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Original Article

Obstetrics and Gynaecology Section

Comparison of Ultrasound and CT Findings of Pelvic Masses with Histopathology: A Cross-sectional Study

YASHI[1], MANOJ MATHUR[2], MANPREET KAUR[3], ARSHDEEP KAUR[4]

ABSTRACT

Introduction: Benign and malignant pelvic masses can occur in different age groups, primary diagnosis and choosing the appropriate surgical procedure is very important. Ultrasound (USG) is the diagnostic test of choice in evaluating pelvic masses, while Computed Tomography (CT) scan is most helpful as a second-line study, for in-depth evaluation of the abdomen and pelvis.

Aim: To compare the findings of ultrasound and CT scans of pelvic masses with definitive histopathological or laboratory findings.

Materials and Methods: A cross-sectional study was conducted at Government Medical College and Rajindra Hospital, Patiala, Punjab, India, from December 2014 to September 2015. Sixty patients from Outpatient and Inpatient Department, with clinical suspicion of pelvic pathology, were evaluated sonographically and then by CT scan. Ultrasound characterisation of mass as high or low risk was done based on septae and solid part echogenicity. CT findings used to diagnose malignancy were cystic solid mass, necrosis in a solid lesion, cystic lesion with thick, irregular walls or septa, and/or papillary projections. The presence of ascites, lymphadenopathy, omental cake, peritoneal deposits, mesenteric deposits was noted to diagnose metastasis. Data was analysed using Statistical Package for Social Sciences (SPSS) version 16.0. A p-value was calculated using Chi-square test. For finding, the level of agreement between USG/CT scan and histopathology, Kappa statistic was applied.

Results: Ultrasound had sensitivity of 73.7%, specificity of 80.3%, Positive Predictive Value (PPV) of 53.8% and Negative Predictive Value (NPV) of 90.7%. Computed tomography scan had a sensitivity of 78%, specificity of 95.08%, PPV of 83.3%, and NPV of 93.5%. Kappa statistics showed moderate level of agreement between USG and histopathological findings (k=0.47, p-value=0.017) and good level of agreement between CT scan and histopathological findings (k=0.68, p-value=0.001).

Conclusion: Ultrasound with its good sensitivity can be used as an effective screening modality for pelvic masses. Computed tomography scan has better specificity than USG and should be used as a confirmatory investigation.

Keywords: Benign, Computed tomography, Malignant, Mass, Pathology, Radiology

INTRODUCTION

It has always been difficult to venture into the complex anatomical region of the pelvis. Hence, pelvic masses are difficult to evaluate. As benign and malignant pelvic masses can occur in different age groups, primary diagnosis and choosing the appropriate surgical procedure is very important. Clinically, these masses are detected in the advanced stage when they become large enough to cause pressure symptoms and symptoms like pain in the abdomen, and bleeding per vaginum or per rectum [1].

Ultrasound is the diagnostic test of choice in evaluating pelvic masses and may diagnose >90% of the pelvic masses. In the study conducted by Raju P et al., the overall sensitivity of Ultrasound (USG) was 79.2% and specificity was 85.5% [2]. In the study conducted by Karthikeyan B et al., the sensitivity of USG was 89%, and specificity was 84% [3]. In the study conducted by Liu Y et al., the sensitivity, specificity, and accuracy of ultrasound were determined to be 52.8%, 86.7%, and 68.75%, respectively [4]. Beyond 7 cm, the diagnostic performance of ultrasound decreases [5]. Transabdominal ultrasound gives an overall assessment of organ size and anatomy, whereas transvaginal ultrasound with its higher image resolution gives more detailed information about pelvic structures and masses [6].

