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Role of USG and CT Scan in Evaluation of Female Pelvic Pathology

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ABSTRACT
Imaging modalities, including Ultrasonography (USG), Magnetic Resonance Imaging (MRI) and Computed Tomography (CT), play pivotal roles in managing gynecological disorders, with USG being particularly valuable for diagnosing acute pelvic pain, and CT demonstrating superior diagnostic capabilities in characterizing pelvic masses. Despite advanced modalities like MRI, USG remains essential as a screening tool. Ultrasonography offers diverse imaging capabilities, while CT serves as a valuable adjunct to overcome the limitations of USG. However, concerns regarding ionizing radiation exposure exist with CT, especially in young and pregnant females. This prospective study, conducted from July 2015 to November 2017 at the Gujarat Cancer and Research Institute, included 100 patients with suspected or diagnosed female pelvic pathology. Data were collected through CT and USG imaging, along with histopathological diagnoses. Patients underwent imaging examinations using specific protocols for each modality and detailed clinical information was recorded. Analysis revealed age-specific distributions of pelvic pathologies, with cervical pathology predominantly affecting the 4th decade and ovarian pathology peaking in the 5th decade. Cervical cancer was the most prevalent diagnosis, followed by ovarian and endometrial cancers. CT exhibited higher sensitivity than USG in detecting malignancies and assessing organ involvement, particularly in cervical and ovarian cancers. Additionally, CT demonstrated superior sensitivity for lymphadenopathy detection in cervical cancer. The study emphasized CT's diagnostic accuracy and its potential to guide treatment decisions. In conclusion, the study comprehensively evaluated female pelvic pathology using USG and CT, highlighting CT's superiority in diagnostic accuracy, particularly in malignancy detection and organ involvement assessment. CT emerged as the preferred imaging modality, potentially enhancing treatment planning and reducing mortality and morbidity associated with pelvic tumors.

INTRODUCTION

Imaging modalities play a crucial role in the management of gynecological disorders. Ultrasonography (USG), Magnetic Resonance Imaging (MRI), and Computed Tomography (CT) are the primary methods utilized for assessing the female pelvis[1]. USG is particularly valuable for diagnosing acute pelvic pain due to its high sensitivity and specificity[2]. However, CT demonstrates superior diagnostic capabilities in characterizing both benign and malignant pelvic masses[3]. Despite the emergence of advanced modalities like MRI, USG remains essential as a screening tool for pelvic pathologies[4]. When evaluating gynecological causes of pelvic pain, USG is deemed reliable, with CT and MRI serving as supplementary tools for unresolved cases[5]. Ultrasonography continues to serve as the primary imaging modality, providing transabdominal and transvaginal approaches, as well as color and power Doppler investigations, along with three-dimensional and four-dimensional capabilities[6,7]. It is characterized by its ready accessibility, non-invasiveness, real-time imaging capability, relatively low cost, absence of radiation hazards, patient preference due to comfort, reproducibility and accuracy in proficient hands[8].

Computed tomography (CT) serves as a valuable adjunct when ultrasonography reaches its limitations[9]. CT allows for the examination of masses both with and without intravenous and/or oral contrast, capturing various phases of arterial and venous enhancement post-contrast administration. It proves particularly beneficial in delineating the extent of disease, discerning between benign and malignant pathology and staging malignant lesions. Offering a more comprehensive and less operator-dependent view of the surrounding anatomy, CT scanning surpasses ultrasonography in certain aspects. Although magnetic resonance imaging (MRI) appears promising for pelvic pathology evaluation due to its superior soft tissue resolution and absence of ionizing radiation, its widespread use is hindered by cost, availability and feasibility issues[10,11]. Advancements in multi-detector CT scanning machines, coupled with reformatting software and dose-reducing techniques, render CT well-suited for imaging both gynecologic and non-gynecologic pelvic diseases[12]. The American College of Radiology has issued guidelines delineating the circumstances under which ultrasound is deemed an appropriate imaging modality for assessing the female pelvis[13]. Conversely, computed tomography (CT) exposes patients to ionizing radiation, posing potential risks, particularly concerning for young individuals and females undergoing evaluation for suspected pregnancy[14]. The study aims to investigate the roles of both USG and CT scan in assessing female pelvic pathology, analyzing their respective advantages and disadvantages, examining the incidence of pelvic pathologies across different age groups and etiological factors, guiding surgeons and clinical oncologists in treatment planning and prognosis determination and assessing residual or recurrent lesions in treated patients.

