AIM OF THE WORK

The aim of the work was to study the role of multidetector computed tomography in evaluation of peritoneal and mesenteric tumors .

PATIENTS AND METHODS

The study was conducted on thirty patients with peritoneal and mesenteric tumors referred to the Radiology department at Alexandria Main University Hospital from June 2013 to October 2014.

Each patient was subjected to:

- Complete history taking.
- Complete Clinical examination.
- Routine laboratory investigations and coagulation profile.
- Contrast enhanced MDCT:

  - CT was performed using a 64-detector row (MX, Philips) CT machine.
  - Non-ionic iodinated contrast material was injected with a power injector at a rate 3-5mL/s through the antecubital vein. The total amount of injected contrast material was injected according to the body weight of the patient (1.5 mL/kg, 350 mg/mL)
  - Pre and post contrast CT scans were done, post contrast images was obtained in venous phase with post injection delay 70 seconds.
  - Range of each imaging phase was adjusted anatomically; guided by the non-contrast images, the venous phase covered from the diaphragmatic dome to the symphysis pubis.
  - Administration of oral neutral contrast (manitol and water) was done in gastrointestinal tumors or in cases with serosal implants on bowel surface.
  - Images were interpreted by dedicated workstation and post processing software using multi-planner (axial, sagittal and coronal) views.

- The CT data was correlated with the pathological results:

  - In some cases pathological data was retrospectively reviewed.
  - Other cases were subjected to biopsy from the primary non peritoneal tumor and /or from peritoneal and mesenteric tumors.

- Inclusion criteria: cases of peritoneal or mesenteric tumors with available pathological data or candidate for biopsy.

- Exclusion criteria;

  - unavailable pathological data when biopsy was contraindicated:

    - The clinical condition of the patient didn't allow biopsy or surgery.
    - Bleeding coagulopathy.
    - No perfect site of biopsy and difficult technique.

  - Pathologically proved tumor like pathological conditions affect the peritoneum and mesentery as granulomatous peritonitis, sclerosing mesnteritis, inflammatory pseudotumor and endometriosis,

The medical ethics was considered. The patient was aware of the examination, and patient's approval was obtained.

Statistical analysis of the data

Data were fed to the computer and analyzed using IBM ***SPSS software package version 20.0.***

Qualitative data were described using number and percent. Quantitative data were described using mean and standard deviation, median, minimum and maximum.

RESULTS

This study included 30 cases of peritoneal and mesenteric tumors were referred to radiology department of Alexandria University from June 2013 till October 2014 to do CECT study.

According to demographic data the age of studied patients ranged between 5 to 73 years old with mean age 44.87 ± 17.30 years (Table I).

seventeen cases were females (56.7 %) and 13 cases were males (43.7 %) (Table I).

Clinically the patients presented by abdominal or pelvic pain, abdominal distension, fever, obstructive jaundice, vomiting, weight loss, dyspepsia, diarrhea, cough, palpable abdominal mass and some cases were known malignancy for follow up or for staging (Table II).

The CECT was requested for detection of suspected tumor (22 cases) or follow up of known malignancy (six cases), or for staging of recently discovered primary non peritoneal tumor (two cases).

Table (I): Distribution of the studied cases according to demographic data:

	No.	%
Sex		
Male	13	43.3
Female	17	56.7
Age		
≤35	7	23.3
36 - 55	16	53.3
>55	7	23.3
Min. – Max.	5.0 – 73.0	
Mean ± SD	44.87 ± 17.30	
Median	48.0	

Table (II): Distribution of the studied cases according to clinical presentation:

	No.	%
Clinical Presentation*		
Abdominal pain	9	30.0
Pelvic pain	6	20.0
Follow up of known malignancy	6	20.0
Abdominal distension	5	16.7
Fever	4	13.3
Diarrhea	3	10.0
Palpable abdominal mass	3	10.0
Staging of known malignancy	2	6.7
Obstructive jaundice	2	6.7
Vomiting	2	6.7
Weight loss	2	6.7
Dyspepsia	2	6.7
Cough	1	3.3

* More than one clinical presentation in one case

This study showed that secondary peritoneal and mesenteric tumors were much more common than primary tumors, as 23 cases were secondary tumors (76.7%), while primary peritoneal and mesenteric tumors were seven cases (23.3%) (Table III).