Computed Tomography (CT) scan is not recommended for the initial evaluation of pelvic masses because ultrasound is less expensive and results in no radiation exposure. In the study conducted by Raju P et al., the sensitivity of CT scan was 97.6%, specificity 91.4% [2]. In the study conducted by Karthikeyan B et al., CT was found to have 98% sensitivity, 91% specificity, and an accuracy of 96% in the differentiation of benign and malignant ovarian masses [3]. In the study conducted by Liu Y et al., the sensitivity, specificity, and accuracy of CT scan were determined to be 80.3%, 90.3%, and 85%, respectively [4].The novelty of the present study is that, various types of pelvic masses have been studied, whereas in studies by Raju P et al.,[2] and Karthikeyan B et al., [3], only ovarian masses were studied. Computed tomography is helpful as a second line of investigation, for in-depth evaluation of the abdomen and pelvis when malignancy is suspected [7]. Reimaging of mass with USG can be done in case of abnormal CT findings for better clarification of vascularity of mass and indications uniquely suited to USG like pregnancy [8].

The present study was conducted with objectives:

- Detection of pelvic mass suspected on clinical examination using USG and CT scan and to find its site of origin.
- To classify the detected pelvic masses as benign or malignant.
- To compare the findings of USG and CT scan with definitive histopathological or laboratory findings.

MATERIALS AND METHODS

A cross-sectional study was conducted at Government Medical College and Rajindra Hospital, Patiala, Punjab, India, from December 2014 to September 2015. Permission from the Institution's Ethics Committee was taken {Trg 9(310)2022/17861}. Informed written consent was obtained from all the selected patients. A total of 60 patients with clinically suspected pelvic masses (age 2-81 years, 57 females and three males) who visited the hospital during the stated

duration of the study form the sample population and they were evaluated sonographically first and then by CT scan.

Inclusion criteria: Patients with clinically suspected pelvic mass, and patients with sonographically diagnosed pelvic mass were included in the study.

Exclusion criteria: All pregnant female and patients with deranged renal function tests were excluded from the study.

A total number of masses was 80, as some of the patients had more than one mass. History, clinical findings, and biochemical investigations including routine investigations (complete blood count, renal function tests, liver function tests, urine complete examination) and tumour markers, relevant to the suspected tumour were recorded in performa.

Study Procedure

Ultrasound: USG was performed with Philips envisor or Philips US unit HD3 and Wipro GE Logic 200 alpha machines. Ultrasound scanning was done in supine position, with urinary bladder physiologically distended to provide an acoustic window in pelvis for Transabdominal Sonography (TAS). Transvaginal sonography and Transrectal ultrasound were performed on an empty bladder. Evaluation was limited to TAS in virgins, and for large masses which exceed the maximum field of view of the transvaginal transducer. No specific preparation was given prior to the examination, only unco-operative patients (mostly paediatric age group) were studied after mild sedation. Ultrasound characterisation of mass as high or low risk was done based on septae and solid part echogenicity.

Computed tomography: CT scan was performed on Siemens-somtam Emotion 6 slice third generation spiral CT. The patient was scanned from base of the lungs to symphysis pubis in supine position after intravenous injection of non ionic contrast (like ioversol) in portovenous phase with a scanning delay of 60-90 seconds. Oral or rectal contrast was given, if the patient's clinical condition permitted. Image slices of 8 mm thickness were obtained followed by reconstruction in sagittal and coronal sections. CT findings used to diagnose malignancy were, cystic solid mass, necrosis in a solid lesion, cystic lesion with thick, irregular walls or septa, and/or papillary projections. CT abdomen-pelvis protocol was used. The presence of ascites, lymphadenopathy, omental cake, peritoneal deposits, and mesenteric deposits was noted to diagnose metastasis.

Histopathological examination: The histopathological examination was the gold standard for diagnosis. Biopsy material included resected specimen or biopsy from the lesion. All the specimens were fixed in 10% formalin, sectioned, and subjected to macroscopic and microscopic examination. Thin sections were prepared from the area of growth, adjoining areas and any separate tissue received like omentum and lymph nodes. Tissue sections were stained with routine Haematoxylin and Eosin (H&E) stain. The slides were then subjected to the histopathological examination, under both low power (100X) and high power (400X), serial sections were examined wherever required.

The study outcome was considered in the following ways:

- **True positive:** A mass with ultrasound findings or CT findings of malignancy getting confirmed on histopathology.
- **False positive:** A mass with ultrasound findings or CT scan diagnosis of malignancy turned out to be benign in nature on histopathology.
- **True negative:** A mass which was described as benign on USG or CT scan, proved to be benign on histopathology.
- **False negative:** A mass which was diagnosed as benign on USG or CT scan was diagnosed as malignant on histopathology.

