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Computed tomography (CT) Evaluation of ovarian Tumors Compared with Histopathological Findings

PARVEEN AKTER[1], KHURSHED AHMED[2], MD ENAYET KARIM[3], SADIA IMAM[4], FARJANA YESMIN KHAN[5], ABM MANIRUL ALAM[6]

Abstract

Background: *Ovarian tumors are a group of neoplasms affecting the ovary and have a diverse spectrum of features according to the particular tumor entity. They include benign, low malignant potential and malignant subtypes.* ***Aims:*** *To establish diagnostic usefulness of computed tomography (CT) in evaluation of ovarian tumors compared with histopathological findings.* ***Methods:*** *This cross-sectional study was carried out in the Radiology and Imaging department in collaboration with the Departments of Obstetrics and Gynaecology and Department of Pathology of Bangabandhu Sheikh Mujib Medical University, Dhaka, during July 2012 to June 2014. A total of 52 consecutive patients having ovarian tumor enrolled for surgical management were included in this study. CT was done in all these patients and they were followed up from the admission up to the post operative histopathological tissue diagnosis of tumor in pathology department. Patients were divided into two groups, which were malignant (group-I) and benign (group-II) according to histopathological diagnosis. Statistical analysis of the results was obtained by using windows computer software with SPSS-version 26.* ***Result:*** *CT diagnosis of ovarian tumors were 17 true positive cases, 03 false positive cases, 02 false negative cases and 30 true negative cases as confirmed by histopathological diagnosis. The validity of CT scan evaluation of ovarian tumors was calculated which showed a sensitivity of 89.5%, specificity of 90.9%, accuracy of 90.4%, positive predictive values (PPV) of 85% and negative predictive values (NPV) of 93.8%.* ***Conclusion:*** *A computed tomography finding is significantly consistent with histopathological diagnosis in evaluation of ovarian tumors and CT is associated with high sensitivity and negative predictive value, thus is very much effective in the evaluation of ovarian tumors.*

Keywords: *Computed tomography, ovarian tumors, benign, malignant*

Introduction:

Gynecologic malignancies include cervical cancer, endometrial cancer, and ovarian cancer. Ovarian cancer is the second most common gynecologic malignancy; however, it remains the leading cause of death among these diseases and is the fourth leading cause of cancer deaths in women in the United States.[1] Ovarian cancer accounts for about 4% of all female cancers. In spite of diagnostic and therapeutic advances in the care of women with ovarian cancer, the overall 5-year survival rate has changed little.[2]

Ovarian tumors can be categorized as epithelial, germ cell, sex cord–stromal, or metastatic tumor. Epithelial tumors are the most common histopathologic type of malignant ovarian tumor (85% of cases). Subtypes of epithelial tumors include serous, mucinous, endometrioid, clear cell, and Brenner's tumors. Epithelial tumors are rare before puberty; their prevalence increases with age and peaks in the 6th and 7th decades of life. The most common type of ovarian malignancy is serous cystadenocarcinoma (approximately 40% of cases).[3] Sex cord stromal tumors includes fibromas and hormone secreting tumors such as thecomas, granulosa cell tumors and Sertoli cell tumors.

1. Assistant Professor, Department of Radiology & Imaging, Kurmitola General Hospital, Dhaka. 2. Associate Professor, Department of Cardiology BSMMU, Dhaka. 3. Professor & Ex-Chairman, Department of Radiology & Imaging, BSMMU, Dhaka. 4. Consultant Radiologist, Ibne Sina Hospital, Dhanmondi, Dhaka. 5. Medical Officer, Department of Radiology & Imaging, Kurmitola General Hospital, Dhaka. 6. Assistant Professor, Department of Radiology & Imaging, Sheikh Hasina Medical College, Tangail.

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Germ cell tumors include Dermoid cysts or benign cystic teratoma and malignant tumors such as dysgerminoma and immature teratoma. Management of all ovarian cancers is similar. CT has a central role in the management of ovarian cancer. Therefore, it is important to be familiar with the clinical and imaging aspects of ovarian benign and malignant tumors in particular.

Among women with ovarian disorders, CT has been used primarily in patients with ovarian malignancies, either to assess disease extent prior to surgery or as a substitute for second-look laparotomy. Although CT may play a useful role in diagnosing ovarian tumors, it is more often of limited value in this setting.[4]

CT, has several advantages: It is widely available and can be performed rapidly and relatively easily. Moreover, CT of the abdomen or pelvis allows comprehensive evaluation of all potential sites of peritoneal implants or lymphadenopathy as well as of the primary tumor site. CT allows use of oral contrast agent to distend and mark the bowel and help differentiate bowel from peritoneal implants, which gives this modality a major advantage over US and MR imaging. For these reasons, CT is a very attractive method for evaluating the extent of disease in women with ovarian malignancy. CT is superior to ultrasonography in distinguishing between benign and malignant epithelial tumors. A few small-scale studies have suggested that MR imaging, particularly with gadolinium-enhanced, fat-saturated breath-hold techniques, may be more accurate than CT in staging ovarian carcinoma.[5] The largest study to date comparing US, CT, and MR imaging in the staging of ovarian malignancy showed little difference between the modalities.[6]

CT is most useful for evaluating the extent of disease in the abdomen and pelvis. In some studies, CT has demonstrated reasonable accuracy in determining which patients may have tumor implants that can be optimally surgically debulked (i,e, all tumor nodules greater than 2 cm can be removed).[5] Patients with unresectable disease would undergo percutaneous or laparoscopic biopsy, after which they would undergo chemotherapy and optimal surgical debulking after completion of chemotherapy. Clinical trials have shown that optimal debulking after chemotherapy improves survival rate in these patients.[7]

Lee et al. compared the statistical proportions for the frequencies of the sign in ovarian tumors and sub serosal uterine myomas.[8] The ovarian vascular pedicle sign on helical CT confirmed the ovarian origin, the sensitivity, specificity, positive predictive value and negative predictive value, and diagnostic accuracy were 92% (99/108), 87% (20/23), 97% (99/102), 69% (20/29), and 91% (119/131), respectively.

Ozasa et al. showed the accuracy for the histologic diagnosis with ultrasound and CT which was 56% and 84% respectively ($P<0.05$).[9] The fact that CT is competent in detecting adhesions adds further value to CT as a powerful tool for the preoperative investigation of pelvic mass.