The 23 cases of the secondary peritoneal and/or mesenteric tumors were eight cases from malignant ovarian tumors, seven cases from gastriointestinal malignancies, two cases were Burkitt's lymphoma, two cases were mesenteric lymphoma, one from cholangiocarcinoma, one from renal cell carcinoma, one from neuroblastoma and one from uterine endometrial carcinoma. (Table III)

It was found that ovarian tumors (34.7%) followed by gastrointestinal tumors (30.4%) were the most common source of secondary peritoneal tumors.

By analysis of the CT images; the site of secondary peritoneal and mesenteric tumors were classified according to the peritoneal space affected to greater omentum, mesentery, pelvic peritoneum, serosal covering of the liver, subhepatic space, paracolic space and diffuse peritonieal and mesnteric involvement (Table IV) .

It was found that greater omentum was the most common peritoneal space for secondaries (43.5 %).

Our study also showed that CT patterns of peritoneal and mesenteric tumors range from small nodules to large soft tissue masses ; it can present as:

- Omental cake.
- Fine nodular thickening of the peritoneum.
- Small peritoneal nodule(s).
- Heterogeneously enhanced mass(es).
- Sheets of peritoneal soft tissue.
- Serosal hepatic subcapsular implants.
- Serosal implant on the bowel.
- Mesenteric lymphadenopathy.

The most common patterns of peritoneal secondaries in our study were omental cake (34.8%), followed by fine nodular thickening of the peritoneum (26.1%) (Table IV).

Table (III): Distribution of the studied cases according to type of the tumor:

	No.	%
Peritoneal and mesenteric tumors (n=30)		
Peritoneum	17	56.7
Mesentery	8	26.7
Peritoneum & mesentery	5	16.7
Type of Peritoneal and mesenteric tumors (n=30)		
Primary	7	23.3
Secondary	23	76.7
Malignant/Benign (n=30)		
Malignant	26	86.7
Benign	4	13.3
Primary tumor of the secondary peritoneal tumors (n=23)		
Ovarian	8	34.7
Gastrointestinal	7	30.4
Lymphatic system	4	17.4
Neuroblastoma	1	4.3
Kidney	1	4.3
Uterus	1	4.3
Biliary system	1	4.3

Table (IV): Distribution of the studied cases of secondary peritoneal tumors (n=23) according to CT appearance and peritoneal spaces affected:

	No.	%
CT appearance of secondary peritoneal tumors *		
Omental cake	8	34.8
Fine nodular thicking of peritoneum	6	26.1
Sheets of peritoneal soft tissue	5	21.7
Serosal hepatic subcapsular deposits	4	17.4
Heterogeneously enhancing mass(es)	4	17.4
Mesenteric lymphadenopathy	4	17.4
Peritoneal small nodule(s)	2	8.7
Serosal implant on the bowel	1	4.3
Peritoneal space affected*		
Greater omentum	10	43.5
Mesentery	6	26.1
Pelvic peritoneum	6	26.1
Paracolic space	5	21.7
Serosal covering of liver	4	17.4
Diffuse peritonieal&mesnteric involvment	4	17.4
Subhepatic space	2	8.7

*more than CT pattern & more than one space affected in one case.

According to pathological type of the secondary peritoneal tumors ; 14 cases were peritoneal carcinomatosis, two cases were pseudomyxoma peritonei, two cases were peritoneal sarcomatosis and five cases were peritoneal lymphomatosis and mesenteric lymphadenopathy (Table V).

It was found that even after total excision of the primary tumor with clear surgical bed, peritoneal deposits could be detected in follow up CT studies (figures 27,33).