STATISTICAL ANALYSIS

Data was analysed using Statistical Package for Social Sciences (SPSS) version 16.0 software. A p-value was calculated using Chi-square test and a p-value <0.05 was considered statistically significant. Sensitivity, specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV) were calculated. For finding the level of agreement between USG/CT scan and histopathology, the Kappa statistic was applied.

RESULTS

Both USG and CT diagnosed 30 cases of uterine masses, one pelvic abscess and two cases of carcinoma bladder. Adnexal masses diagnosed on ultrasound were 44 and on CT scan were 46. On USG, three masses remained indeterminate about their origin [Table/Fig-1]. On CT scan, two out of these three indeterminate masses, were diagnosed as adnexal masses and one was diagnosed as sacrococcygeal teratoma on CT. Indeterminate masses are the ones that cannot be definitively characterised as probably benign or possibly malignant, and they are considered indeterminate at USG. These sonographically indeterminate masses

S. No.	CT scan diagnosis	No. of masses	Total %	S. No.	USG diagnosis	No. of masses	Total %
1.	**Uterine masses**	30	37.5	1.	**Uterine masses**	30	37.5
	Leiomyoma	24	30.0		Leiomyoma	28	35
	Endometrial carcinoma	1	1.3		Endometrial carcinoma	1	1.3
	Carcinoma cervix	2	2.6		Carcinoma cervix	1	1.3
	Rhabdomyosarcoma uterus	1	1.3		Rhabdomyosarcoma uterus	0	0
	Leiomyosarcoma	2	2.6				
2.	**Extrauterine masses**	50	62.5	2.	**Extrauterine masses**	47	58.7
A	Adnexal masses	46	57.5	A	Adnexal masses	44	55
1.	Serous cystadenoma	14	17.5	1.	Serous cystadenoma	13	16.3
2.	Mucinous cystadenoma	6	7.5	2.	Mucinous cystadenoma	1	1.3
3.	Ovarian cyst	8	10	3.	Ovarian cyst	7	8.7
4.	Benign ovarian teratoma	4	5	4.	Benign ovarian teratoma	1	1.3
5.	Endometrioma	4	5	5.	Endometrioma	2	2.5
6.	Ovarian carcinoma	10	12.5	6.	Ovarian carcinoma	20	25
B	Miscellaneous	4	5	B	Miscellaneous	3	5
1.	Carcinoma urinary bladder	2	2.6	1.	Carcinoma urinary bladder	2	2.6
2.	Pelvic abscess	1	1.3	2.	Pelvic abscess	1	1.3
3.	Sacrococcygeal teratoma	1	1.3	3.	Indeterminate	3	3.8
Total		80			Total	80	100

[Table/Fig-1]: Diagnosis of origin of pelvic mass by CT scan and USG.

have avascular internal components, such as internal irregular thick septations or solid-appearing nodules without blood flow, or they are otherwise benign-appearing entities, such as haemorrhagic cyst, endometrioma, or mature teratoma, that cannot be entirely assessed with USG due to their large size and/or atypical features.

Final histopathological characterisation of the masses revealed that out of total 80 masses, 61 (76.3%) masses were benign in nature while 19 (23.7%) masses were malignant.

The number of females presenting with pelvic mass was 57 (95%) while that of males was 3 (5%), total patients were 60. Most of the subjects with benign pelvic masses (56.1%) were seen in age group of 20-39 years. Subjects with malignant pelvic masses (52.6%) were more common in age group of 60 and above [Table/Fig-2]. In the age group <10 years, there were total three children and all of them had a benign mass. In the age group between 10-19 years, there were two adolescents and both of them also had a benign mass.

