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RESEARCH ARTICLE

THE COMPARATIVE STUDY OF USG AND MDCT IN THE EVALUATION OF PELVIC MASSES IN FEMALES

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Abstract

Introduction: Pelvic masses in females of all ages are a routine gynaecological issue for which healthcare is sought, and in a populous country like India, these masses form a significant part of the disease burden. The evaluation of the female pelvis is a radiological necessity and a challenge. The foremost aim for any imaging modality in this scenario is to rule out malignancy in the mass, and further to characterise and define the mass so as to guide appropriate management of the patient. Of the wide range of imaging modalities available, ultrasonography and computed tomography are commonly available and extensively used for the evaluation of the varied female pelvic masses. We studied the ultrasonography and multi detector computed tomography findings and their usefulness in the diagnosis and characterization of various pelvic masses in females.

Methodology: It was a prospective observational study, ranging over the duration of one and a half years,of 100 female patients fulfilling inclusion criteria, who underwent ultrasonography and multidetector computed tomography scanning in the Department of Radiodiagnosis at RNT medical college, Udaipur. Pelvic masses were evaluated for origin, size, margins, composition, vascularity, ascites, lymphadenopathy and other features to characterise as benign or malignant. Final diagnosis was by histopathological correlation.

Results: The most common age group belonged to 35-45 years group (22%) followed by 55-65 years group (21%). Mean age for benign masses was 35.84 years and for malignant masses was 51.64 years. Ovarian origin was the commonest followed by uterine origin. Features like solid areas, ill-defined margins, lymphadenopathy and ascites favoured malignancy. Most common pathologies were adenocarcinoma ovary, carcinoma cervix, benign ovarian cysts and uterine fibroids.

Conclusion: Ultrasonography is often the first imaging study performed in patients with symptoms related to the pelvis. Results indicated higher diagnostic capability of CT as a problem-solving tool. Overall diagnostic accuracy of CT was higher than USG in characterising both benign and malignant pelvic masses.

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Introduction:-

The female pelvis is home to a diverse range of organs and organ systems and hence is also a storehouse of myriad common as well as rare pathologies. Pelvic masses in females of all ages are a routine gynaecological issue for which healthcare is sought, and in a populous country like India, these masses form a significant part of the disease burden. The majority of masses are adnexal. Other pelvic masses include inflammatory and tumourous conditions affecting the gastrointestinal tract such as the sigmoid colon, rectum, anal canal; the lower urinary tract such as the ureters and the urinary bladder; the lymph nodes, muscles and connective tissue in pelvis. Thus, colorectal carcinoma, appendicular abscess, lymphadenopathy, peritoneal inclusion cyst, lymphocele and mesenteric cyst should always be considered.[1]

Ultrasonography remains the stalwart primary imaging modality, offering transabdominal and transvaginal approaches as well as colour and power Doppler investigations and three-dimensional and four-dimensional capabilities.[2,3]It is readily available, non-invasive, real-time, relatively inexpensive, free of radiation hazards, preferred by patients for its comfort, reproducible and accurate in experienced hands.[4]

Computed tomography steps in where ultrasonographic reach is limited.[5] The mass can be studied without and with intravenous and/or oral contrast, in various phases of arterial and venous enhancement after contrast administration. CT scanning is very helpful in defining the extent of disease, evaluating benign and malignant pathology and in staging malignant lesions. It provides a more comprehensive and detailed view of the anatomy surrounding the mass and is less operator-dependent. While MRI may seem ideal to evaluate pelvic pathology because of its soft tissue delineation and lack of radiation, it is significantly deterred by its inherent cost, unavailability and poor feasibility in many places.[6,7]With multidetector CT scanning machines, various reformatting softwares and innovation in dose-lowering techniques, CT becomes well suited for imaging gynaecologic and non-gynaecologic diseases of the pelvis.[8]

Of the wide range of imaging modalities available, ultrasonography and computed tomography are commonly available and extensively used for the evaluation of the varied female pelvic masses. Given this, the author is interested in drawing out a correlation between ultrasonography and multi detector computed tomography for evaluation of pelvic masses, to determine their diagnostic value. In the current study, we look into how they may complement each other, or conversely, obviate the other's requirement for some particular suspected pathology.