Peritoneal lymphomatosis was reported in two cases of Burkitt's lymphoma and one case of small bowel lymphoma. (figures 34,35)

Mesenteric lymphoma may show sandwich sign by encasement of the mesenteric vessels by bulky mesenteric lymph nodes.(figure 36)

Ascites was detected in 8 cases (26.7%),and this can be explained by disturbed peritoneal fluid absorption mechanism in presence of peritoneal soft tissue masses (Table VI).

Calcifications was detected in 6 cases (20%) ; cases of peritoneal metastesis from mucin producing tumors as ruptured mucinous adenocarcinoma of the appendix and signet cell gastric adenocarcinoma. It was also found as a characteristic of some primary tumors; as in cases of mesenteric carcinoid tumors and neuroblastoma case (Table VI).

The primary peritoneal and mesenteric tumors included in our study were seven cases; two cases were desmoid tumors, two cases were carcinoid tumors, one was cystic mesothelioma, one was liposarcoma, and one case was leiomyomatosis peritonalis disseminata.

Some primary mesenteric tumors have characteristic features that guide to the diagnosis like mesenteric carcinoid tumors (speculated hyperenhancing mesenteric mass with internal calcifications and surrounded desmoplastic reaction) ,desmoid tumors (well defined hypoattenuating mass with history of previous surgery or associated colonic polyposis), lipomas or liposarcomas (fat attenuation soft tissue).

Table (V): Distribution of the studied cases according to pathological type of secondary peritoneal tumors:

	No.	%
Type of the secondary peritoneal tumor (n = 23)		
Peritoneal carcinomatosis	14	60.9
Pseudomyxoma peritonei	2	8.7
Peritoneal sarcomatosis	2	8.7
Peritoneal lymphomatosis & mesenteric lymphoma	5	21.7

Table (VI): Distribution of the studied cases according to presence of calcifications and ascites:

	No.	%
Calcifications		
No	24	80.0
Yes	6	20.0
Ascites		
No	22	73.3
yes	8	26.7

Pathological correlation was done in the thirty cases; 16 cases were biopsied form peritoneal and mesenteric tumors, 9 cases were biopsied form primary non peritoneal tumors and 5 cases were biopsied form both peritoneal and non peritoneal tumors (Table VII).

The biopsies were taken by excisional biopsy of the primary tumor ,omentectomy, endoscopic biopsy, percutaneous transhepatic biopsy, ultrasound and CT guided biopsies (Table VII).

Table (VII): Distribution of the studied cases according to taken biopsy:

	No.	%
Biopsy		
Biopsy form peritoneal/mesenteric tumors	16	53.3
Biopsy form non peritoneal tumors	9	30.0
Biopsy form peritoneal and non peritoneal tumors	5	16.7
Type of biopsy		
Excisional biopsy of the primary mesenteric or primary nonperitoneal tumor	12	40.0
Omentectomy	1	3.3
Excisional biopsy of the primary nonperitoneal tumor & omentectomy	3	10.0
CT guided biopsy of the peritonium	5	16.7
Ultrasound guided biopsy of peritonium	5	16.7
Endoscopic biopsy	1	3.3
Endoscopic biopsy & ultrasound guided biopsy of peritonium	2	6.7
Ultrasound guided percutanous transhepatic biopsy	1	3.3

In correlation with the pathological analysis of the biopsies, The CECT was able to correctly diagnose 26 cases of the 30 cases (86.6%), while four cases were misdiagnosed;

- Case of 51 years old female presented by abdominal pain, the CECT showed multiple well defined heterogeneously enhanced soft tissue masses at geater omentum, mesentery and subhepatic space, it was diagnosed as peritoneal secondaries of unknown primary, pathological analysis revealed leiomyomatosis peritonalis disseminata, which is rare primary tumor and more seen in female of reproductive age or females on oral contraceptive intake and may be associated with uterine fibroid.(figure 42)

- Case of 43 years old male presented by abdominal pain, CECT showed mesenteric soft tissue mass with speculated borders ,CT diagnosis was carcinoid tumor however pathological analysis by excisional biopsy revealed desmoid tumor.(figure 43)