Parameters	Final diagnosis			
	Benign		Malignant	
	n, %		n, %	
Age (years)				
<20	5 (12.2%)		0	
20-39	23	56.1	4	21.1
40-59	12	29.3	5	26.3
≥60	1	2.4	10	52.6
Total	41	100	19	100
Clinical presentation				
Pain abdomen	24	36.4	8	17.0
Menstrual disturbance	23	34.8	8	17.0
Mass/distension	11	16.7	6	12.8
Discharge per vaginum	0	0	2	4.3
Urinary symptoms	5	7.6	5	10.6
Bowel symptoms	3	4.5	1	2.1
Loss of weight	0	0	17	36.2

[Table/Fig-2]: Pelvic masses according to age group, clinical presentation and benign/malignant nature (N=60).
Pain abdomen was the most common clinical presentation in subjects with benign masses; Loss of weight was the most common complaint in subjects with malignant masses

Amongst the 46 adnexal masses, a total of 19 masses (including both benign and malignant) were found to have cystic consistency both on USG and CT scan [Table/Fig-3].

Consistency		Cystic	Mixed solid cystic consistency masses		Solid	Total	Test
			Predominantly cystic	Predominantly solid			
Consistency on CT							
Benign	n	17	11†	4†	1§	33	χ^2=7.74 p-value=0.02
	%	51.5%**	33.3%**	12.2%	3%	100%	
Malignant	n	2	2†	6†	3§	13	
	%	15.4%	15.4%	46.1%††	23.1%††	100%	
Consistency on USG							
Benign	n	15	13‡	5‡	0‖	33	χ^2=3.1, p-value=0.2
	%	45.5%‡‡	39.4%‡‡	38.5%	0.0%	100%	
Malignant	n	4	3‡	5‡	1‖	13	
	%	30.8%‖‖	23.0%	38.5%§§	7.7%	100%	

[Table/Fig-3]: Consistency of benign and malignant pelvic masses on CT scan and Ultrasound.
**On CT scan, majority of benign masses were cystic (51.5%) or predominantly cystic (33.3%); ††Majority of malignant masses were purely solid in 23.1% and predominantly solid in 46.1% cases (p<0.05); ‡‡USG finding of benign masses showed majority being cystic (45.5%) or predominantly cystic (39.4%); §§Malignant group showed that, overall the most common mass was predominantly solid mass (38.5%); ‖‖However, cystic and predominantly cystic masses combined together were more than 50% (p-value >0.05) on USG

On CT scan, metastatic deposits were absent in all the benign masses but were present among 11 (58%) of malignant masses (n=19) which was statistically significant (p-value <0.05). Presence of ascites, lymphadenopathy, omental cake, peritoneal deposits, mesenteric deposits was noted to diagnose metastasis. Ascites and lymphadenopathy were seen in few subject with malignant masses, as described in [Table/Fig-4]. However, omental caking, peritoneal deposits and mesenteric deposits were not found in any of the subjects with malignant masses.

Septal thickness on USG (N=46)	Number of cases			Percentage
No septae*	24	Benign	22	47.8
		Malignant	2	4.3
Thin septae ≤3 mm†	9	Benign	6	13.0
		Malignant	3	6.6
Thick septae >3 mm‡	13	Benign	5	10.9
		Malignant	8	17.4
Test	χ^2=11.9, p-value=0.002			
Necrosis on CT scan (N=80)	Necrosis present§	Necrosis absent		Total
Benign	2 (3.3%)	59 (96.7%)		61
Malignant	17 (89.5%)	2 (10.5%)		19
Test	χ^2=59.43, p-value=0.001			
Wall thickness on CT scan (N=46)	Thin‖	Thick **		Total
Benign	29 (88%)	4 (12%)		33 (100%)
Malignant	3 (23%)	10 (77%)		13 (100%)
Test	χ^2=18.5, p-value=0.001			
Ascites on CT scan (N=80)	Absent	Present††		Total
Benign	54 (88.5%)	7 (11.5%)		61 (100%)
Malignant	6 (31.6%)	13 (68.4%)		19 (100%)
Test	χ^2=25, p-value=0.001			
Ascites on USG (N=80)	Absent	Present‡‡		Total
Benign	46 (75.4%)	15 (24.6%)		61 (100%)
Malignant	5 (26.3%)	14 (73.7%)		19 (100%)
Test	χ^2=15.1, p-value=0.001			
Lymphadenopathy on CT scan (N=80)	Absent	Present§§		Total
Benign	56 (91.8%)	5 (8.2%)		61 (100%)
Malignant	5 (26.3%)	14 (73.7%)		19 (100%)
Test	χ^2=34.3, p-value=0.001			
Lymphadenopathy on USG (N=80)	Absent	Present‖‖		Total
Benign	58 (95%)	3 (5%)		61 (100%)
Malignant	15 (80%)	4 (20%)		19 (100%)
Test	χ^2=4.7, p-value=0.03			