Materials and Methods:-

This prospective hospitalbasedstudy was conducted in the department of Radio-diagnosis, R.N.T. Medical College and attached hospitals, Udaipur from June 2020 to November 2021.100 female patients referred to the radiodiagnosis department for USG and CT scanning with clinically suspected pelvic mass, follow up cases of pelvic mass, patients with pelvic mass detected on USG, were included in the study after informed written concent and institutional ethical committeeapproval(No.RNT/STAT./IEC/2020/410). Pregnant patient, patients who had refused for study participation, patients with deranged RFT and contraindicated for CECT were excluded from the study.

After history taking, the pelvic masses were prospectively studied on both USG and CT scan.Detailed history and relevant clinical and laboratory examination were undertaken.

Ultrasonography was done onvarious ultrasonography scanner available in our department like Alokaprosound SSD-4000SV, Siemens Acuson X300, Toshiba nemio30, VINNO E10, esaote My lab40, SAMSUNG RS80A etc. Linear & curved array transducers of different frequencies were used depending on the patient's body habitus and the distance between the probe and the object of study. The following features of a mass were noted: number, size, margins, origin, content and nature, sonographic characteristics such as acoustic shadowing or enhancement, colour flow on Colour Doppler.[9]

Sonographically indeterminate masses or masses that required further evaluation were referred for a CT scan.Contrast enhanced computed tomography was done on Philips 16 slice or Siemens 128 slice MDCT scanner available in our department. Patients were kept fasting for at least 6-8 hrs prior to examination and CT scan was

performed after oral administration of 20 mL of non-ionic iodinated contrast in 1 litre of plain drinking water for bowel preparation. Non-contrast CT and contrast-enhanced CT were acquired with patient in supine position using the following protocol:

120 KVp and 100-300 mAs with 5 to 10 mm thickness and retro reconstruction of 0.6 to 1.0 mm thickness. For contrast study, 80-100 ml of 350mg/ml non-ionic iodinated contrast (Iohexol) was injected in adults at the rate of 3-4ml/sec. In children a dose of 2 ml/kg of 350 mg/ml non-ionic iodinated contrast (Iohexol) was injected at a rate of 1.5- 2ml/sec. Various phases were performed depending upon the clinical and radiological indications. Multiple datasets were acquired with a single bolus of contrast. The following possible imaging times were be used in some cases of imaging the abdomen and pelvis—unenhanced, early arterial phase (20 seconds); late arterial-enteric phase (40 seconds); portal venous phase (70-90 seconds); equilibrium phase (210 seconds); and delayed phase (7-10 minutes). For general survey abdominal imaging, obtaining scans during the portal venous phase was adequate. Images were reconstructed in axial, coronal and sagittal planes with a slice thickness and interval of 5 mm.CT was evaluated for the following: number, size, margins, origin, content and nature, contrast enhancement in masses.

Final diagnoses were achieved by correlating ultrasonography and CT findings with clinical, operative, pathological or follow up findings whenever possible.

All the data were entered into a Microsoft Excel spreadsheet. Analysis of the statistical data obtained from the study was carried out by Open EPI. Sensitivity, specificity, positive predictive and negative predictive value and diagnostic accuracy for each modality USG and CT were calculated and Chi-square and Mc Nemar tests were performed to find the association between two attributes. *p*- Value <0.05 was considered statistically significant.

Results and Discussion:-

Our study consisted of 100 female patients, the youngest being 3 days old and the oldest being 80 years. Maximum number of patients were in the age group of 35-45 years (22%) and 55-65 years (21%). Minimum number of patients were in the age group of <15 years (6%).Benign pelvic masses were commoner in the 25-35 years age group making 10 (71%) out of total 14 cases in this age group. Maximum percentage of malignant pelvic masses in any age group was noted in much older patients of more than 65 years of age with 12 (92.3%) out of total 13 cases seen in this age group. This is in concordance with various studies showing higher chances of malignancy as age increases.