Onyeka, Atalla and Deemer compared with transabdominal grey-scale ultrasound (TAUS) and found CT scan more sensitive in making an overall presumptive diagnosis of pelvic mass (15/31, 48% vs. 9/31, 29%).[10] The sensitivity of CT scan for all ovarian cancer detection was greater than that of TAUS (5/6, 83% vs. 4/6, 67%) but TAUS was more specific. The false negative and false positive values for cancer detection were comparable. Both methods were equally efficacious in detecting and staging advanced ovarian cancer cases (4/4, 100%). Visualization of the ovaries occurred more readily with TAUS, which in addition offered a more precise assessment of ovarian tumor size. There were no significant differences in the two methods regarding tumor localization (organ of origin), Characterization and the details of descriptive report when no presumptive diagnosis is offered. Overall CT did not offer significant additional features and did not result in changes in management plan in any of the patients reviewed. The marginal benefit of CT scan over TAUS will not warrant its routine usage in the diagnosis of gynaecological pelvic mass.

Yen et al. evaluated imaging characteristics of ovarian fibromas and fibrothecomas and to identify clinical markers and imaging features to help in their diagnosis.[11] On CT with contrast, 2 of 8 lesions (25%) showed enhancement. On T1-weighted MRI, 5 lesions (83%) showed an isointense signal and 1 (17%) showed a hyperintense signal compared to the myometrium. On T2-weighted MRI, 4 of 6 lesions (67%) were hypointense; 1 (16.5%) was isointense; and 1 (16.5%) was hyperintense.

Elevated CA-125 was present in 5 of 29 patients (28%). One had Meigs syndrome. For a cystic adnexal mass where the primary consideration is commonly an epithelial tumor, the possibility of a cystic stromal tumor should also be considered. Unlike previous studies reporting both T1 and T2 hypointensity, fibrothecomas and fibromas can also show T1 and T2 isointensity and, exceptionally, hyperintensity. Vascularity, shown by Doppler flow and MRI and CT enhancement, is a characteristic of some fibromas and fibrothecomas.

CT is the preferred technique in the pre-treatment evaluation of ovarian cancer to define the extent of disease and assess the likelihood of optimal surgical cytoreduction. Tumor involvement of the diaphragm and the large bowel mesentery has been shown to be the most reliable CT predictor of suboptimal cytoreduction, although other features such as supra-renal para-aortic adenopathy; omental tumor extending into the spleen, stomach, or lesser sac; tumor growth into the pelvic sidewall; and hydroureter, are also associated with a poor surgical result.[12] CT has been shown to predict suboptimal cytoreduction with sensitivity of 79% and specificity of 75%. However, accuracy varies considerably among institutions, likely reflecting variations in surgical practice and technique as well as differing definitions of optimal cytoreduction.[13] For predicting correct stage, the sensitivity and specificity of CT were reported to be 50% and 92%, respectively, in one series.[5]

There are no satisfactory screening tests which are cost effective for diagnosis of ovarian tumor. Routine pelvic examinations will not detect early ovarian cancer. By clinical examination & investigation suspected cases can be detected earlier. Then aggressive surgery and adjunctive therapy will decrease the mortality rate and will increase life expectancy for few years.[5]

Materials and Methods:

This cross-sectional study was done in admitted patients with ovarian tumors, in the Department of Radiology and Imaging in collaboration with Department of Pathology and Department of Obstetrics and Gynaecology of Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, during July 2012 to June 2014. Patient with suspected ovarian tumor on clinical examination or clinical and biochemical examination, or suggested by Ultrasonography and diagnosed by CT as having ovarian tumor and patients diagnosed by Computed tomography (CT) as having ovarian tumor incidentally were enrolled in this study. Past history of major pelvic surgery for non-ovarian pathology, fibrosis, vascular changes and anatomical distortion of pelvic organs are normally expected, suspected or diagnosed ectopic pregnancy and corpus luteal cyst and patients with ovarian tumor with peritonitis were excluded from the study. A total of 65 patients were enrolled in this study, out of which 13 patients were excluded due to 3 cases had ectopic pregnancy, 5 had corpus luteal cyst, 3 patients were not available later and biopsy report was not available of 2 patients. Finally 52 patients were included in the study. The research work was approved by the Institutional Review Board, prior to the commencement of the study. The objectives of the study along with its procedure, risk and benefits to be derived from the study was explained to the patients in easily understandable local language and then informed consent was sought from them. It was assured that all records would be kept confidential and would not be disclosed anyway except for the purpose of study. Proper history taking, clinical examination, were performed. All findings were collected in a pre-designed data collection sheet.

Study procedure:

The patients were assessed, prepared and after taking informed consent surgery was done. Histopathology or cytology of the specimen collected by surgery and USG guided FNAC was done to confirm the diagnosis of ovarian tumor and to know the type of the tumor, whether benign or malignant. All the reports were noted in the data collection sheet. Those who were diagnosed as malignant was placed in group I (n=19) and those who were diagnosed as benign ovarian neoplasm was placed in group II (n=33). CT findings that were used to diagnose malignancy are: cystic-solid mass, necrosis in a solid lesion, cystic lesion with thick, irregular walls or septa, and/or with papillary projections. Presence of ascites, peritoneal metastases, omental cake and lymphadenopathy were considered as features of malignancy. In addition, presence of involvement of the liver, spleen bowel, ureter was also documented. Benign lesions had well defined

margins, without evidence of local or distant spread. Cystic lesions were unilocular, and had thin walls with minimal septations, and the absence of papillary projection. Mature cystic teratoma have various CT appearances depending on its contents including low density areas due to fat or oil, high density from dental elements or calcifications, a flat fluid level etc. Alternatively they may appear as cystic lesions.

Procedure of MDCT scanning:

CT examinations were performed with a Hitachi Scenaria 64 slice MDCT machine. Patients were fasted for at least 6-8 hours before the examination. Oral contrast medium was given to the patients 1.5 hours before I/V contrast examination. Each patient received 40-50 ml of a nonionic contrast material (iopromide, Ultravist 370, Bayer Health Care) through an 18-gauge angiographic catheter inserted into a forearm vein. CT scans was routinely obtained with the patient in a supine position during full inspiration. The contrast material was injected at a rate of 3.5 ml/s with an automatic power injector. MDCT scan was performed using the following parameters: detector collimation, 5-8 mm; kVp 120; tube current 25 mA; slice thickness,5-10 mm; and reconstruction intervals, 5 mm. After an initial unenhanced scan, an MDCT scan was obtained at 90-120 seconds after initiation of I/V contrast injection. This scanning delay was done to optimize venous enhancement and for differentiating iliac blood vessels from lymph nodes.