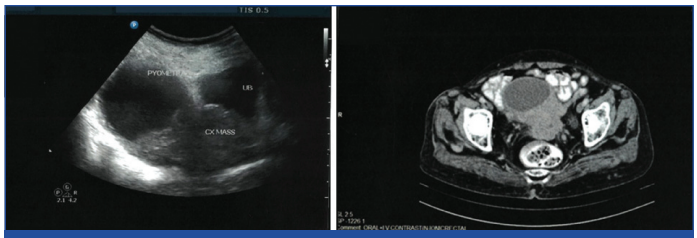
[Table/Fig-4]: Comparison of benign and malignant pelvic masses on basis of morphological features including septal thickness, wall thickness, necrosis, ascites and lymphadenopathy.
*No septae were seen on ultrasound in 24 cases out of which 22 (47.8%) were benign masses and 2 (4.3%) were malignant. †Thin septae ≤3 mm septa were seen in 6 (13%) benign masses and 3 (6.6%) malignant masses. ‡Thick septa >3 mm were seen in 5 (10.9%) benign masses and 8 (17.4%) malignant masses.; §Necrosis was found in 2 (3.3%) benign masses and 17 (89.5%) malignant masses on CT scan; ‖Thin walls were seen on CT scan in 32 masses, out of which 29 were benign and 3 were malignant **Thick walls were seen on CT scan in 14 masses out of which 4 were benign and 10 were malignant (p<0.05); †Ascites was seen on CT scan in 7 (11.5%) subjects with benign masses and 13 (68.4%) subjects with malignant masses (p<0.05); ‡‡Ascites was seen on ultrasound in 15 (24.6%) subjects with benign masses and 14 (73.7%) subjects with malignant masses (p<0.05); §§Lymphadenopathy on CT scan was detected in 14 (73.7%) subjects of malignant group but only in 5 (8.2%) subjects of benign group (p<0.05); ‖‖Lymadenopathy on ultrasound was detected in 4 (20%) subjects of malignant group and 3 (5%) subjects of benign group (p<0.05)

On USG, metastasis were detected only in two cases of malignant group. Adnexal masses were unilateral in 38 (82.6%) cases and bilateral in 8 (17.4%) cases. The CT scan had higher sensitivity (78%),

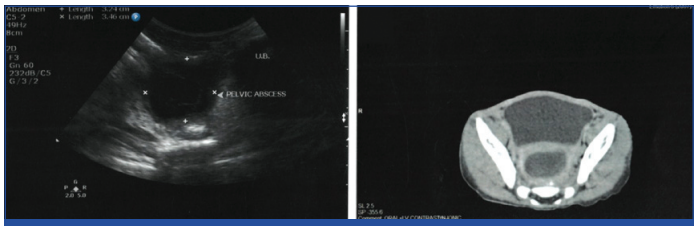
specificity (95.08%), positive predictive value (83.3%) and negative predictive value (93.5%) as compared to ultrasound [Table/Fig-5]. Patient presented with discharge per vaginum and loss of weight. Both USG and CT scan diagnosed it accurately, as a case of carcinoma cervix. Diagnosis was confirmed on histopathology [Table/Fig-6,7]. A four and half year old female child, presented with pelvic pain and fever. It was diagnosed as pelvic abscess on both USG and CT scan. However, organ of origin could not be identified. It proved to be an abscess on aspiration [Table/Fig-8,9].