All clinical presentations, including systemic features like fever, anorexia and weight loss, were more common in malignancies. Pelvic pain (in 88%) was the commonest presenting complaint followed by pelvic lump and/or distension with or without pelvic pain.

Origin and nature of Masses

Ovarian origin was the commonest (59%) followed by uterine origin (30%). Other sites of origin were other adnexa, bowel, bladder, bone, retroperitoneum.

Out of 59 ovarian masses, 39 (66.2%) out of 59 were malignant while the rest of 20 (33.8%) were benign. Most of the malignant ovarian masses (12 of 39) were in the 55-65 years age group. Of the uterine masses, 21 (70%) were malignant, maximum 8 of which were seen in the 35 to 45 years age group and commonly being diagnosed as carcinoma cervix.

Other sites of origin included broad ligament, peritoneal lining, retroperitoneum, urinary bladder and bowel. (Table-1)

A study conducted by Himani Sharma et al.[(10)] showed a similar predominance of ovarian and uterine masses, in that order. The subjects for that study were in the 15 to 45 years age group, while our study includes patients of all ages. Despite that, we can see an overarching similarity in the origin of masses.

Nature of Masses

There were total of 38 benign pelvic mass lesions and 62 cases of malignant pelvic mass lesions in this study. While benign masses are overall more common, this study reflects that a higher number of cases were malignant, since cases that could not be fully evaluated or conclusively proven benign on ultrasonography were the ones who

underwent further evaluation on computed tomography.Ovarian adenocarcinoma was the commonest malignancy constituting 33 (33%) cases out of total 100 cases. In benign pathologies, commonest was benign ovarian cysts in 10 (10%) out of total 100 cases followed by uterine fibroids in 9 (9%) out of total 100 cases.

Characterisation of cases on Ultrasonography (Table-2)

Number:

Ultrasonography revealed multiple masses in 15 cases such that it gave a total of 123 masses in 100 cases. Many of these multiple masses were fibroids and ovarian masses. As size increases beyond the range of ultrasonography probe, we see a tendency towards the inability to detect the number of masses accurately.

Size:

The minimum size on ultrasonography was 4 cm while the maximum was 31 cm. As size increases beyond the range of ultrasonography probe, we see a tendency towards the inability to detect the size of masses accurately on this modality.

Extent:

53 of the 100 cases had masses restricted to the pelvis while 47 of 100 cases showed masses involving abdominal cavity as well as pelvic cavity.

Contents:

14 (48.2%) of the 29 cystic masses were benign while 27 (71%) of the 38 solid masses were classified as malignant.This is in agreement with ErlingEkerhovdet al.[11], who concludedthat the risk for malignancy in cysts containing papillary formations or solid parts was 3 to 6 times higher than that in unilocular echo-free cysts.

Internal Septations:

This was considered for masses with ovarian origin. 7 (70%) cases with thick septations were classified as malignant[12] while 2 (20%) cases could not be classified as benign or malignant. In contrast, only 3 (18.75%) of 16 cases with thin septations in masses were found to be malignant.

Internal solid areas more than one-third of the mass:

This was considered for masses with ovarian origin. Such solid areas were present in 15 (33.3%) cases and all (100%) of these were classified as malignant.

Vascularity:

On colour Doppler examination, vascularity was absent or minimal in 33 (33%) cases, of which 13 were given as malignant, keeping in mind other aspects of the mass. Moderate, marked, nodular and septal patterns of colour flow were seen in 52 (52%) cases. Of these, 43 (82.69%) cases were classified as malignant on ultrasonography. Malignant masses were seen to have higher colour flow and vascularity in internal septae and mural nodules.