In most patients, images of the upper abdomen were obtained immediately before dedicated pelvic scanning to optimize contrast material dynamics in the liver, spleen, pancreas, and kidneys. This was done to ensure the detection of metastatic implants in the mid and upper abdomen. A delay of at least 1 hour after oral contrast material administration was done for all patients. Delayed images after bladder enhancement differentiated urinary bladder from ovarian mass.

CT Appearances of Primary Tumor:

The ovarian tumor in the pelvis typically lies in the adnexa lateral to the uterus and posterior to the round ligament. Less common locations for ovarian tumor are in the midline cul-de-sac or anterosuperior to the uterus and bladder in the midline.[14] Most ovarian carcinomas are greater than 4–5 cm in diameter at the time of presentation.[5,8] CT features suggestive of malignancy include (*a*) lesion diameter greater than 4 cm; (*b*) papillary projections, which are often seen on contrast material–enhanced images; (*c*) walls and septa more than 3 mm thick; (*d*) a partially cystic, partially solid mass; (*e*) a lobulated solid mass; and (*f*) the presence of tumor vessels on contrast-enhanced images.[15] None of these features are specific enough to indicate the diagnosis pre-operatively. In general, however, the likelihood of malignancy increases with increasing solid-tissue elements and thicker septa.[16]

CT Appearances of Local Extension:

Early in the disease, ovarian cancer is confined to the ovary. With time, capsular invasion takes place, and direct involvement of adjacent structures can occur. The anterior and posterior cul-de-sac, sigmoid colon, omentum, small intestine, pelvic wall peritoneum, uterus, fallopian tubes, and broad ligament are the most common sites of direct involvement.[2] CT signs of tumor extension in the pelvic organs include (*a*) localized distortion of the uterine contour, (*b*) an irregular interface between the tumor and the myometrium, (*c*) loss of a tissue plane between the solid component of the tumor and the wall of the sigmoid colon or the bladder, (*d*) encasement of the sigmoid colon by the tumor or direct tumor extension to the sigmoid colon, (*e*) distance between the tumor and the pelvic side wall of less than 3 mm and (*f*) iliac vessels surrounded or displaced by the tumor.[5]

There is poor correlation between the gross pathologic appearance and the histologic type or aggressiveness of the tumor.[8,16] However, secondary findings suggestive of malignancy such as pelvic organ and pelvic side wall invasion; peritoneal, omental, or mesenteric involvement; ascites; and lymphadenopathy increase the confidence in a diagnosis of malignancy.[5] When these secondary criteria are used in addition to the primary criteria, the reported accuracy of CT in characterization of ovarian tumors as benign versus malignant is 92%–94%.[15,18] In part, the excellent accuracy of CT reflects the advanced stage at presentation of many ovarian tumors.

Statistical analysis:

Statistical analyses of the results were obtained by using window based computer software devised with Statistical Packages for Social Sciences (SPSS-26). The results were presented in tables, figures, diagrams. Continuous variables were expressed as mean, standard deviation, and categorical variables as frequencies and percentages. For the validity of study outcome, sensitivity, specificity, accuracy, positive predictive value and negative predictive value of the CT diagnosis of ovarian tumors was calculated.

Results:

Regarding the age distribution, 8(42.1%) patients age belonged to 51-75 years in group I and 17(51.5%) patients were belonged to age 15-30 years in group II. The mean age was found 49.0±18.7 years varied from 15 – 75 years in group I and 30.6±11.8 years varied from 23 – 60 years in group II.

About the presenting complaints of the study patients, it was observed that 2(10.5%) in group I and 4(12.1%) in group II were asymptomatic. Majority 17 (89.5%) patients had lump in group I and 29(87.9%) in group II. Ten (52.6%) patients had lower abdominal pain in group I and 18(54.5%) in group II. Fourteen (73.7%) patients had constitutional symptoms in group I but not found in group II.

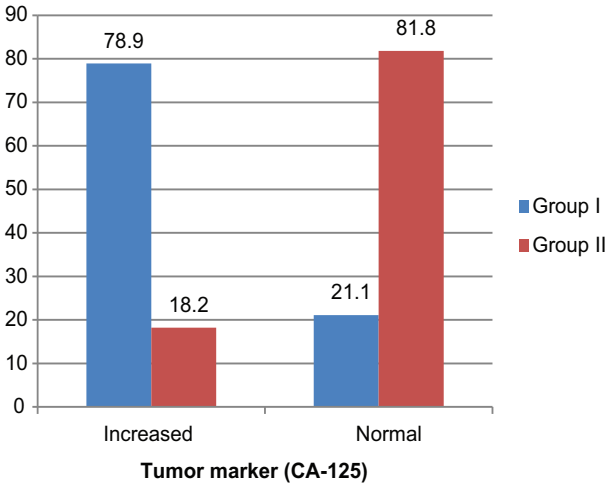

Fig.-1: *Bar diagram showing tumor marker (CA-125) of the patients.*

Table I

Distribution of the study patients according to CT evaluation of ovarian tumors (n=52)

CT findings	Group I (n=19)		Group II (n=33)	
	n	%	n	%
Site				
Adnexal region	12	63.2	27	81.8
Others	7	36.8	6	18.2
Size				
<4 cm	2	10.5	0	0
>4 cm	17	89.5	33	100
Component				
Cystic	4	21.1	21	63.7
Solid	6	31.6	1	3
Mixed	9	47.3	11	33.3
Internal septations				
No	13	68.4	16	48.5
Yes	6	31.6	17	51.5
Thick	4	66.7	3	17.6
Thin	2	33.3	14	82.4
Fat				
Present	2	10.5	11	33.3
Absent	17	89.5	22	66.7
Calcification				
Present	3	15.8	15	45.5
Absent	16	84.2	18	54.5
Contrast enhancement				
No enhancement	0	0	3	9.1
Homogenous	2	10.5	19	57.6
Heterogenous	17	89.5	11	33.3
Local spread (uterus, uterine tube, bladder)				
Present	7	36.8	0	0
Absent	12	63.2	33	100
Spread to pelvic side wall				
Present	2	10.5	0	0
Absent	17	89.5	33	100
Ascites				
Present	11	57.9	1	3
Absent	8	42.1	32	97
Lymphadenopathy				
Present	1	5.3	0	0
Absent	18	94.7	33	100
Hydronephrosis				
Present	2	10.5	0	0
Absent	17	89.5	33	100
Involvement of small or large bowel				
Present	0	0	0	0
Absent	19	100	33	100
Peritoneal and mesenteric masses				
Present	3	15.8	0	0
Absent	16	84.2	33	100
Involvement of other abdominal organs				
Present	2	10.5	0	0
Absent	17	89.5	33	100