Nature of mass	CT	HPE	USG	HPE
Benign	62	61	54	61
Malignant	18	19	26	19
Sensitivity	78%		73.7%	
Specificity	95.08%		80.3%	
Positive predictive value	83.3%		53.8%	
Negative predictive value	93.5%		90.7%	
Test	K=0.68, p-value=0.001		K=0.47, p-value=0.017	

[Table/Fig-5]: Sensitivity and specificity of CT scan and USG with histopathological findingas gold standard.
p-value <0.05 was considered as statistically significant

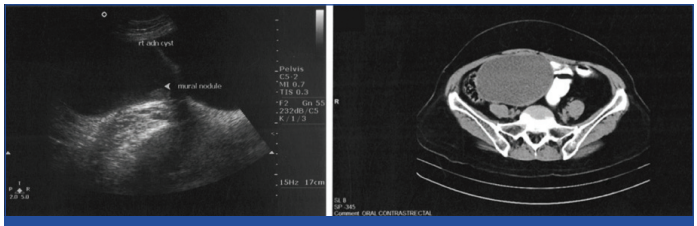


[Table/Fig-6]: Ultrasound Image of carcinoma cervix.
[Table/Fig-7]: CT scan Image of carcinoma cervix. (Images from left to right)



[Table/Fig-8]: Ultrasound Image of pelvic abscess.
[Table/Fig-9]: CT scan Image of pelvic abscess. (Images from left to right)

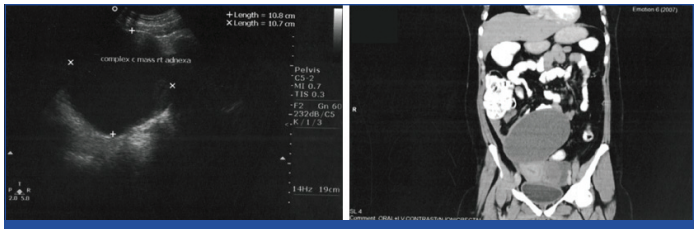
Patient presented with abdominal distension and pelvic mass. USG described it as cystic mass with presence of a small mural nodule and provisionally diagnosed it as a carcinoma of ovary. CT scan diagnosed it correctly based on no enhancement of the mural nodule. On histopathology, it was confirmed as serouscystadenoma [Table/Fig-10,11]. A 23-year-old female presented with menstrual disturbances and dysmenorrhoea. USG and CT diagnosed it as serous cystadenocarcinoma, however it was confirmed as serous cystadenoma on histopathology [Table/Fig-12,13].



[Table/Fig-10]: Ultrasound Image of serouscystadenoma.
[Table/Fig-11]: CT scan image of serouscystadenoma. (Images from left to right)

DISCUSSION

In present study, maximum number of cases i.e. 36 (45%) were in 20-39 age group. In the current study, age range was 2-81 years, the mean age was 40.±16.7 years. Similarly, the age range in study by Firoozbadi RD et al., and Alcazar JL et al., were 17-75 and 17-79,



[Table/Fig-12]: Ultrasound Image of serouscystadenoma.
[Table/Fig-13]: CT scan Image of serouscystadenoma. (Images from left to right)

respectively [9,10]. The mean age in studies by Gatreh-Samani F et al., and Hafeez S et al., Mubarak F et al., were 48.63 years, 40.95 yrs and 60 years, respectively [11-13]. Most of the benign pelvic masses (52.6%) were seen in the age group of 20-39 years while malignant pelvic masses (47.4%) were more common in the age group of 60 and above. Bren JL and Maxon WS, reported that 35% of all ovarian neoplasms in childhood and adolescent were malignant, but this was not the case in current study, because there was a wide range of patients [14]. In the present study, 95% cases were females while 5% while were males. According to Moore RG and Bast RC, approximately 20% of women will develop a pelvic mass at some time in their lives [15].