Ascites:

Increasing amount of free fluid in cases with ovarian masses favoured malignancy. This is in agreement with Alcazar et al[13] who concluded that the presence or absence of ascites may be helpful for discriminating malignant from benign solid adnexal masses.

Lymphadenopathy:

Ultrasonography was not very useful in the detection of lymphadenopathy as either the mass itself or overlying bowel gases obscured the lymph nodes. Regardless, in cases with lymphadenopathy found on USG, the diagnosis was malignant in 17 (94.44%) out of 18 cases.

Provisional Diagnosis on USG:

Characterisation of masses on ultrasonography was better for fluid and cystic lesions. Ultrasonography classified 27 masses as benign, 59 as malignant and 14 as indeterminate. The causes of indeterminate characterisation included large mass size such that it could not be completely evaluated on USG and obscuration by limited acoustic window as in overlying bowel gases, large body habitus or dense calcification. Four of the indeterminate lesions finally classified as malignant, while the rest were benign.

Characterisation of cases on MDCT (Table-3)

Number:

CT revealed multiple masses in 18 cases such that it gave a total of 131 masses in 100 cases. Many of these multiple masses were fibroids and ovarian masses. CT is more accurate than USG for detection of number but discrepancies are seen when necrosis, infiltration or inherent soft tissue contrast limitations hinder accurate determination of number, for example, in a uterus with numerous fibroids with degenerative changes.

Size:

The minimum size on CT was 4 cm while the maximum was 35 cm. CT is very accurate for size determination as the whole of anatomy of scanned area is visualised at once.

Extent:

53 of the 100 cases had masses restricted to the pelvis while 47 of 100 cases showed masses involving abdominal cavity as well as pelvic cavity.

Contents:

CT showed that 26 (26%) cases had cystic masses while 44 (44%) cases had solid masses. 14 (14%) of the cases showed mixed solid-cystic masses. The rest of the masses were viewed as either predominantly cystic or predominantly solid on CT. 8 (30.7%) of the 26 cystic masses were malignant while 31 (70.44%) of the 44 solid masses were classified as malignant.

Internal Septations:

This was considered for masses with ovarian origin. Out of the 12 cases with thick septations, 11 (91.67%) cases were classified as malignant. In contrast, only 1 (7.6%) of 13 cases with thin septations in masses were classified as malignant.

Internal solid areas more than one-third of the mass:

This was considered for masses with ovarian origin. Such solid areas were present in 19 (42.2%) cases and all (100%) of these were classified as malignant.

Enhancement:

On scanning after contrast administration, enhancement was absent in 11 (11%) cases, of which 10 (90.9%) were given as benign and 1 remained indeterminate. Heterogeneous enhancement was seen in 70 (70%) cases. Of these, 51 (72.85%) cases were classified as malignant on CT. Malignant masses were seen to have higher and heterogeneous enhancement and enhancement in internal septae and mural nodules.

Ascites:

All 19 (100%) cases with marked ascites were provisionally diagnosed as being malignant. Increasing amount of free fluid in cases with ovarian masses favoured malignancy.

Lymphadenopathy:

CT was very useful for the detection of lymphadenopathy. Out of 40 cases with lymphadenopathy found on CT, the diagnosis was malignant in 33 (82.5%) and benign in 6 (15%) cases.

Provisional Diagnosis on CT:

Characterisation of masses on computed tomography showed improved visualisation of details like large size, solid areas, enhancement and lymphadenopathy compared to ultrasonography. CT classified 36 masses as benign, 59 as malignant and 5 as indeterminate. The causes of indeterminate characterisation included mixed features of benign and malignant masses such that histopathological examination was required for further diagnosis. These included cases of both uterine and ovarian origin, as well as a case of pyosalpinx. CT was able to classify most cases deemed indeterminate on USG.