Table II

Distribution of the study patients according to histopathological findings of ovarian tumors (n=52)

Histopathological findings	Number of patients	Percentage (%)
Malignant (n=19)		
Serous cystadenocarcinoma	7	36.8
Mucinous cystadenocarcinoma	2	10.5
Immature teratoma	3	15.8
Dysgerminoma	1	5.3
Granulosa cell tumor	1	5.3
Krukenberg tumor	3	15.8
Others	2	10.5
Benign (n=33)		
Dermoid cyst/ teratodermoid	11	33.3
Serous cystadenoma	16	48.5
Mucinous cystadenoma	5	15.2
Fibroma	1	3

In malignant cases, 4 patients of serous cystadenocarcinoma had mixed component with predominant solid and small cystic portions. Two were solid and another 1 was cystic. Six cases were heterogeneously enhancing. Ascites was present in 4 cases and 5 cases showed features of tumor spread. Mucinous cystadenocarcinoma showed cystic (1) and mixed (1) solid cystic components having thick internal septation and irregular thick wall. Both lesions were heterogeneously enhancing. Two immature teratoma had large mixed cystic and solid components having scattered coarse calcification and a few foci of fat. Another immature teratoma had large heterogeneously enhancing solid mass with coarse calcification. Ascites was present in 1 case. Dysgerminoma and Granulosa cell tumor presented as large heterogeneously enhancing solid masses. Two Krukenberg tumor had mixed solid and cystic components and another case had solid component. Two were heterogeneously enhancing and all presented with ascites. Both adenocarcinoma had heterogeneously enhancing cystic components having thick irregular internal septation. One of the cases showed ascites.

In benign cases, all the dermoid cysts (11) had fat and calcification. Eight of the cases showed mixed components and 3 were cystic. Cystic component was found 15 serous cystadenoma, 8 of them were unilocular and rest 8 showed one or two thin internal septation. Fifteen cases had homogeneous marginal and septal enhancement. Marginal calcification was present in 4 cases. Three of the mucinous cystadenoma had cystic components and 2 mixed components with a small solid and large cystic portion. All the lesions were multiloculated. Three were homogenous and 2 were heterogeneous in contrast enhancement. There was a single case of bilateral ovarian fibroma which were mild homogeneously enhancing solid lesions with huge ascites and right sided mild pleural effusion (Meigs syndrome).

Table III

CT findings of ovarian tumors according to histopathological findings (n=52)

Histopathological diagnosis	Component			Internal septation					Contrast enhancement			
	Cystic	Solid	Mixed	No	Thick	Thin	Fat	Calcification	No	Homogeneous	Heterogeneous	Ascites
Malignant												
Serous cystadenocarcinoma	1	2	4	5	0	2	0	0	0	1	6	4
Mucinous cystadenocarcinoma	1	0	1	0	2	0	0	0	0	0	2	1
Immature teratoma	0	1	2	3	0	0	2	3	0	0	3	1
Dysgerminoma	0	1	0	1	0	0	0	0	0	0	1	1
Granulosa cell tumor	0	1	0	1	0	0	0	0	0	0	1	0
Krukenberg tumor	0	1	2	3	0	0	0	0	0	1	2	3
Adenocarcinoma	2	0	0	0	2	0	0	0	0	0	2	1
Benign												
Dermoid Cyst	3	0	8	7	0	4	11	11	2	0	9	0
Serous cystadenoma	15	0	1	8	0	8	0	4	1	15	0	0
Mucinous cystadenoma	3	0	2	0	3	2	0	0	0	3	2	0
Fibroma	0	1	0	1	0	0	0	0	0	1	0	1

Table IV
Validity of CT findings in the diagnosis of ovarian tumors

CT diagnosis	Histopathological diagnosis	
	Malignant (n=19)	Benign (n=33)
Malignant (n=20)	17 (True positive)	3 (False positive)
Benign (n=32)	2 (False negative)	30 (True negative)

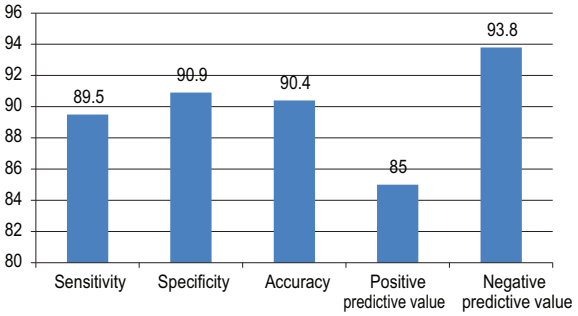

Fig 2: *Bar diagram showing sensitivity, specificity, accuracy, positive and negative predictive values of the CT diagnosis of ovarian tumors.*

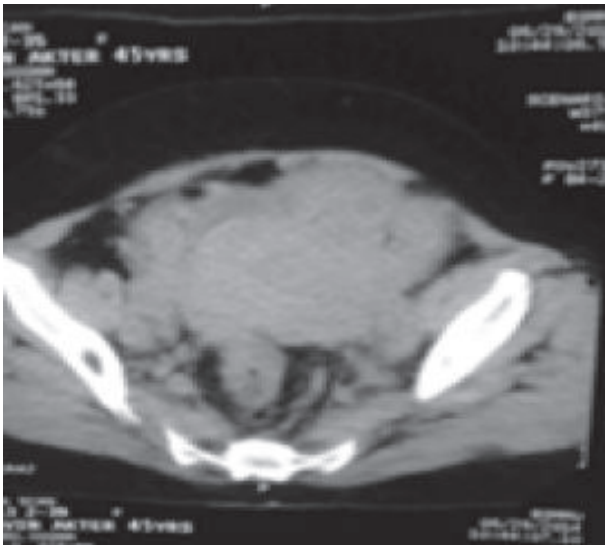

Fig.-1: *Krukenberg Tumor — soft tissue density masses in both ovaries Pre Contrast Scan*