MATERIALS AND METHODS

The study was conducted within the Department of Radiology at the same institute over a duration spanning from July 2015 to November 2017. Data for the study were soured from the Radiology Department of Gujarat Cancer and Research Institute, which serves as a referral center for patients from various regions of Gujarat and other states. This prospective study comprised a sample size of 100 patients, including individuals diagnosed or suspected of having female pelvic pathology, irrespective of their prior medical interventions such as surgical, chemotherapy, or radiotherapy treatments. Exclusion criteria encompassed patients with contrast allergies or contraindications to CT scan procedures. Prior to investigations, consent was obtained from all participants, who were then scheduled for appointments and instructed to fast for at least four to six hours before examination, except in cases of emergencies. Detailed medical histories and clinical findings were recorded, with sedation administered under anesthetist supervision for uncooperative patients. The study involved noting the computed tomography (CT) and ultrasonography (USG) characteristics of various lesions, along with recording histopathological diagnoses. CT scans were performed using Siemens SOMATOM EMOTION 6 and 16 slice machines, with parameters including a variable field of view (FOV), 5mm slice thickness and 130 kV, with mA adjusted according to patient build. Contrast-enhanced CT (CECT) scans of the abdomen and pelvis were conducted, employing Omnipaque as the contrast media, along with administration of oral and rectal contrast agents prior to the scan. The study also monitored adverse drug reactions due to contrast agents. Ultrasonography was carried out using GE Model LOGIQ P5 and Siemens ACUSON S3000 machines equipped with high-frequency transducers ranging from 4-11 MHz. Evaluation initially involved an abdominal transducer with a full bladder to assess potential pathologies outside the focal length of the vaginal transducer. Subsequently, transvaginal sonography was performed with patients having an empty bladder, utilizing gel application and lubricated condom insertion into the anterior or posterior vaginal fornix based on uterine position.

RESULTS AND DISCUSSIONS

The current investigation enrolled 100 cases of female pelvic masses conducted at the Gujarat Cancer and Research Institute in Ahmedabad. This study

scrutinized observations pertaining to age distribution, anatomical site, morphological characteristics, as assessed by USG and CT and subsequent data analysis was performed. The predominant age range for the manifestation of endometrial pathology is typically observed between 50-70 years. For cervical pathology, the most prevalent age group for presentation falls within the range of 40-49 years, followed by 50-59 years. These observations are consistent with the findings reported by Liu *et al.*[15] and Firoozabadi *et al.*[16], which documented a spectrum of age from 18-77 years, with the majority of patients being over 40 years old in Liu *et al.*'s study[15]. Regarding ovarian pathology, the primary age of presentation is frequently noted between 50-59 years, followed by 40-49 years. These outcomes are in concordance with the investigation conducted by Moideen *et al.*[17], which highlighted a prevalent presentation age between 50-59 years, with a mean age±standard deviation of 47.5±15.5 years. The majority of participants in this study were aged over 40 years, with only nine patients falling below this threshold. Among a cohort of 100 patients, 45 were diagnosed with cervical cancer, 30 with ovarian cancer and 18 with endometrial cancer. Additionally, two cases of fibroids, two cases of gestational trophoblastic neoplasia (GTN) and three cases of simple cysts were documented. Thus, the prevalence rates were as follows: 45% for cervical cancer, 30% for ovarian cancer, 18% for endometrial cancer, 2% for fibroids, 2% for GTN and 3% for simple cysts. These findings align with those reported by Liu *et al.*[15], which identified uterine fibroids and cervical cancer as the predominant diagnoses, followed by benign ovarian tumors, endometrial cancer and ovarian tumors, with uterine sarcoma being less prevalent.

In present study, USG demonstrated the capability to detect benign lesions in 10 out of 100 patients, while CT identified benign lesions in 8 out of 100 patients. Conversely, USG detected malignant lesions in 89 out of 100 patients and CT identified malignant lesions in 91 out of 100 patients. Additionally, one case exhibited suspiciously malignant characteristics in both CT and USG examinations. Hence, the sensitivity of USG for detecting malignancy in my study was determined to be 89%, while CT exhibited a sensitivity of 91%. These findings are consistent with those reported by Firoozabadi *et al.*[16], indicating a sensitivity of 51.9% for USG and 79.2% for CT in detecting malignancies within female pelvic pathology. Furthermore, it was observed that CT scan images demonstrated greater alignment with pathological findings, enhancing the accuracy of surgical planning compared to sonographic examinations. Forty-five percent of the cases were diagnosed with cervical cancer according to both USG and CT modalities. Endometrial cancer was diagnosed by USG in 17% of cases and CT accurately identified it in 18% of cases. Ovarian cancer was detected in 30% of cases by both USG and CT. Additionally, simple cysts were correctly diagnosed in 3% of cases, fibroids in 2% of cases and gestational trophoblastic neoplasia (GTN) in 2% of cases through both USG and CT imaging modalities.

