lesion seen in the premenopausal group (12%). Serous cystadenocarcinoma was the most common malignant tumour in both premenopausal (20%) and post-menopausal (51.85%) groups. Metastasis formed a considerable 12 % amongst the post-menopausal malignant lesions. One case of dysgerminoma (1.9% prevalence) in a young patient was found. Known or concordant malignancy was found in six cases [Table/Fig-2-5].

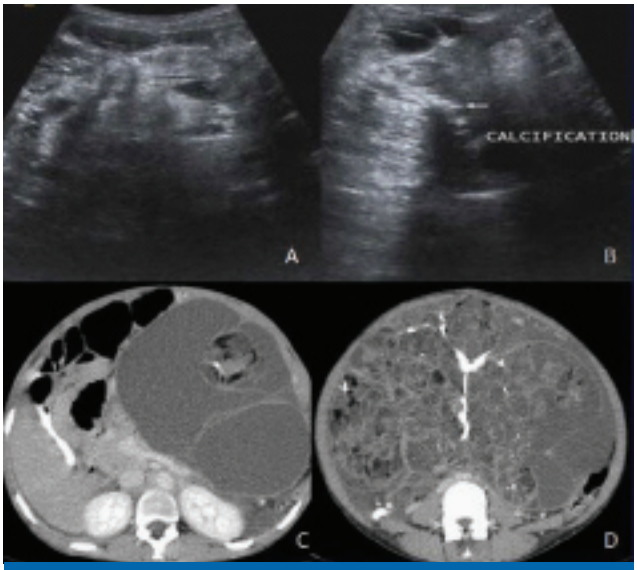
Age Group (in years)	Number (n)	Percentage (%)
18–20	3	5.77
21–30	10	19.23
31–40	11	21.15
41–50	17	32.69
51–60	10	19.23
61–70	1	1.92
Total	52	100.00

[Table/Fig-1]: Age distribution.

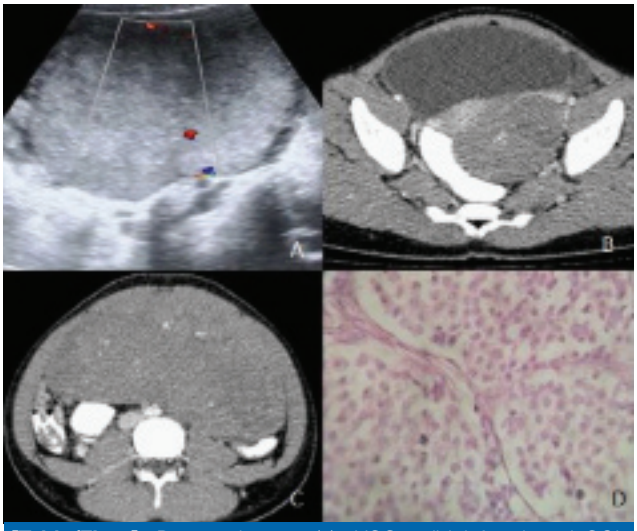
Lesion Characteristics on USG and CT [Table/Fig-6]: Cystic lesions were equally distributed in benign and malignant patients. However, solid lesions were largely (70%) malignant. CT was more sensitive in detecting lesion size and laterality. 75.8 % of large lesions, having >10 cm size were found to be malignant.



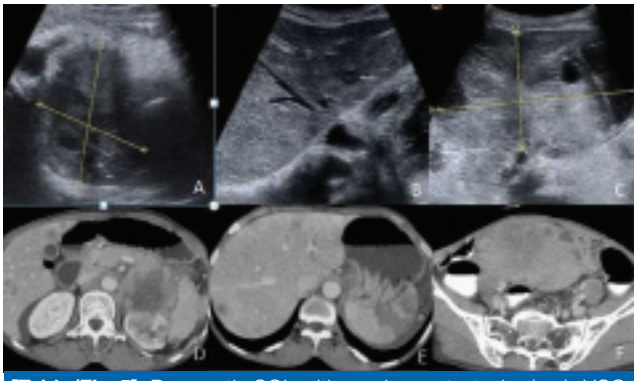
[Table/Fig-2]: Serous cystadenocarcinoma in a postmenopausal patient- (a-c): USG showing pelvic solid cystic lesion with intense vascularity; hyperechoic diaphragmatic deposits and hypoechoic focal hepatic lesion suggestive of metastasis; (d-e): axial contrast enhanced CT showing Ill-Defined enhancing solid cystic pelvic SOL with ascites and peripherally enhancing hypodense hepatic focal lesion suggesting metastasis; (f) HPE proving papillary serous cystadenocarcinoma.