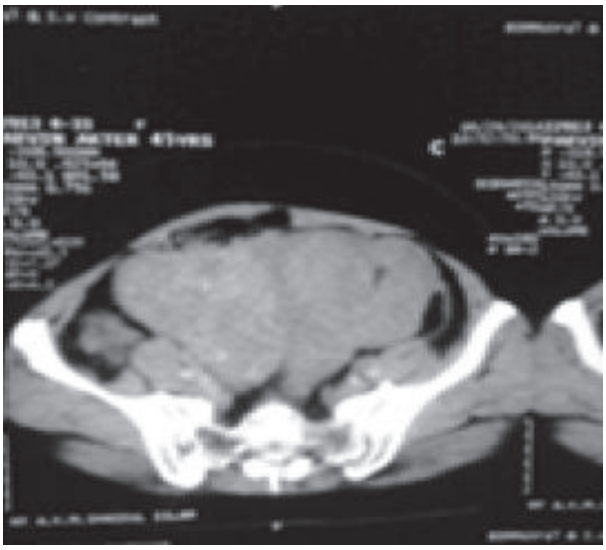

Fig.-2: *Krukenberg Tumor Post Contrast Scan heterogeneously enhancing soft tissue density masses in both ovaries*

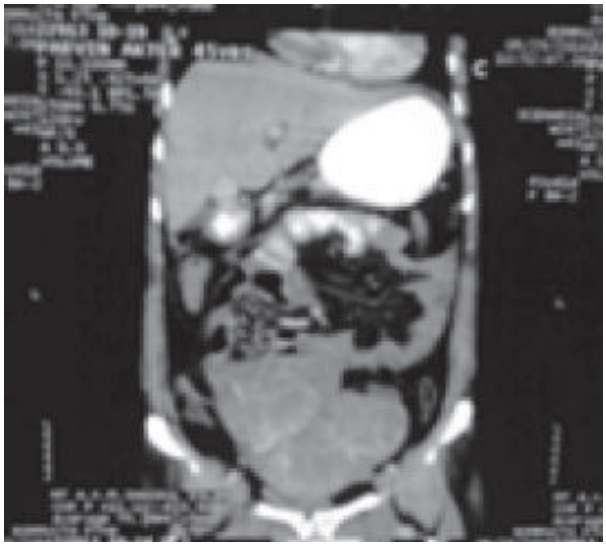

Fig.-3: *Krukenberg Tumor Post Contrast Scan Heterogeneously enhancing soft tissue density masses in both ovaries*

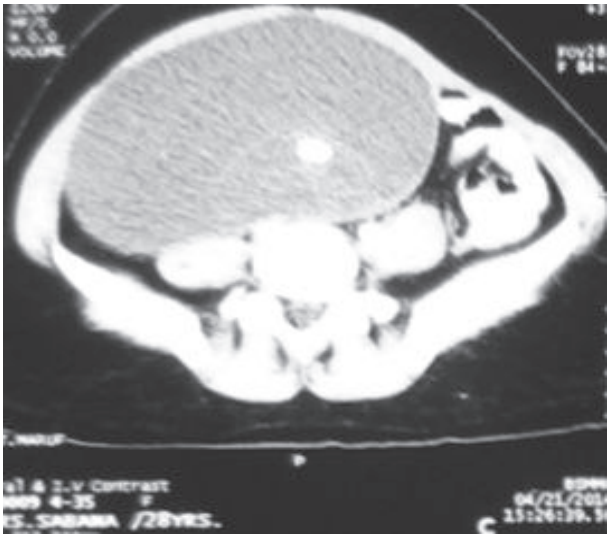

Fig.-4: *Serous cystadenoma of right ovary-Well defined smooth marginated cystic lesion with enhancing few thin internal septation and eccentric calcification*

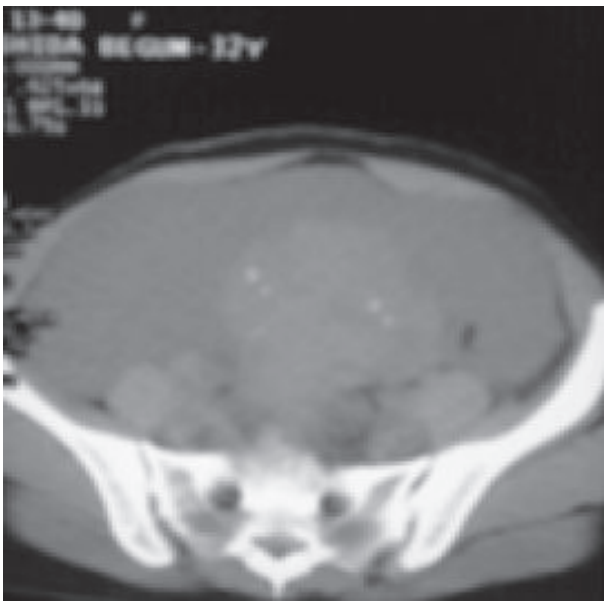

Fig.-5: *Serous cystadenocarcinoma of left ovary with peritoneal metastases and ascites - Pre Contrast Scan*

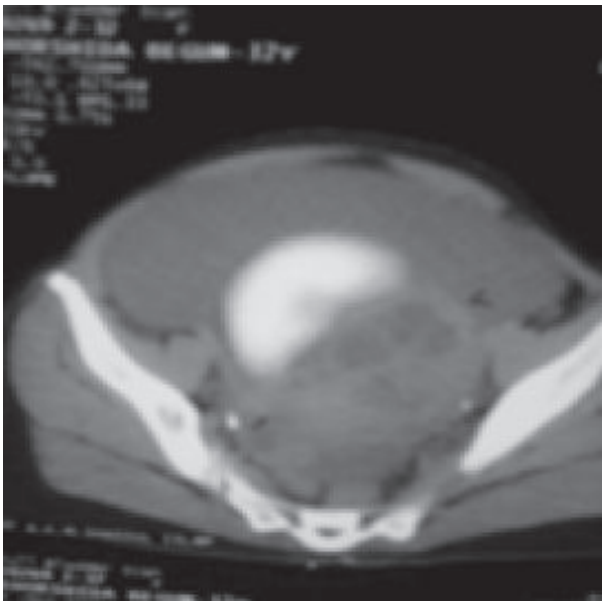

Fig.-6: *Serous cystadenocarcinoma of left ovary with peritoneal metastases and ascites - Post Contrast Scan*