Among a cohort of 67 patients, the most prevalent diagnostic observation in uterine pathology was carcinoma of the cervix, identified in 45 patients, followed by carcinoma of the endometrium in 18 patients, gestational trophoblastic neoplasia (GTN) in 2 patients and fibroids in 2 cases. In our investigation, among 18 patients diagnosed with endometrial cancer, myometrial invasion of less than 50% was detected in 5 patients by both USG and CT. Conversely, myometrial invasion exceeding 50% was observed in 13 patients by both USG and CT modalities. Serosa invasion in endometrial cancer was identified in 2 patients by both USG and CT. Our study indicates a consistent detection of myometrial and serosa invasion in endometrial cancer using USG and CT imaging modalities. These findings are in line with those reported by Kim *et al.*, which suggested comparable sensitivity between USG and CT for detecting myometrial invasion in

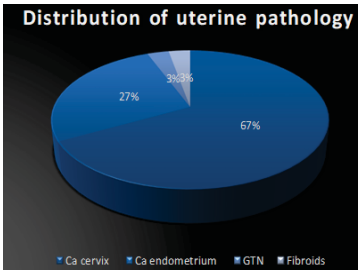

Fig. 1: Distribution of uterine pathology

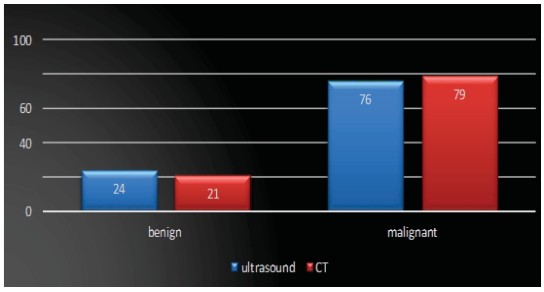

Fig. 2:Comparison of USG and CT finding of nature of ovarian pathology

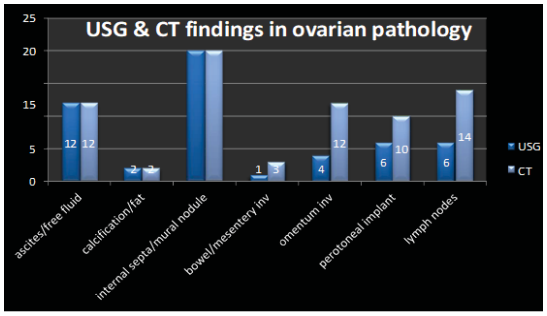

Fig 3: USG and CT findings in ovarian pathology

Table. 1: Age wise distribution of female pelvic pathology

Descriptive Statistics	Endometrial pathology	Ovarian pathology	Cervical pathology
Age (years)	n	n	n
20-29	3	2	0
30-39	2	1	5
40-49	4	10	16
50-59	5	13	14
60-69	5	5	7
>=70	3	2	3
Total = 100	22	33	45

Table. 2: Distribution according to diagnostic findings

Diagnosis	Frequency	Percentage
Ca Cervix	45	45
Ca Ovary	30	30
Ca Endome- trium	18	18
Fibroid	2	2
GTN	2	2
Simple Cyst	3	3
Total	100	100

Table. 3: Comparison of USG and CT results for detection of lesion.

Lesion	USG		CT	
	Number	Percent	Number	Percent
Benign	10	9.00	8	8
Malignant	89	89	91	91
Suspiciously malignant	01	1.00	01	1.00

Table 4: Association of masses according to diagnosis

Diagnosis by CT	Ca cervix	Diagnosis by USG				
		Ca endometrium	Ca ovary	Fibroid	GTN	Simple cyst
Ca cervix	45	0	0	0	0	0
Ca endometrium	1	16	0	0	0	0
Ca ovary	0	0	30	0	0	0
Fibroids	0	0	0	2	0	0
GTN	0	0	0	0	2	0
Simple cyst	0	0	0	0	0	3
Chi-square	342.4	p-value	0		Significant	

Table. 5: USG findings in endometrial cancer

Ecogenicity	Frequency	Column N %
Hyperechoic	15	83.33
Hypoechoic	2	11.11
Thickening	1	5.55
Total	18	100.00
Myometrial Invasion	**Frequency**	**Column N %**
Less than <50%	5	27.78
More than >50%	13	72.22
Total	18	100.00
Serosal Invasion	**Frequency**	**Column N %**
Absent	16	88.89
present	2	11.11
Total	18	100.00
Lymphadenopathy	**Frequency**	**Column N %**
Present	4	22.22
Absent	14	77.78
Total	18	100.00
Peritoneal Implants	**Frequency**	**Column N %**
Present	0	0.00
Absent	18	100.00
Total	18	100.00