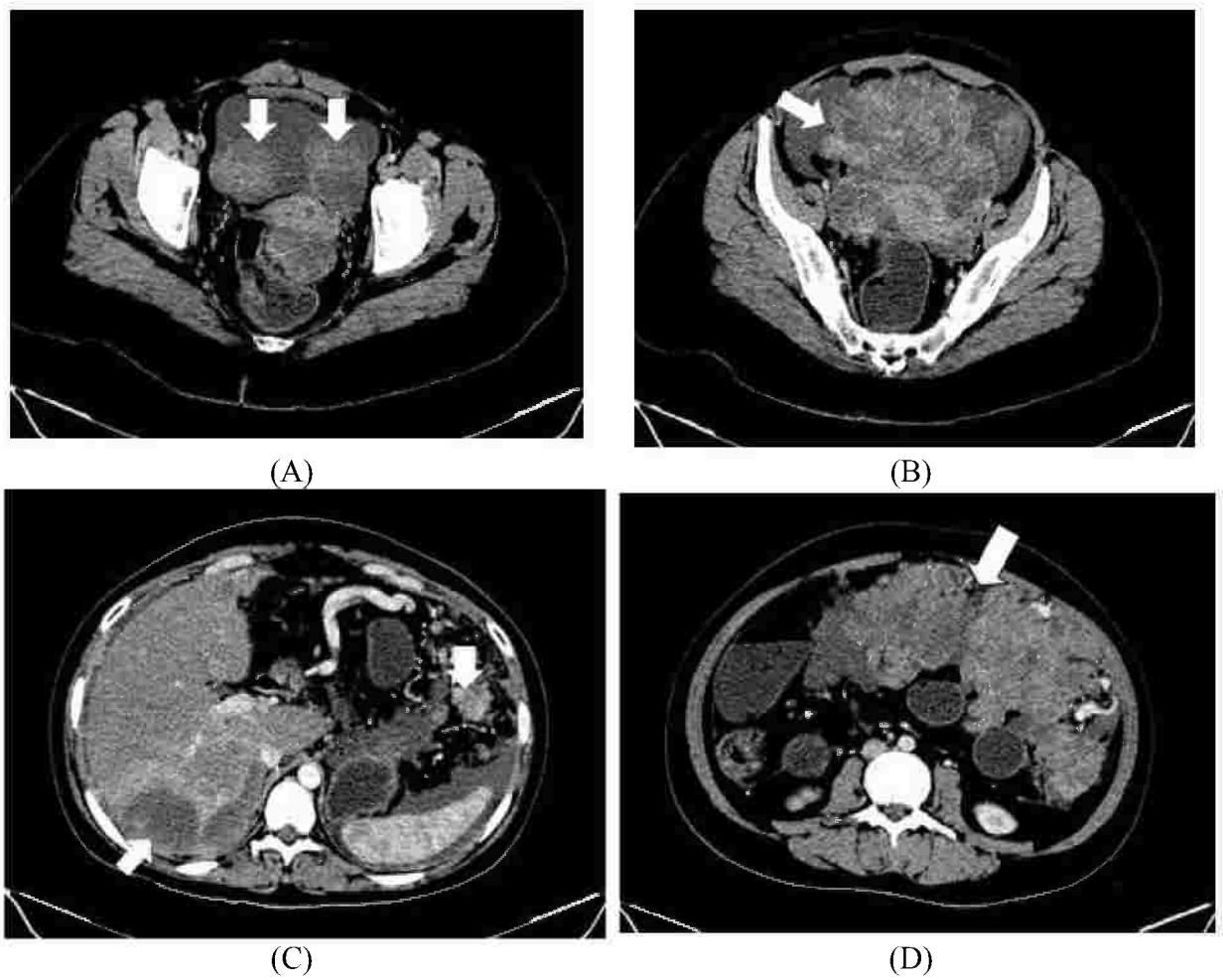
- Case of 20 years old male patient presented by abdominal distension, fever, dyspnea and cough. CECT showed diffuse peritoneal soft tissue thickening and diagnosed as granulomatous peritonitis mostly TB, due to predominance of chest symptoms and associated pleural effusion and mediastinal lymphadenopathy in basal chest scans. Pathological analysis revealed Burkitt's lymphoma.(figure 44)