[Table/Fig-3]: Benign cystic teratoma- (a-b): USG shows solid component of large pelvic SOL with fat and calcification; (c-d): Axial enhanced CT shows large solid cystic SOL filling pelvic cavity with macroscopic areas of fat and calcification.



[Table/Fig-4]: Dysgerminoma- (a): USG solid left adnexal SOL with vascularity; (b-c): Axial CECT: Bilateral solid adnexal SOLs in a young patient with moderate post contrast enhancement; (d): HPE (H & E;40 X) show multiple round cells arranged in well defined nests separated by fibrous strands, consistent with dysgerminoma.



[Table/Fig-5]: Pancreatic SOL with ovarian metastasis- (a-c): USG shows heterogenous SOL in tail of pancreas with hypoechoic hepatic metastases and solid right adnexal SOL. (d-f): Axial enhanced CT confirms the USG findings showing a splenic infarct and free fluid in peritoneal cavity.

The characters of cystic components of the lesions in order to derive a comprehensive character association with benignity and malignancy by both modalities was analyzed.

Amongst the 42 solid cystic and purely cystic lesions, CT (27 cases) was better in detecting a wall thickness of >3 mm than USG (24 cases). USG detected papillary projections better (13 cases; sensitivity: 100%) than CT (12 cases; sensitivity: 83.33%). In all 11 out of these 13 cases were found to be malignant, thereby strongly linking this finding with malignancy in this study.

	USG		CT	
	Benign (n = 18)	Malignant (n = 34)	Benign (n = 18)	Malignant (n = 34)
Type of Lesion:				
Solid	1	7	1	9
Cystic	10	6	10	5
Solid Cystic	7	21	7	20
Size of Lesion:				
<10 cm	9	15	11	12
> 10 cm	9	19	7	22
Laterality:				
Unilateral	15	14	15	15
Bilateral	3	20	3	19
Wall Thickness:				
< 3mm	12	8	11	4
> 3mm	5	19	6	21
Papillary Projection	2	11	2	10
Septations	10	21	10	21
Solid Component	6	25	6	20
Fat/Calcifaction	5	13	5	15
Associated Findings:				
Ascites	5	27	5	27
Omental Thickening	0	19	0	21
Hepatic Metastasis	0	5	0	5
Ureteric Invasion	1	2	1	3
Lymphadenopathy				
Pelvic	0	0	1	7
Para-aortic	0	8	0	10

[Table/Fig-6]: Characters of benign and malignant lesions on USG and CT.

Multilocular cystic component was seen in 31 cases (73% prevalence amongst cystic lesions). A large proportion (21cases) were proven malignant comprising of a large 84% prevalence in the malignant group. Both USG and CT depicted all 21 malignant lesions as multilocular showing 100% sensitivity.

Total 31 cases showed solid component within the cyst. A striking 24 out of 25 malignant cases (96%) showed solid components. USG showed a sensitivity of 100% while CT only 83.33% in detecting solid component in malignant cystic lesions.

In all 32 cases presented with peritoneal free fluid on both USG and CT, out of which 27 (84.3 %), were found to be malignant.This is the most common associated finding in this study.

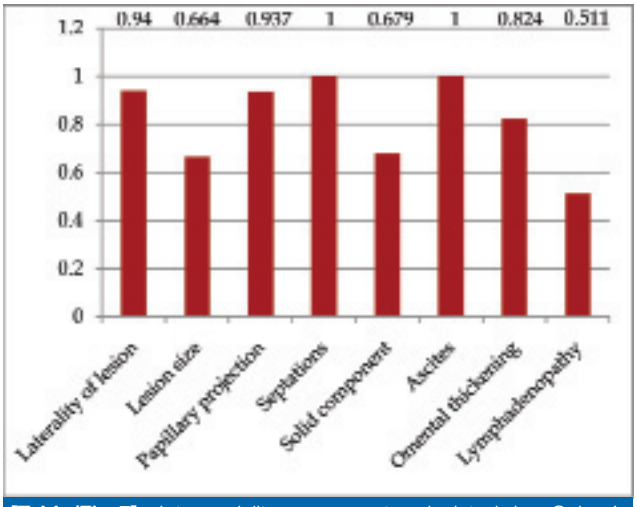
The second most common associated finding was omental thickening. CT was better in detecting this finding in 21 cases in comparison to USG which showed it in 19 cases. It showed a significant prevalence in the malignant group 20 of 34 malignant cases (58.82%) suggesting it as a feature of malignancy.