Table. 6: CT findings in endometrial cancer

Myometrial Invasion	Frequency	Column N %
Less than <50%	5	0.40
More than >50%	13	0.60
Total	18	1.00
Serosal Invasion	**Frequency**	**Column N %**
Absent	16	88.89
Present	2	11.11
Total	18	100.00
Lymphadenopathy	**Frequency**	**Column N %**
Present	7	38.89
Absent	11	61.11
Total	18	100.00
Peritoneal Implants	**Frequency**	**Column N %**
Present	0	0.00
Absent	18	100.00
Total	18	100.00

Table. 7: USG findings in adnexal pathology

Nature of pathology	Frequency	Column N %
Benign	8	24
Malignant	25	76
Total	33	100
Type of lesion	**Frequency**	**Column N %**
Solid	4	12.12
Cystic	6	18.18
Solid-Cystic	23	69.70
Total	33	100
USG finding	**Present**	**Absent**
Vascularity	17 (51%)	16 (49%)
Ascites/Free fluid	12 (36%)	21 (64%)
Calcification/Fat	2 (6%)	31 (94%)
Internal Septa/Mural Nodule	20 (60%)	13 (40%)
Bowel/Mesentery Involvement	1 (3%)	32 (97%)
Omentum Involvement	4 (12.12%)	29 (87.88%)
Peritoneal Implants	6 (18.18%)	27 (81.82%)
Lymphadenopathy	**Frequency**	**Column N %**
Present	6	18
Absent	27	82
Total	33	100

Table. 8: CT findings in ovarian pathology

Nature of pathology	Frequency	Column N %
Benign	7	21.21
Malignant	26	78.79
Total	33	100
Type of Lesion	**Frequency**	**Column N %**
Solid	4	12.12
Cystic	6	18.18
Solid-Cystic	23	69.70
Total	33	100
CT finding	**Present**	**Absent**
Ascites/Free fluid	12 (36%)	21 (64%)
Calcification/Fat	2 (6%)	31 (94%)
Internal Septa/Mural Nodule	20 (60%)	13 (40%)
Bowel/Mesentery Involvement	3 (9%)	30 (91%)
Omentum Involvement	12 (36.36%)	21 (63.64%)
Peritoneal Implants	10 (30%)	23 (70%)
Lymphadenopathy	**Frequency**	**Column N %**
Present	14	42
Absent	19	58
Total	33	100

Table. 9: Comparison of USG and CT results of Omentum, bowel/mesentery and peritoneal implant involvement by ovarian cancer.

Ovarian Cancer Involvement	Ultrasound		CT	
	Number	Percentage	Number	Percentage
Bowel/mesentery involvement	1	(3)	3	(9)
Omentum involvement	4	(12.12)	12	(36.36)
Peritoneal implant	6	(18.18)	10	(30)

Table. 10: USG findings in cervical cancer

Size of lesion	Frequency	Column N %
Less than 4cm	18	40.00
More than 4cm	27	60.00
Total	45	100.00
Lymphadenopathy	**Frequency**	**Column N %**
Present	12	27
Absent	33	73
Total	45	100
USG finding	**Involved**	**Uninvolved**
Parametrium	24 (53.33%)	21 (46.67%)
Urinary bladder	6 (13.33%)	39 (86.67%)
Rectum	4 (8.90%)	41 (91.10%)

Table. 11: CT findings in cervical cancer

Size of lesion	Frequency	Column N %
Less than 4 cm	18	40.00
More than 4 cm	27	60.00
Total	45	100.00
Lymphadenopathy	**Frequency**	**Column N %**
Present	34	76
Absent	11	24
Total	45	100
CT finding	**Involved**	**Uninvolved**
Parametrium	24 (53.33%)	21 (46.67%)
Urinary bladder	6 (13.33%)	39 (86.67%)
Rectum	8 (17.78%)	37 (82.20%)

Table. 12: Comparison of USG and CT results of rectal wall and lymph node involvement by cervical pathology.