In the present study, 32 patients (53.3%) presented with pain in abdomen and pelvis, 31 (51.7%) cases had menstrual disturbance, 17 cases (28.3%) presented with complaint of mass inabdomen or abdominal distension, 10 (16.7%) had urinary symptoms, 17 (28.4%) had loss of weight and appetite. In the study conducted by Munir SS et al., 68 (63.6%) patients had pain, 25 (4%) presented with self-diagnosed tumour, 11 (0.9%) had dyspepsia, 8 (3.71%) had abdominal distension [16]. Givens et al., stated that patients with an adnexal mass, may present with varying symptoms [17]. Abdominal fullness and pressure, back pain, and lack of energy may be prominent symptoms as studied by Stenchever MA, [18], Goff BA et al., [19], Friedman GD et al., [20]. These vague symptoms are present for months in up to 93 % of persons with ovarian cancer Olson SH et al., [21].

In the present study, on histopathological findings; 61 (76.3%) and 19 (23.7%) masses were benign and malignant, respectively. Stein SM et al., reported similar findings with 123 (71.8%) benign masses and 46 (28.2%) malignant masses [22]. Rehn M et al., found 259 masses to be benign while 51 cases were malignant [23]. Luxman D et al., reported 72% subjects had benign tumours and 28% had malignant tumours [24]. Firoozabadi RD et al., found 44% cases to be benign while 55.4% masses were malignant [9]. In the current study, 82.6% of the subjects had unilateral masses and 17.4% had bilateral masses. Similarly, in a study by Prabhakar BR and Maingi K, 90.89% subjects had unilateral mass and 9.11% had bilateral masses [25].

Out of total 80 cases of pelvic masses, majority 46 (57.5%) were of adnexal origin on CT and 36 cases were benign according to CT findings. USG detected 44 cases of adnexal masses and characterised 22 of them as benign. Similarly, Brown D, concluded that most pelvic masses arise from ovarian tissue and most intraovarian masses are benign, especially in premenopausal women [26].

Adnexal masses: In present study, the difference among the benign and malignant group regarding consistency of masses were statistically significant on CT but not on USG. The findings suggest that USG was unable to differentiate between a benign and malignant mass on the basis of consistency which got revealed on CT scan. The present study findings are supported by work of Wani S et al., who stated that it is possible to suspect malignancy on the basis of ultrasonic image but a definite diagnosis cannot always be made [27]. Granberg S et al., concluded that complexity of an ovarian cyst can be a predictor of malignancy [6]. Abbas AM et al., found that multilocular-solid mass was the most common pattern of ovarian malignancy (30.4%) followed by solid mass (28.3%) [28].

Study	Place of study	Sensitivity	Specificity	PPV	NPV
Study on accuracy of USG					
Lin JY et al., [32] (1992)	New York	83	50	58	
Finkler NJ et al., [33] (1988)	Boston	50	96	43	
Herrmann UJ et al., [34] (1987)	Italy	82.6		73	
Munir SS et al., [16] (2010)	Lahore	75	95	60	
Buy JN et al., [35] (1996)	France	83%	82%	-	-
Jacobs I et al., [36] (1997)	Whitechapel	85%	97%	-	-
Alcazar JL et al., [10] (1999)	Pamplona, Spain	85.7%	100%	100%	95.5%
Madan R et al., [37] (2004)	Department of radiology, harvard medical school	92.5%	55.36%	54.3%	92.8%
Van Calster B et al., [38] (2007)	Multicentre Study (International Ovarian Tumour Analysis) included nine European Ultrasound Centres	93%	-	-	-
Menon U et al., [39] (2009)	London, UK	84.9%	-	-	-
Sasson AM et al., [40] (1991)	New York	100%	83%	37%	100%
Timmerman D et al., 31](2010)	Multicentre study involving nine centres: Malmo (Sweden), Leuven (Belgium), London (UK), Rome, Naples, Monza, Milan (Italy) and 2 centres in Paris (France)	90%	89%	-	-
Present study	Patiala	73.7	80.3	53.8	
Study on accuracy of CT scan					
Kinkel K et al., [29] (2005)	Meta analysis, data from 46 studies was included.	81%	87%		
Tsili AC et al., 41] (2008)	Greece	90%	88%		
Zhang J et al., [42] (2008)	New York	90%	89%		
Liu Y, [43] (2009)	New Jersey, USA	87%	100%		
Mubarak F et al., [13] (2011)	Pakistan	97%	91%		
Gatreh-Samani F et al., [11] (2011)	IRAN	92.8%	88%	95.5%	81.4%
Present study (2013)	Government Medical College, Patiala	78%	95.08%	83.3%	93.5%

[Table/Fig-14]: Comparative analysis of accuracy of USG and CT scan in ovarian masses [10,11,13,16,29,31-43].