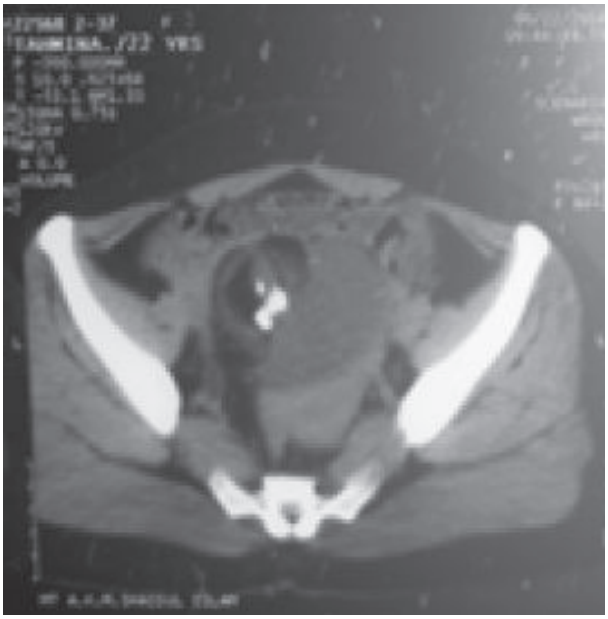

Fig.-7: *Teratodermoid of Left Ovary Pre Contrast Scan-Mixed density lesion having internal cystic, fat density area and calcification*

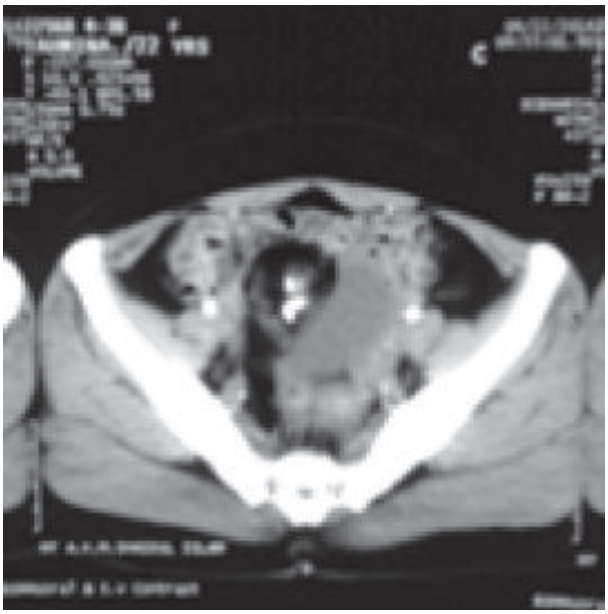

Fig 8: Teratodermoid of Left Ovary Post Contrast Scan-Mixed density lesion having internal cystic, fat density area and calcification

Discussion:

This cross sectional study was carried out with an aim to find out the validity of CT scan in evaluation of benign and malignant ovarian tumors and to assess histopathological findings of ovarian tumors and also to determine and validate the diagnostic accuracy, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of Computed tomography (CT) in evaluation of benign and malignant ovarian tumors.

One of the most important predictors of malignancy is the age of the patient. The risk of malignancy in ovarian tumors increases 12 fold from the ages 12-29 years to 60-96 years.[19] Ovarian malignancy

is a serious disease, affecting women of all ages, more so above 50 years.[20] In this present study it was observed that majority (42.1%) patients were belonged to 51-75 years in group I and 17(51.5%) patients were belonged to age 15-30 years in group II. The mean age was found 49.0±18.7 years in group I and 30.6±11.8 years in group II. Similarly, Wasim et al.[20] & Rafiq et al.[21] showed identical mean age of the patients having ovarian tumors and thus, support the present study. However, Olsen et al.[22] & Shaikh et al.[23] showed younger age group for malignant tumor in their study. On the other hand Malik et al.[24] and Hassen et al.[25] found the mean age was 49.5±13 years and 52 years with range from 20-85 years respectively. In another study, Wasim et al. showed that the mean age of the patients with malignant tumors was 49.07 ± 18.5 years. The above findings are similar with the current study.[20] The higher age range may be due to increased life expectancy and geographical influences may have significant impacts on ovarian tumors.

In this current study it was observed that 2(10.5%) patients in group I and 4(12.1%) patients in group II were asymptomatic. Majority 17 (89.5%) patients had lump in group I and 29(87.9%) in group II. Ten (52.6%) patients had lower abdominal pain in group I and 18(54.5%) in group II. Fourteen (73.7%) patients had constitutional symptoms in group I but not found in group II. Rafiq et al.[21] and Sultana et al.[26] in their study reported symptoms were, pain in abdomen 58%,46%, 57.1% and mass in lower abdomen as 77%, 66%, 50.7% respectively. Yasmin et al.[27] in their study showed that the commonest presenting symptom was pain abdomen 48 (70.69%) followed by mass abdomen 10 (14.71%). The result comply well with a study carried out by Rashid et al.[28] in Lahore showed that abdominal pain was the commonest presenting complaint (59%) followed by abdominal mass/distension (37%).

Family history of ovarian and breast cancer is a strong risk factor for ovarian cancer as it may indicate presence of inherited germ line mutation in either BRCA-1 or BRCA-2. In this series it was observed that family history of ovarian, breast, endometrial or colorectal carcinoma was found in 26.3% patients in group I and 3.0% in group II. Malik found that 20.0% of the patients had a positive family history of cancer.[24]

In this current study it was observed that elevated tumor marker (CA-125) was found 78.9% in group I and 18.2% in group II. Normal tumor marker (CA-125) was 21.1% and 81.8% in group I and group II respectively. Regarding tumor markers, 88.8% patients had cancer antigen 125 (CA-125) levels elevated found by Yen et al.[11] Previous studies showed a mixture of results, with some, such as Leung and Yuen[29] and Mak et al.[30] showing high values in 80% to 100% of patients, whereas other studies showed results at the other end of the spectrum, such as Chechia et al.[31] with 14% and Bazot et al.[32] with 12% of patients with elevated levels. The wide range of results may be attributable to other confounding factors, such as sample sizes and other afflictions involving the lungs, gastrointestinal tract, and breasts.