- Case of 42 years old female with known history of ovarian neoplasm managed with TAH&BSO. CT showed peritoneal soft tissue masses with loculated ascites and calcifications, diagnosis was pseudomyxoma peritonei of ovarian origin, while pathological analysis revealed pseudomyxoma peritonei of mucinous adenocarcinoma of the appendix that was ruptured and not detected by CT. (figure 45)

ILLUSTRATIVE CASES

A) Secondary peritoneal and mesenteric tumors:

Case (1)

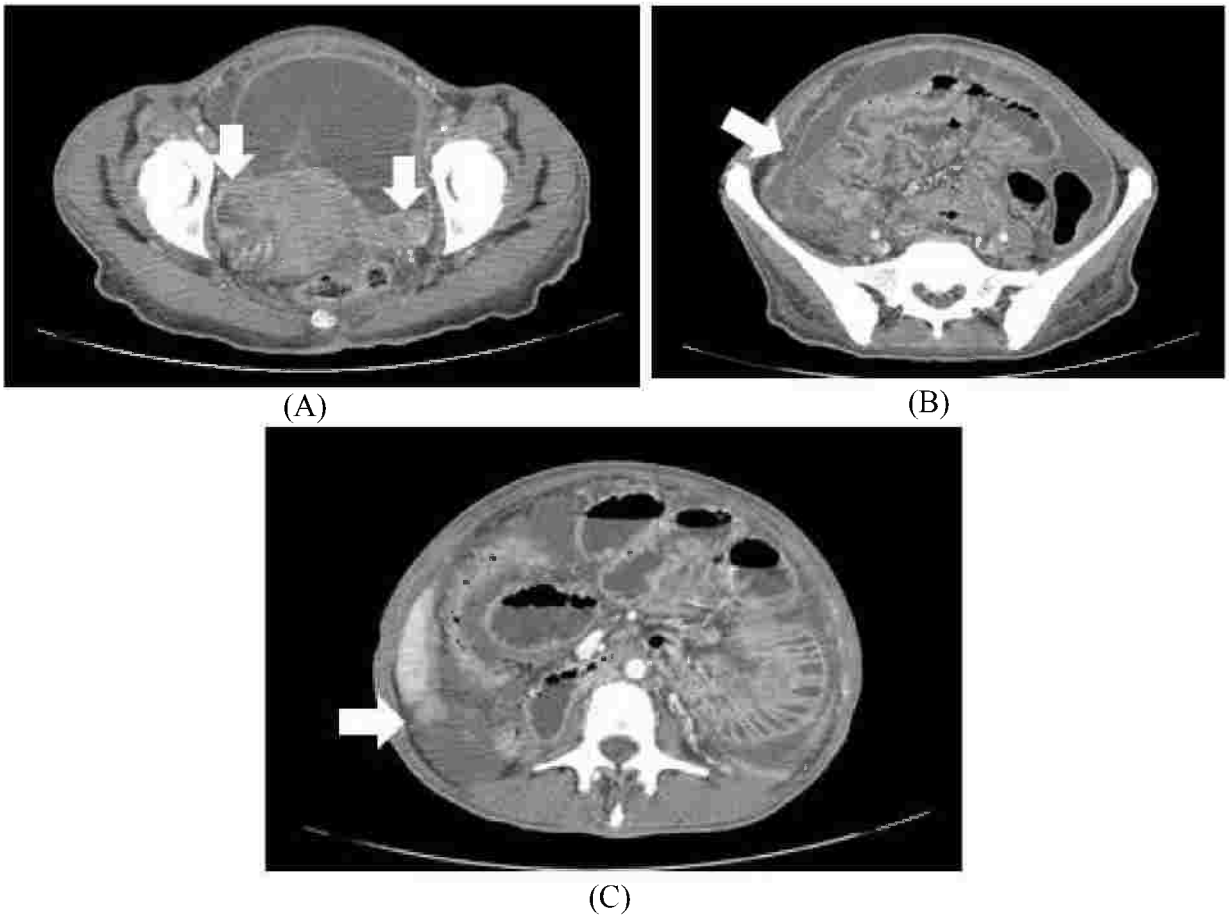


(A) (B)