In the current study, 42.1% malignant adnexal masses had thick septae and 57.9% showed thin septae or no septae on USG. Thin septae or no septae were seen in 84.8% of the benign adnexal masses while 15.2% showed thick septae. Abbas AM et al., concluded that the malignant cystic masses often had papillary projections (42.4% vs 4.3%, p-value <0.001) and thick septae (68% vs 6.3%, p-value <0.001) than benign masses [28]. However, Kinkel K et al., concluded that both transvaginal ultrasound and transvaginal ultrasonography, have low specificity for detecting malignancy, owning to overlap in the imaging appearances of benign, borderline and malignant diseases [29].

Ascites is an indirect indicator of malignancy and ascites occurs due to peritoneal spread of tumour, studied by Brown DL et al., [30]. In study conducted by Timmerman D et al., it was reported that there was an increased risk of malignancy, if fluid in cul de sac measures more than 15 mm in anteroposterior dimension on ultrasound [31]. In the current study, ascites and lymphadenopathy were more commonly associated with malignant masses compared to benign masses and this difference was significantly (p-value <0.05) detected by USG as well as CT scan.

In the present study, sensitivity of ultrasound in predicting malignancy in pelvic masses was 73.7%. However, sensitivity and specificity were higher in studies conducted by Alcazar JL et al., [10] Timmerman D et al., [31] Buy JN et al., [35] and Jacobs et al., [36] ascompared to the current study [Table/Fig-14] [10,11,13,16,29,31-43].

A meta-analysis conducted by Kinkel K et al., [29] described that CT showed sensitivity and specificity of 81% and 87%, respectively when used for indeterminate masses seen on USG. For differentiating benign and malignant ovarian masses, CT had a higher sensitivity and lower specificity in studies conducted by Gatreh-Samani F et al., [11] Mubarak F et al., [13], Tsili AC et al., [41], Zhang J et al., [42], as compared to our study, probably due to higher number of participants in these studies; however Liu Y et al., [43] reported lower sensitivity and higher specificity than the current study [Table/Fig-14].

The strength of this study is that various types of pelvic masses have been studied, unlike many other studies where only ovarian masses have been studied. Also in the current study, wide range of age groups have been included. Future recommendations of study include, studying sensitivity and specificity of imaging techniques (ultrasound and CT scan) in diagnosing pelvic pathologies in a larger population. Role of other imaging techniques like magnetic resonance imaging and positron emission tomography scan in diagnosing aetiologies of pelvic masses should be studied.

Limitation(s)

Limitation of this study was small sample size. As study was conducted over a predecided period of time, so only the number of patients who reported to hospital during that time period could be included in the study. Wall thickness was not studied on ultrasound.

CONCLUSION(S)

Both CT and USG are sensitive and specific to categorise pelvic masses into benign and malignant groups. However, interpreting an ultrasound is much more subjective than interpreting a CT scan. USG with its good sensitivity can be used as an effective screening modality for pelvic masses. CT scan has better specificity than USG and should be used as a confirmatory investigation.

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PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Radiology, Gautam Buddha Chikitsa Mahavidyalaya, Subharti Medical College, Dehradun, Uttarakhand, India.
2. Professor and Head, Department of Radiology, Government Medical College, Patiala, Punjab, India.
3. Associate Professor, Department of Obstetrics and Gynaecology, Government Medical College, Patiala, Punjab, India.
4. Senior Resident, Department of Obstetrics and Gynaecology, Government Medical College, Patiala, Punjab, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Arshdeep Kaur,
H. No. 658/8A, Street No. 21, Punjab Mata Nagar, Jawaddi Road,
Ludhiana-141013, Punjab, India.
E-mail: arshdeepkaur658@gmail.com

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