In this present study it was observed that more than one third 09 (47.3%) patients had mixed component in group I and 21(63.7%) had cystic component in group II. Majority (66.7%) patients in group I had thick internal septations and (82.4%) patients had thin septations in group II. Eleven (33.3%) patients had fat in group II. Three (15.8%) patients had calcification in group I and 15(45.5%) in group II. Majority 17 (89.5%) patients had heterogenous enhancement in group I and 19(57.6%) patients had homogeneous marginal and/or septal enhancement in group II, among them, one patient had mild homogeneously enhancing solid bilateral tumors with ascites and right sided pleural effusion(Meigs syndrome).

In this current study it was observed that seven (36.8%) patients had local spread (uterus, uterine tube, bladder) in group I. Eleven (57.9%) patients had ascites in group I and 1(3%) in group II. Three (15.8%) patients had peritoneal and mesenteric masses in group I. A study done by Fowzia[33] in our country and observed ascites in 37.5% of malignant tumors.

Ovarian tumors can be categorized as epithelial, germ cell, sex cord–stromal, or metastatic tumor. Epithelial tumors are the most common histopathologic type of malignant ovarian tumor (85% of cases). Subtypes of epithelial tumors include serous, mucinous, endometrioid, clear cell, and Brenner's tumors. The most common type of ovarian malignancy is serous cystadenocarcinoma

(approximately 40% of cases).[3] Sex cord stromal tumors includes fibromas and hormone secreting tumors such as thecomas, granulosa cell tumors and Sertoli cell tumors. Germ cell tumors include Dermoid cysts or benign cystic teratoma and malignant tumors such as dysgerminoma and immature teratoma. In this series it was observed that more than one third (36.8%) patients had serous cystadenocarcinoma, 15.8% Krukenberg tumor, 15.8% Immature teratoma, 10.5% Mucinous cystadenocarcinoma, 5.3% Dysgerminoma, and 5.3% Granulosa cell tumor in malignant group evaluated by histopathology. 10.5% were diagnosed as adenocarcinoma in malignant group evaluated by cytology. In benign tumor 48.5% patients had serous cystadenoma, 33.3% had Dermoid cyst, 15.2% Mucinous cystadenoma and 3.0% had Fibroma.

Malik[24] showed serous cystadenocarcinoma 53.0%, mucinous cystadenocarcinoma 22.0% and undifferentiated in 2% cases.[24] Schneider et al[34] found in their study in benign tumors that serous cystadenoma 23.5%, mucinous cystadenoma 17.6% dermoid cyst 29.4 %, endometrioma 17.6%, and fibrothecoma 11.8%, which is consistent with the present study. Schneider et al[34] observed in malignant tumors that serous cystadenocarcinoma 53.3%, endometrioid carcinoma 26.7%, mucinous cystadenocarcinoma 6.7% and mixed (combined) type 13.3%, which is comparable with the current study.

In this present study it was observed that in CT diagnosis of ovarian tumors, there were true positive 17 cases, false positive 3 cases, false negative 2 cases and true negative 30 cases in identification by histopathological diagnosis.

In this study the validity of CT scan evaluation of ovarian tumors was correlated by calculating sensitivity 89.5%, specificity 90.9%, accuracy 90.4%, positive predictive values (PPV) 85% and negative predictive values (NPV) 93.8%. Meyer et al.[7] showed CT scans, with a specificity of 100% with PPV 100%. Lee et al.[8] reported that CT confirmed the ovarian origin, with the sensitivity 92%, specificity 87%, positive predictive value 97% and negative predictive value 69%, and diagnostic accuracy 91%, which closely resembled with the present study. Ozasa et al.[9] showed the accuracy for the histologic diagnosis with ultrasound and CT was 56% and 84.0%, respectively ($P<0.05$). The fact that CT is competent in detecting adhesions adds further value to CT as a powerful tool for the preoperative investigation of pelvic mass. Onyeka, Atalla and Deemer[10] mentioned that the sensitivity of CT scan for all ovarian cancer detection was 83.0%. CT has been shown a sensitivity of 79% and specificity of 75% by Axtell et al.[13] For predicting correct stage, the sensitivity and specificity of CT were reported to be 50% and 92%, respectively, in one series.[5]

Conclusion:

The validity test of CT is significantly consistent with histopathological diagnosis in evaluation of ovarian tumors and almost identical as observed by many investigators. It can be concluded that the CT is a useful diagnostic modality in evaluating benign and malignant ovarian tumors.

References:

1. Landis SH, Murray T, Bolden S, Wingo PA. Cancer statistics, 1998. *CA cancer Journal for clinicians*. 1998 Jan;48(1),6-29.
2. Morrow CP, Curtin JP. Synopsis of gynecologic oncology. Saunders; 1998.
3. Parker SL. Cancer statistics, 1997. *CA cancer J clin*. 1997;47:5-27.
4. Katz ME, Schwartz PE, Kapp DS, Luikart S. Epithelial carcinoma of the ovary: current strategies. *Annals of internal medicine*. 1981 Jul 1;95(1):98-111.
5. Forstner R, Hricak H, Occhipinti KA, Powell CB, Frankel SD, Stern JL. Ovarian cancer: staging with CT and MR imaging. *Radiology*. 1995 Dec;197(3):619-26.
6. Kurtz AB, Tsimikas JV, Tempany CM, Hamper UM, Arger PH, Bree RL, Wechsler RJ, Francis IR, Kuhlman JE, Siegelman ES, Mitchell DG. Diagnosis and staging of ovarian cancer: comparative values of Doppler and conventional US, CT, and MR imaging correlated with surgery and histopathologic analysis—report of the Radiology Diagnostic Oncology Group. *Radiology*. 1999 Jul;212(1):19-27.
7. Meyer JI, Kennedy AW, Friedman R, Ayoub A, Zepp RC. Ovarian carcinoma: value of CT

in predicting success of debulking surgery. *American Journal of Roentgenology*. 1995 Oct;165(4):875-8.