Organs of origin	Number of masses	%
Ovarian	59	59
Other Adnexal	3	3
Uterine	30	30

Bowel	1	1
Bladder	1	1
Others	6	6

(Table 1:- Organ of Origin**).**

Content and Nature of masses on USG				
	Benign	Malignant	Indeterminate	Total
Cystic	14	9	6	29
Predominantly Cystic	0	2	1	3
Solid	10	27	1	38
Predominantly Solid	1	6	3	10
Mixed	2	15	3	20
Total	27	59	14	100

(Table 2:- Content and Nature of Masses on USG**).**

Content and Nature of Masses on CT				
	Benign	Malignant	Indeterminate	Total
Cystic	14	8	4	26
Predominantly Cystic	3	2	0	5
Solid	13	31	0	44
Predominantly Solid	3	8	0	11
Mixed	3	10	1	14
Total	36	59	5	100

(Table 3:- Content and Nature of Masses on CT**)**

	Sensitivity	**Specificity**	**PPV**	**NPV**	**Diagnostic Accuracy**
USG	98.28%	92.86%	96.61%	96.30%	96.51%
CT	98.33%	97.22%	98.33%	97.22%	97.89%

(Table 4:- USG and CT For Malignant Pelvic Masses**)**

Final Diagnosis

Histopathological evaluation diagnosed 38 cases as benign and 62 cases as malignant. Benign causes were commoner in the age group of 25-35 years (71%) while malignancies were in the highest proportion in the age group of >65 years (92.3%) and 45-55 years (80%). Commonest benign conditions were ovarian cysts and uterine fibroids. Commonest malignancies were ovarian adenocarcinoma and carcinoma cervix.

Role of USG in malignant pelvic masses

The sensitivity, specificity, PPV and NPV of USG for the assessment of malignant pelvic masses was 98.28%, 92.86%, 96.61% and 96.30% and diagnostic accuracy was 96.51% and p value <0.001.(Table -4)

Role of CT in malignant pelvic masses

The sensitivity, specificity, PPV and NPV of the CT for the assessment of malignant pelvic masses was 98.30%, 97.22%, 98.30% and 97.22% and diagnostic accuracy was 97.89% and p value <0.001. (Table-4)

Masses classified as indeterminate on either modality were excluded from the statistical analysis.

Comparative analysis of CT with USG

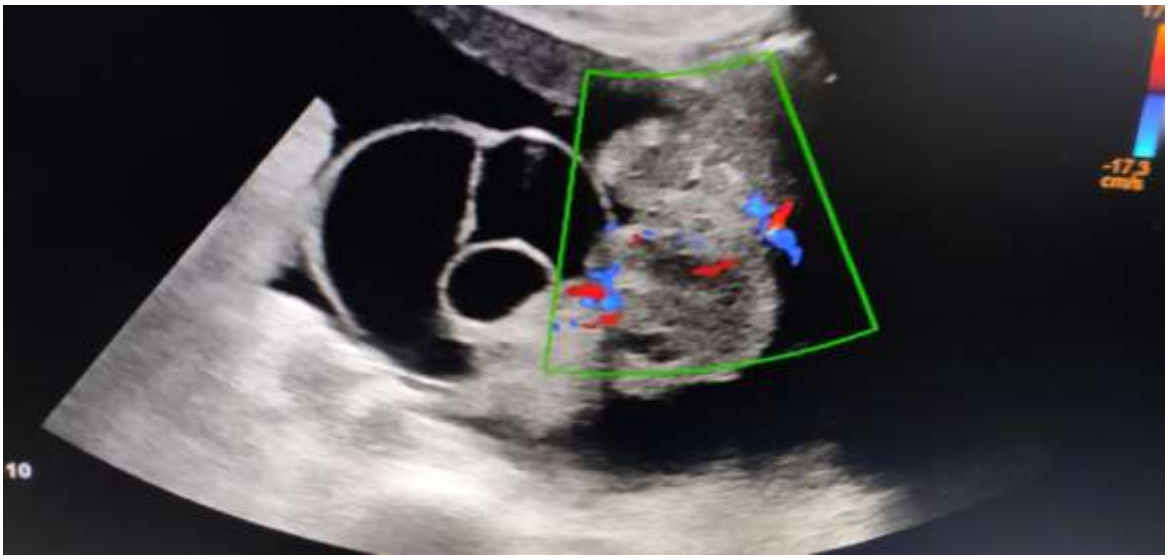
Results indicated higher diagnostic capability of CT as a problem-solving tool in cases of indeterminate masses on USG.We concluded that overall diagnostic accuracy of CT was higher than USG in characterising both benign and malignant pelvic masses.Diagnostic accuracy of computed tomography (97.89%) was higher than that of ultrasonography (96.51%).