(C) (D)

Figure(25): 30 years old female, presented by pelvic pain and abdominal distension, CECT abdomen showed (A) bilateral enhancing ovarian masses(arrows),(B) sheets of peritoneal soft tissue deposits seen at the pelvic region,(C) subcapsular serosal deposits indenting liver surface and greater omental nodules.(D) large greater omental cake. CT diagnosis was malignant ovarian neoplasm with omento-peritoneal deposits. Debulking was done (TAH&BSO with omentectomy), proved pathologically to be ovarian serous cyst-adenocarcinoma with peritoneal carcinomatosis.

Case (2):

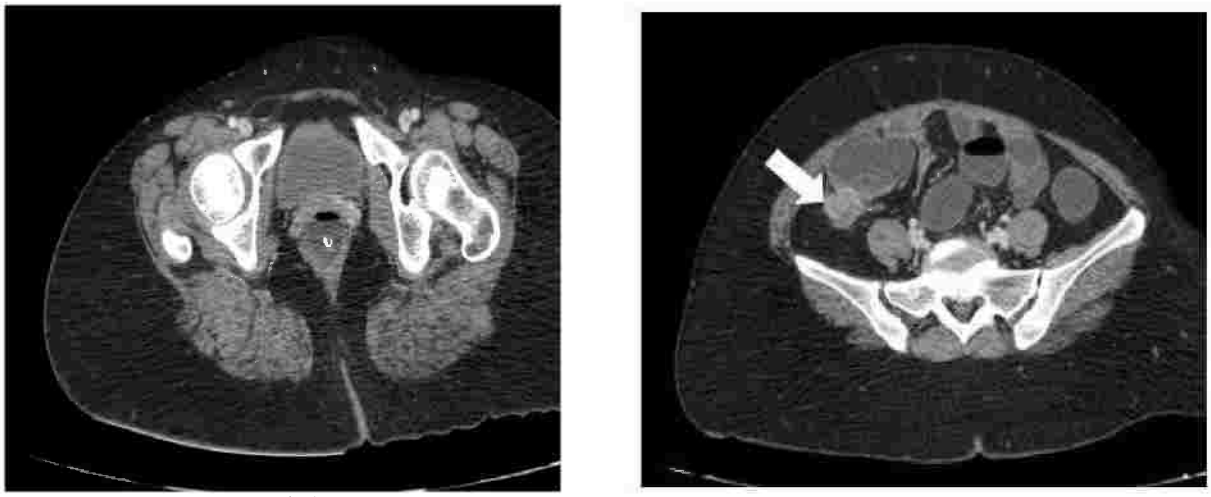


(A) (B)

(C)

Figure (26): 36 years old female presented by abdominal distension, ultrasound examination revealed bilateral bulky ovaries with moderate ascites. CECT abdomen showed (A) bilaterally ovarian soft tissue masses with cystic changes(arrows).(B,C) enhancing fine nodular thickening of the peritoneum (arrow) with moderate ascites. FNAC from the ovarian mass revealed ovarian serous cystadenocarcinoma.

Case (3):



(A) (B)

Figure(27): 39 years old female with pathologically proven ovarian serous cystadenocarcinoma managed by TAH&BSO, chemo and radiotherapy. CECT showed (A) no recurrent or residual masses at surgical bed.(B) serosal enhancing mass (serosal implant) infiltrating the posterior cecal wall (arrow).