8. Lee JH, Jeong YK, Park JK, Hwang JC. "Ovarian vascular pedicle" sign revealing organ of origin of a pelvic mass lesion on helical CT. *American Journal of Roentgenology*. 2003 Jul;181(1):131-7.
9. Ozasa H, Noda Y, Mori T, Togashi K, Nakano Y. Diagnostic capability of ultrasound versus CT for clinically suspected ovarian mass with emphasis on detection of adhesions. *Gynecologic oncology*. 1986 Nov 1;25(3):311-8.
10. Onyeka AA, Atalla H, Deemer B. Comparative diagnostic values of grey-scale USS versus CT scan in the primary management of gynaecological pelvic mass with emphasis on ovarian cancer detection and staging. *Journal of Obstetrics and Gynaecology*. 2001 Jan 1;21(5):516-9.
11. Yen P, Khong K, Lamba R, Corwin MT, Gerscovich EO. Ovarian Fibromas and Fibrothecomas: Sonographic Correlation With Computed Tomography and Magnetic Resonance Imaging: A 5†Year Single†Institution Experience. *Journal of ultrasound in medicine*. 2013 Jan;32(1):13-8.
12. Bristow RE, Duska LR, Lambrou NC, Fishman EK, O'Neill MJ, Trimble EL, Montz FJ. A model for predicting surgical outcome in patients with advanced ovarian carcinoma using computed tomography. Cancer: *Interdisciplinary International Journal of the American Cancer Society*. 2000 Oct 1;89(7):1532-40.
13. Axtell AE, Lee MH, Bristow RE, Dowdy SC, Cliby WA, Raman S, Weaver JP, Gabbay M, Ngo M, Lentz S, Cass I. Multi-institutional reciprocal validation study of computed tomography predictors of suboptimal primary cytoreduction in patients with advanced ovarian cancer. *Journal of clinical oncology*. 2007 Feb 1;25(4):384-9.
14. Foshager MC, Hood LL, Walsh JW. Masses simulating gynecologic diseases at CT and MR imaging. *Radiographics*. 1996 Sep;16(5):1085-99.
15. Buy JN, Ghossain MA, Sciot C, Bazot M, Guinet C, Prévot S, Hugol D, Laromiguiere M, Truc JB, Poitout P. Epithelial tumors of the ovary: CT findings and correlation with US. *Radiology*. 1991 Mar;178(3):811-8.
16. Wagner BJ, Buck JL, Seidman JD, McCabe KM. From the archives of the AFIP. Ovarian epithelial neoplasms: radiologic - pathologic correlation. *Radiographics*. 1994 Nov;14(6): 1351-74.
17. Walsh JW. Computed tomography of gynecologic neoplasms. *Radiologic clinics of North America*. 1992 Jul 1;30(4):817-30.
18. Ghossain MA, Buy JN, Ligneres C, Bazot M, Hassen K, Malbec L, Hugol D, Truc JB, Decroix Y, Poitout P. Epithelial tumors of the ovary: comparison of MR and CT findings. *Radiology*. 1991 Dec;181(3):863-70.
19. Koonings PP, Campbell KE, Mishell Jr DR, Grimes DA. Relative frequency of primary ovarian neoplasms: a 10-year review. *Journal of Obstetrics and Gynecology*. 1989 Dec 1;74(6):921-6.
20. Wasim T, Majrroh A, Siddiq S. Comparison of clinical presentation of benign and malignant ovarian tumours. JPMA. *The Journal of the Pakistan Medical Association*. 2009 Jan 1;59(1):18.
21. Rafiq B, Rao SI, Kokab H. Ovarian tumours. *The Professional Medical Journal*. 2005 Dec 31;12(04):397-403.
22. Olsen CM, Cnossen J, Green AC, Webb PM. Comparison of symptoms and presentation of women with benign, low malignant potential and invasive ovarian tumors. *European journal of gynaecological oncology*. 2007 Oct 10;28(5):376-80.
23. Shaikh NA, Hashmi F, Samoo RP. Pattern of ovarian tumors: report of 15 years experience at Liaquat University Jamshoro. *J Liaquat Uni Med Health Sci*. 2007 Jan;6:13-5.
24. Malik IA. A prospective study of clinico-pathological features of epithelial ovarian cancer in Pakistan. *Journal of Pakistan Medical Association*. 2002 Apr 1;52(4):155-8.
25. Hassen K, Ghossain MA, Rousset P, Sciot C, Hugol D, Baddoura R, Vadrot D, Buy JN.

Characterization of papillary projections in benign versus borderline and malignant ovarian masses on conventional and color Doppler ultrasound. *American Journal of Roentgenology*. 2011 Jun;196(6):1444-9.

26. Sultana A, Hasan S, Siddiqui QA. Ovarian tumors: A five years retrospective study at Abbasi Shaheed Hospital, Karachi. *Pak J Surg*. 2005 Jul;21(1):37-40.
27. Yasmin S, Yasmin A, Asif M. Clinicohistological pattern of ovarian tumours in Peshawar region. *J Ayub Med Coll Abbottabad*. 2008 Dec 1;20(4):11-3.
28. Rashid S, Sarwar G, Ali A, Clinico A. Pathological Study of Ovarian Cancer in departments of Radiotherapy & Oncology. *Sir Ganga Ram Hospital and Mayo Hospital, Lahore*. 1998 Dec;13(4):117-25.
29. Leung SW, Yuen PM. Ovarian fibroma: a review on the clinical characteristics, diagnostic difficulties, and management options of 23 cases. *Gynecologic and obstetric investigation*. 2006;62(1):1-6.
30. Mak CW, Tzeng WS, Chen CY. Computed tomography appearance of ovarian fibrothecomas with and without torsion. *Acta Radiologica*. 2009 Jun;50(5):570-5.
31. Chechia A, Attia L, Temime RB, Makhlouf T, Koubaa A. Incidence, clinical analysis, and management of ovarian fibromas and fibrothecomas. *American Journal of obstetrics and gynecology*. 2008 Nov 1;199(5):473-e1.
32. Bazot M, Ghossain MA, Buy JN, Deligne L, Hugol D, Truc JB, Poitout P, Vadrot D. Fibrothecomas of the ovary: CT and US findings. *Journal of computer assisted tomography*. 1993 Sep 1;17(5):754-9.
33. Fowzia AF. 'Co-relation between Clinico-Surgical & Histopathological Diagnosis of Ovarian Tumour', Department of Obstetrics and Gynecology, Bangabandhu Sheikh Mujib Medical University and Dhaka Medical College Hospital, Dhaka (BCPS Dissertation), 2013.
34. Schneider D, Halperin R, Langer R, Bukovsky I, Herman A. Peritoneal fluid lactate dehydrogenase in ovarian cancer. *Gynecologic oncology*. 1997 Sep 1;66(3):399-404.