In previous literature, Walsh et al[(14)] concluded that because both imaging techniques depict similar pathology and use similar diagnostic criteria, the two methods tend not to be complementary, while Yan Liu et al.[(15)]concluded that

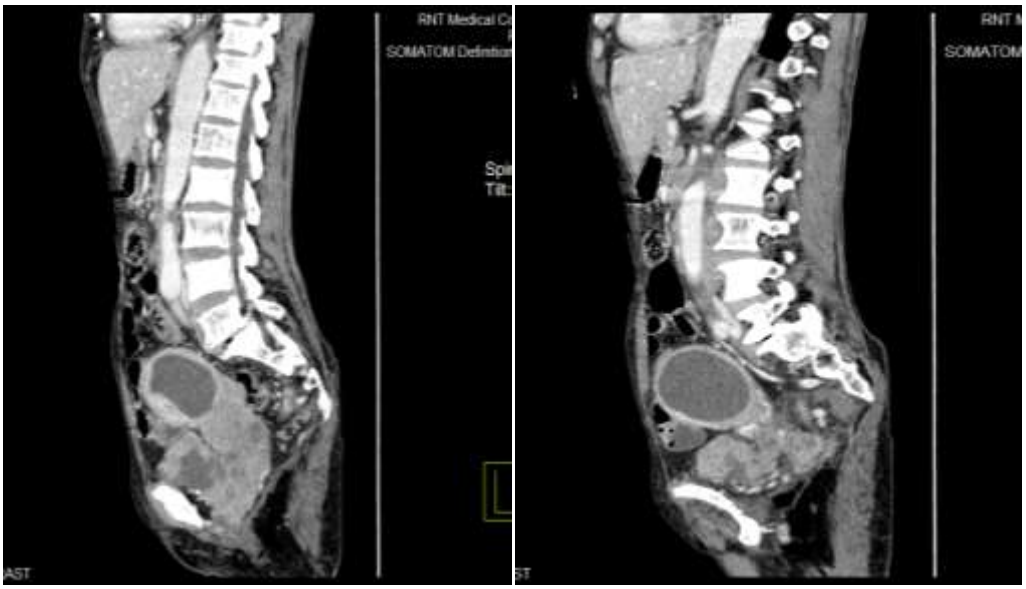
the combined application of ultrasound and CT had higher diagnostic value in female patients with pelvic masses than either method alone.