	Ultrasound		CT	
	Number	Percentage	Number	Percentage
Rectum wall involvement	4	8.90	8	17.78
Lymphadenopathy	12	27	34	76

endometrial cancer. Among the cohort of 18 patients, lymphadenopathy was detected in 4 patients via ultrasonography (USG) and in 7 patients via computed tomography (CT) scanning. Notably, 3 patients with lymphadenopathy were not identified on USG, indicating the superiority of CT over USG for lymph node staging. The sensitivity for detecting lymphadenopathy was calculated to be 71.4% for CT and 42.8% for USG, further supporting the greater sensitivity of CT in this regard. Consequently, CT is deemed superior to USG for lymph node staging due to its heightened sensitivity in detecting lymphadenopathy. In present study of ovarian pathology USG detected benign lesions in 8 out of 33 patients, while CT identified benign lesions in 7 out of 25 patients. Regarding malignant lesions, USG successfully detected them in 25 out of 33 patients, while CT detected malignant lesions in 24 out of 33 patients. Notably, one malignant case was overlooked on USG and erroneously categorized as benign. Consequently, the sensitivity of USG for detecting malignancy was calculated to be 89%, whereas CT exhibited a sensitivity of 91% in present study. These findings align with those reported by Buy *et al*.[18], indicating a sensitivity of 86% for USG and 87% for CT in detecting malignancy in epithelial tumors of the ovary. Additionally, they correlate with the study conducted by Moideen *et al.*[17], which demonstrated a sensitivity of 90.2% for USG and 95.1% for CT in the detection of ovarian malignancy. Among the 33 patients with ovarian pathology, USG revealed bowel/mesentery involvement in 1 patient, while CT identified involvement in 3 patients, with 2 cases missed on USG. Omentum involvement was noted in 4 patients by USG and in 12 patients by CT, with 8 cases missed on USG. Additionally, peritoneal implants were detected in 6 patients by USG and in 10 patients by CT, with 2 cases missed on USG. The sensitivity of USG and CT for detecting omentum, bowel/mesentery and peritoneal implants was calculated to be 33.33%, 34% and 60% for USG and 100%, 100% and 100% for CT, respectively, indicating a higher sensitivity of CT in detecting these involvements. These findings are consistent with the study by Schmidt *et al*.[19], which reported a sensitivity of 90.2% for multi detector computed tomography (MDCT) in diagnosing peritoneal carcinomatosis.

Additionally, our results align with those of Moideen *et al.*[17], indicating an overall accuracy of CT in staging ovarian tumors of 95%, compared to 82% for USG. Furthermore, among the 33 patients, lymphadenopathy was detected in 6 patients via USG and in 14 patients via CT, with 8 patients missed on USG. The sensitivity for diagnosing lymphadenopathy was 42.8% for USG and 100% for CT, highlighting the superiority of CT in lymph node staging. These findings are consistent with Moideen *et al.'s*[17] study, which reported a sensitivity of 88% for diagnosing lymphadenopathy. Among the 45 patients diagnosed with carcinoma of the cervix, rectal wall involvement was observed in 4 patients via ultrasonography (USG) and in 8 patients via computed tomography (CT), with 4 cases missed on USG. The sensitivity for diagnosing rectal wall involvement was 50% for USG and 100% for CT, indicating a superior performance of CT in this regard. These results are consistent with the findings of T.V. Prasad *et al*.[20], which demonstrated a sensitivity of 100% in assessing rectal invasion by cervical cancer. Among the 45 patients included in the study, lymphadenopathy was detected in 12 patients via ultrasonography (USG) and in 34 patients via computed tomography (CT) scan. Notably, 22 patients were missed on USG, highlighting the superiority of CT over USG for lymph node staging. The sensitivity for detecting lymph nodes was determined to be 27% for USG and 76% for CT, indicating a higher sensitivity of CT in detecting lymphadenopathy. These findings are consistent with the study conducted by Yang *et al*.[21], which reported a sensitivity of 64.7% for diagnosing lymph node metastasis in cervical cancer. Similarly, they align with the study by Mamsen *et al*.[22], which demonstrated a sensitivity of 23% in the diagnosis of lymph node metastasis by cervical cancer. In conclusion, ultrasonography is deemed unreliable in the preoperative detection of lymph node metastases in cervical cancer. Furthermore, ultrasound examination offers no advantage over CT scan in the detection of lymph node metastasis.

CONCLUSION

In summary, our study assessed 100 female pelvic pathology cases using USG and CT. Both modalities provided clear imaging, highlighting prevalent conditions such as cervical, ovarian and endometrial cancers. CT showed higher sensitivity for malignancies (91%) compared to USG (89%). It also excelled in detecting lymphadenopathy and organ involvement in cervical cancer. For ovarian pathology, CT demonstrated superior sensitivity. Overall, CT emerged as the preferred imaging method due to its diagnostic accuracy, aiding in treatment planning and potentially reducing mortality and morbidity associated with pelvic tumors.

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