CT was significantly better showing lymphadenopathy in 17 malignant cases while USG could detect only 8 cases with a sensitivity of 90% and 44.44% respectively. 94.4% cases having lymphadenopathy were malignant. Hepatic metastasis seen in 9.62% cases and pleural effusion seen in 5.76% cases were detected equally by both modalities.

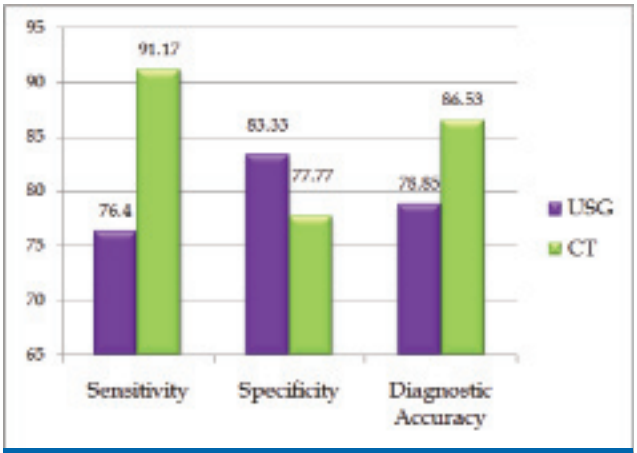
Intermodality agreement for various parameters is depicted in [Table/Fig-7].

Benignity vs Malignancy: In this study, 34 cases (65.38%) were pathologically proven to be malignant while 18 cases (34.6%) were proven to be benign.

USG diagnosed 23 cases to be benign and 29 cases to be



[Table/Fig-7]: Intermodality agreement calculated by Cohen's Kappa value for benign and malignant cases. Intermodality agreement (K value): Very Good to Perfect = 0.80 to 1.00; Good= 0.60 to 0.80; Moderate = 0.40 to 0.60.



[Table/Fig-8]: Statistical analysis of USG and CT in depicting benignity and malignancy (all results in %).

malignant while CT diagnosed 17 cases as benign and 35 cases as malignant. Statistical analysis of final results is shown in [Table/Fig- 8].

The p-value for depiction of USG and CT in depiction of malignancy was found to be 0.1133 which was statistically insignificant.

DISCUSSION

Despite various advances in imaging techniques, ovarian cancer remains to be substantial threat to Indian women being the third most common neoplasm with worst prognosis among all gynecological malignancies [1,2].

Therefore, radiological evaluation is pivotal in characterization of an ovarian mass suggesting the probable etiology of the mass and distinguishing between benign and malignant masses [3]. The results of radiologic assessments helps decide the surgeon about whether the therapeutic approach needs to be surgical or conservative [4].

While most lesions in the reproductive age group are fortunately benign, the prevalence of malignant lesions increases significantly with age and menopause. We found a striking 84% prevalence of malignancy in age group >45 years. The higher prevalence of malignancy in this study is attributed to the study hospital being a tertiary centre, more likely to get malignant patient referrals and our study group selection which prevented CT evaluation in reproductive age group patients impeccably determined to have benign lesions on USG examination [4,10,11].

Epithelial tumours were found to be the most common histological type representing 60% of the study group and 67.6% of the malignant lesions. Serous cystadenocarcinoma was the single most common histological entity with 36.53% prevalence and a striking predominance in post-menopausal patients. Germ cell tumours are the second most prevalent histotype; forming 17 % of the study group, with a marked predominance in the younger age group. Mature teratoma is the most common benign ovarian tumour in women of age less than 45 years. Prevalence of germ cell tumour is 1-2 % with predominance in young patients [12].

USG remains the primary modality for detection and characterization of ovarian masses. Major advantages of USG include its easy availability and good morphological characterization. Lesion characters like size, solid/cystic consistency, shape, probable organ of origin and relationship to surrounding pelvic structures are helpful in the decision making process. Majority of ovarian masses can be adequately characterized with US alone. Lesions that are indeterminate, poorly visualised or inadequately localized warrant further characterization by MRI and CT [13,14].