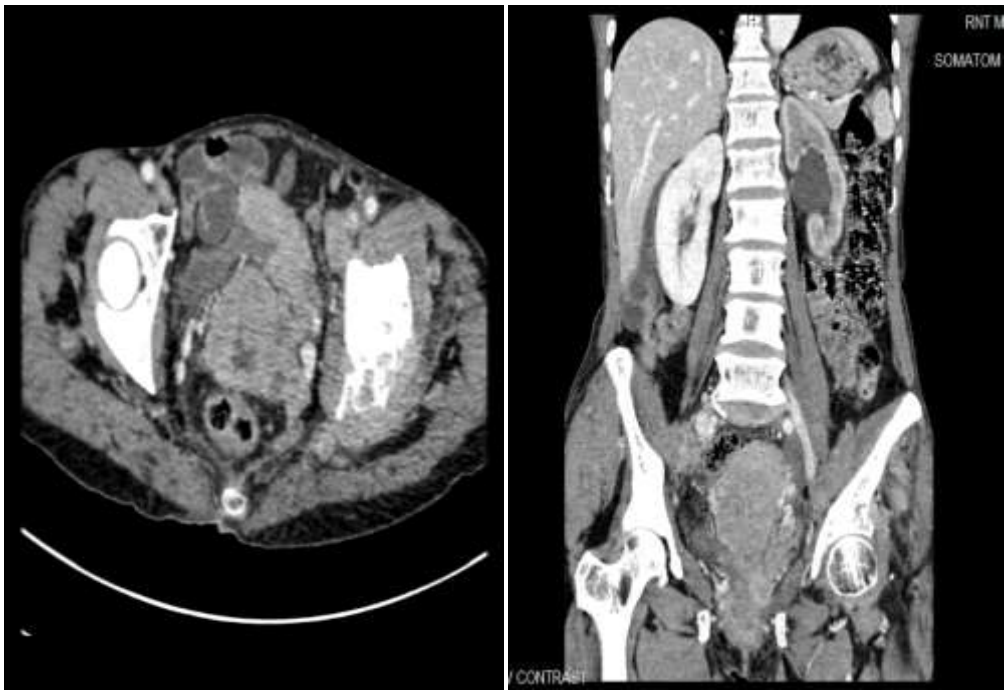
Conclusion:-

After going through our observations and preceding discussion we were able to conclude that ultrasonography is often the first imaging study performed in patients with symptoms related to the pelvis. It is less invasive, more comfortable for the patient and has a good diagnostic accuracy. For indeterminate cases in Ultrasonography, CT should be considered for more specific diagnosis because it may obviate the need for surgery or otherwise change management by identification of benign etiology. The role of CT in staging malignant tumors and its ability to detect metastasis and local infiltration into adjacent structures is now well accepted. CT is on stronger ground in the assessment of recurrent tumors. Over all, agreement with final specific diagnosis and diagnostic accuracy of CT for benign and malignant pelvic masses was higher than ultrasonography.

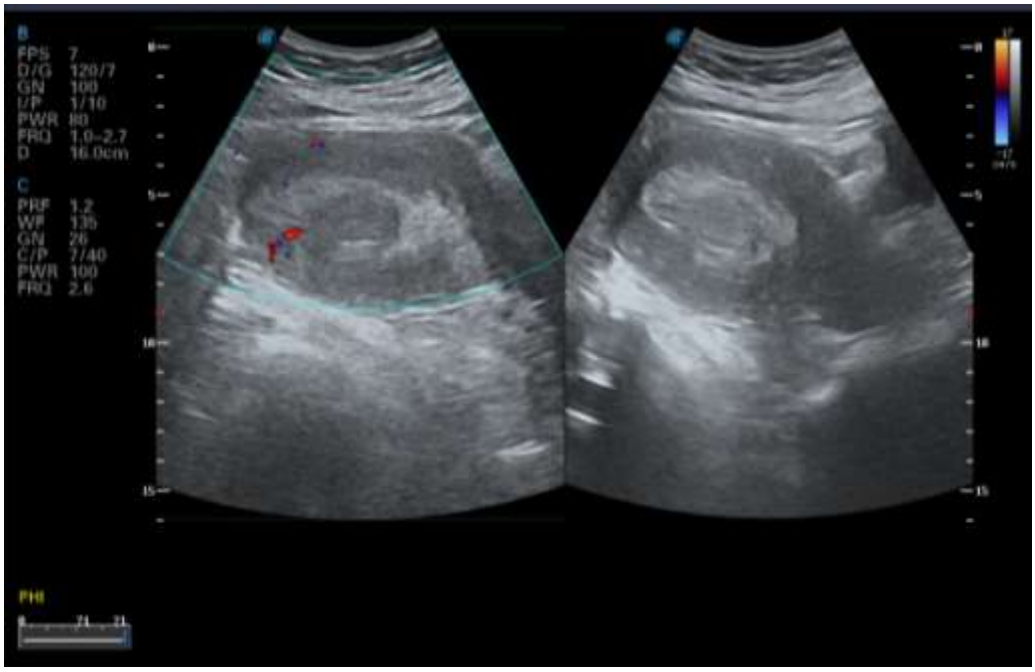


(Case 1)
Ultrasonography demonstrating large mixed solid cystic mass of adnexal origin showing vascularity in solid components and associated with marked ascites: **Adenocarcinoma ovary**

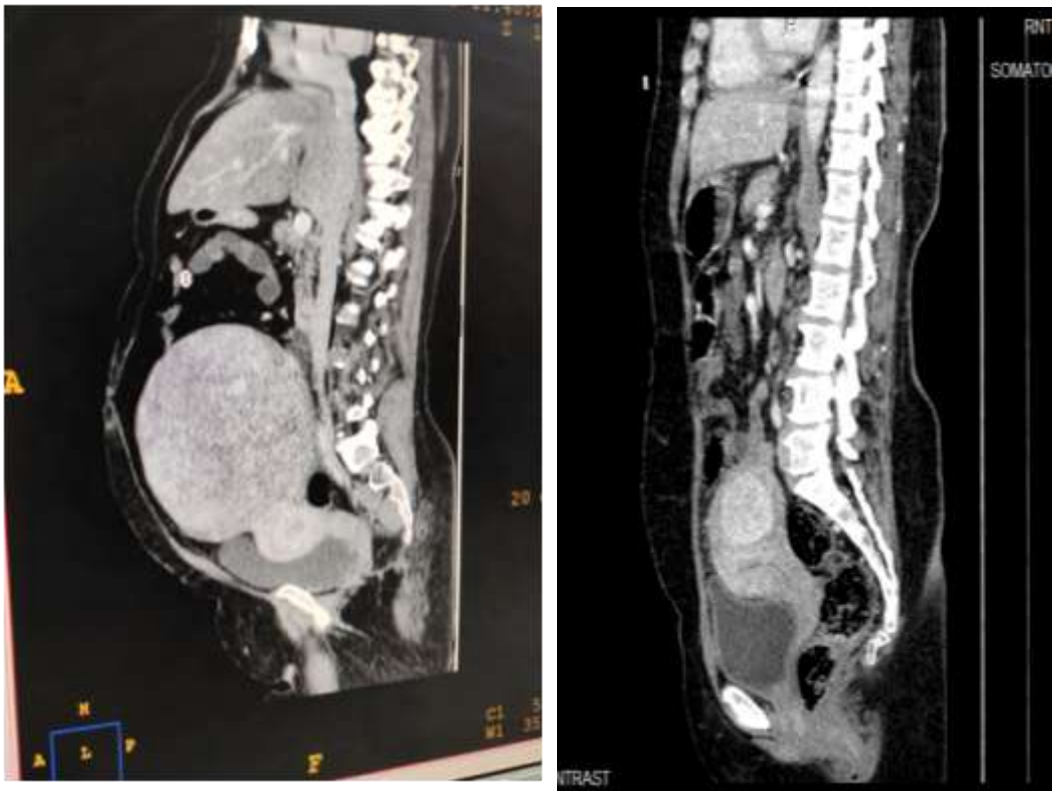




(Case 2)
Sagittal, axial and coronal sections on CECT showing heterogeneously enhancing soft tissue density solid mass with internal necrotic areas arising from uterine cervix and infiltrating uterus, adjacent pelvic wall and urinary bladder, causing left hydroureteronephrosis and proximal endometrial collection: **Carcinoma cervix**



(Case 3)
Sagittal plane in ultrasonography showing well defined pedunculated hypoechoic mass in uterine cavity: **Uterine fibroid**



(Cases 4 and 5)
Sagittal sections on CECT showing well defined rounded mass lesions having heterogeneous enhancement arising from posterior uterine wall: **Uterine fibroids**

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