CT is primarily used in cases of suspected malignancy in order to assess the extent of the disease in pre-operative setting, pertaining to its larger field of view and its comprehensive approach which provides a better evaluation of lymphadenopathy, omental deposits and genitourinary involvement in a single setting. Also, in patients with recurrent or residual ovarian carcinoma, CT-scan act as an alternative to second Laparotomy [15,16].

This study showed that USG was more sensitive in lesion characterization such as solid or solid cystic consistency of lesion, presence of papillary projections, septations and presence of solid component within a cystic lesion. CT was more sensitive in detecting lesion size and laterality. CT was found to be 100% specific in detecting presence of fat/calcification [17].

While there was good to perfect agreement between USG and CT in various parameters as per Kappa value suggesting concordant role of both modalities in lesion characterization; CT was significantly superior to USG in detecting lymphadenopathy with a sensitivity of 91% as against 44.4% sensitivity of USG for this parameter. CT was also more sensitive in detecting ureteric invasion [Table/Fig-7] [11,15].

Overall, USG was found to be better in depicting lesion morphology while CT was found to be better in detecting extent of lesion and features of metastasis [17].

Morphological assessment of our cases with both USG and CT revealed that the presence of certain features such as a larger lesion size (>10 cm) (75.8%), papillary projections (84.6%), multilocularity (67.7%), solid component (96%) and associated features of metastasis such as peritoneal free fluid (84.3%) and lymphadenopathy (94.4%) are predictors of malignant disease. However, we do not conclude that these findings are accurate in their solitary presence, rather their presence in a case of ovarian mass together (we suggest > 3 findings) is more relevant in detection of malignancy [8].

We found a striking specificity of 100% given by the presence of fat/calcification for germ cell tumours. CT was the better modality with a 100% sensitivity and specificity for detection thereby proving to be the modality of choice in evaluation of germ cell tumours [18].

Finally, In detecting malignancy in a suspicious ovarian mass, we found USG to be less sensitive but more specific than CT. Overall diagnostic accuracy of CT was more than USG but we did not find any statistically significant difference in the results of both modalities in detecting benignity and malignancy (p-value >0.05).

The findings of this study are corresponding to the results of Ahmed A et al., [15] who found Trans Abdominal Sonography (TAS) to be 78% sensitive and 88.8% specific and CT to be 91% sensitive and 81.4% specific in evaluating benignity

and malignancy in adnexal masses. While we are discordant with the results of USG in the study of Behtash N et al., [11] showing a sensitivity of 91.2% and specificity of 68.3%; there is close similarity in CT results of current study with them,showing 85.3% sensitivity and 56.1% specificity. Verit FF et al., [16] while evaluating the diagnostic accuracy of different techniques in diagnosis of ovarian tumours in premenopausal women, found USG to be 83% sensitive and 92% specific and CT to be 91% sensitive and 96% specific.

The results of present study suggest that in diagnosing and determining the benign or malignant potential of an ovarian mass, both USG and CT have concordant roles. CT is more sensitive in determining the malignant lesions, USG is more specific and the difference between the two is statistically insignificant. In most findings both modalities show strong agreement to each other,in lesion characterization USG is a better modality while for defining the extent of disease and associated features of malignancy CT is slightly better.

LIMITATIONS

The current study was carried out in a demographic location where economic and availability issues prevented MRI to be a routine radiological modality for pelvic imaging.

Also, in women of reproductive age group, when we found definitely benign cystic ovarian lesions such as functional ovarian cysts on USG, we did not further proceed for CT in order to avoid unnecessary radiation exposure. This may have led to post-menopausal predominance in our study group.

CONCLUSION

USG is easily accessible, economically viable option and is capable of accurate morphological assessment of an ovarian lesion. Also, pertaining to its acceptable sensitivity and a high specificity in depicting malignancy, USG should continue to be the primary radiological modality in evaluation of ovarian masses even today when cross sectional imaging has largely taken over gynecological imaging.

However, if a lesion remains indeterminate on USG or is suspicious for malignant potential, CT is advised as the second radiological modality pertaining to its high sensitivity for evaluating malignant lesion and associated features of metastasis and local disease extent. In presence of a suspicious lesion CT is beneficial in detecting an early stage carcinoma and planning management.

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