Case (4):

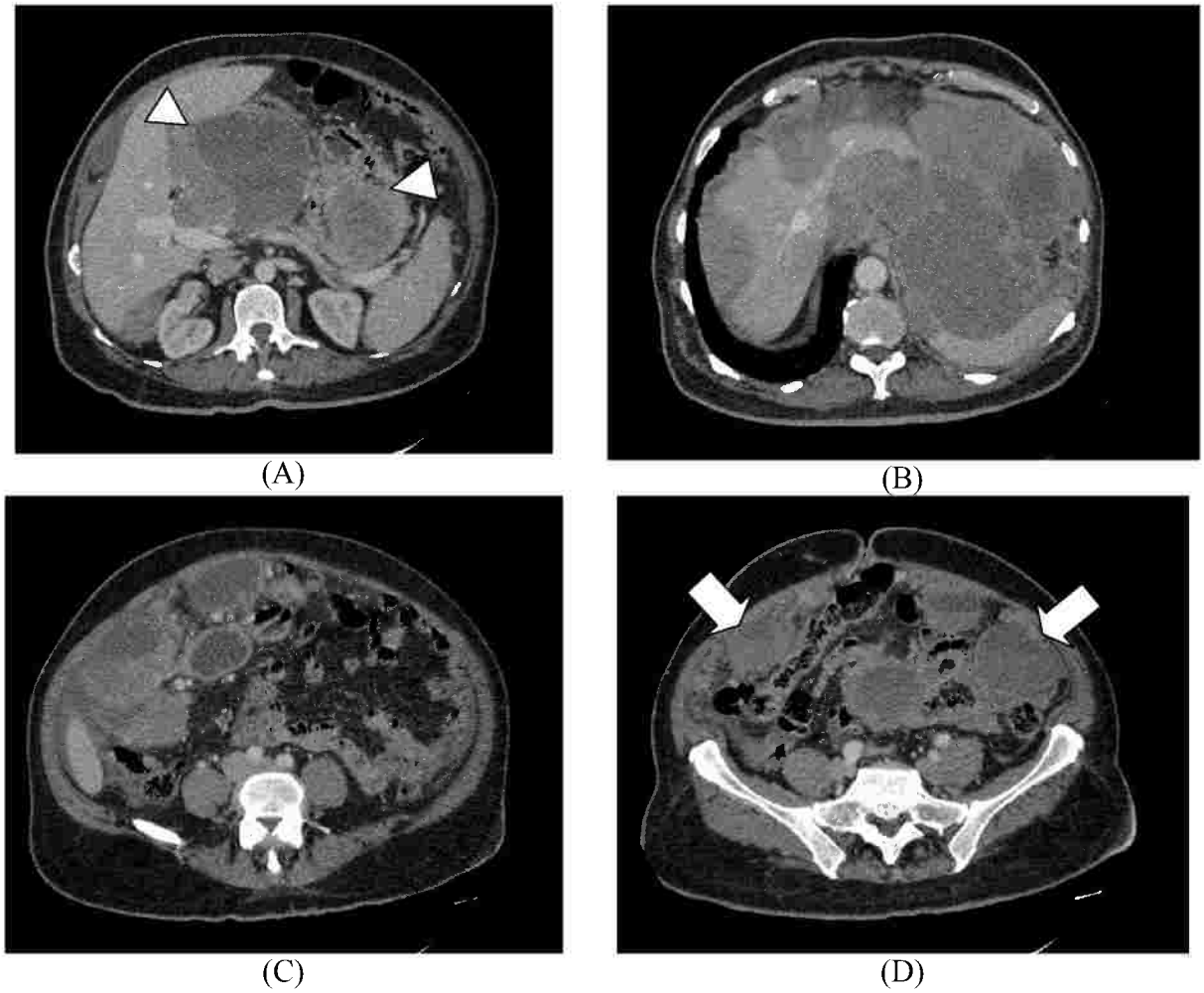
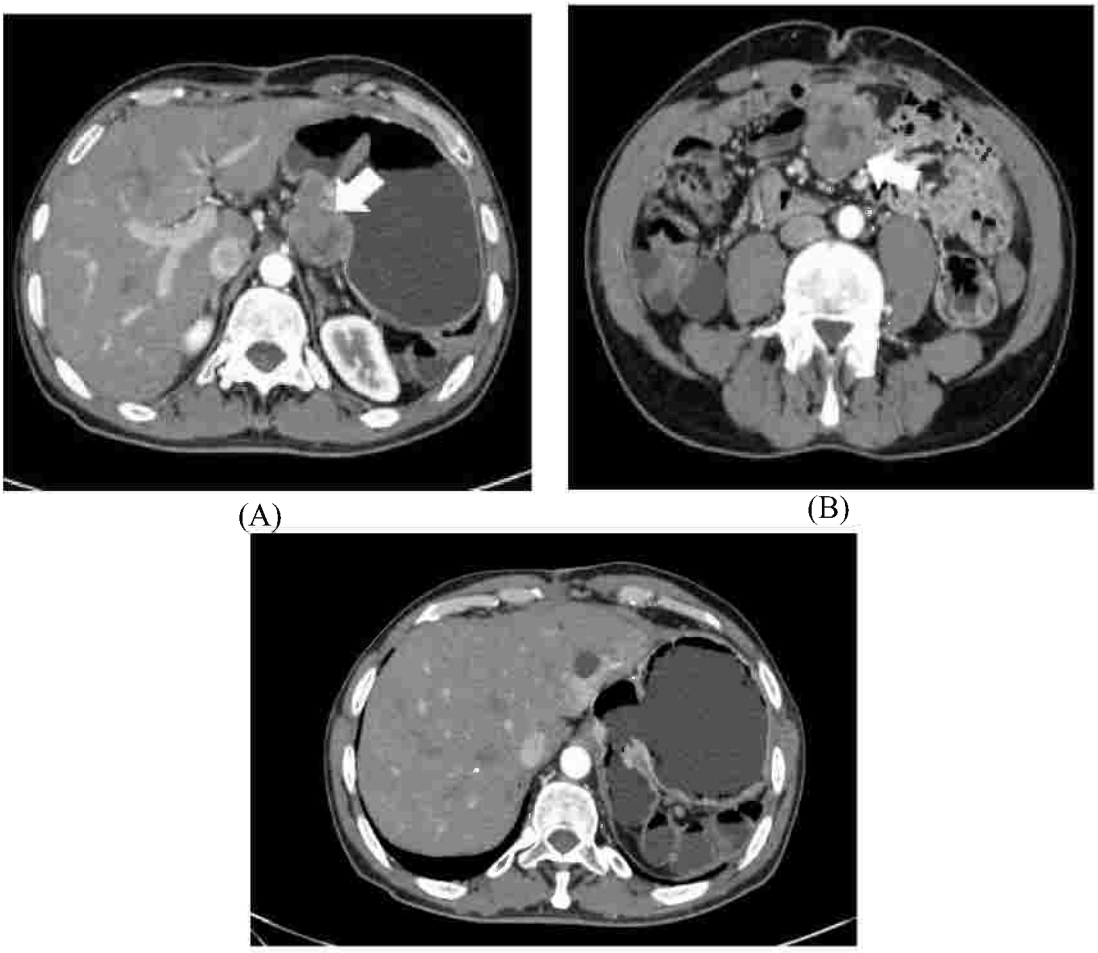


Figure (28): 50 years old male presented by abdominal pain and dyspepsia. CECT showed(A) heterogeneously enhancing masses with necrosis seen implicating the gastric fundus and pyloro-duodenal region (arrow heads) (B) Implication of the hepatic capsule is noted with indentation of the hepatic surface.(C&D) multiple variable sized omento-peritoneal heterogeneously enhancing masses seen all over the abdomen (arrows),showing necrotic areas. Endoscopic biopsy was taken from the gastric mass and proved to be gastric and pyloro-duodenal GIST associated with omental and peritoneal sarcomatous deposits.

Case (5):

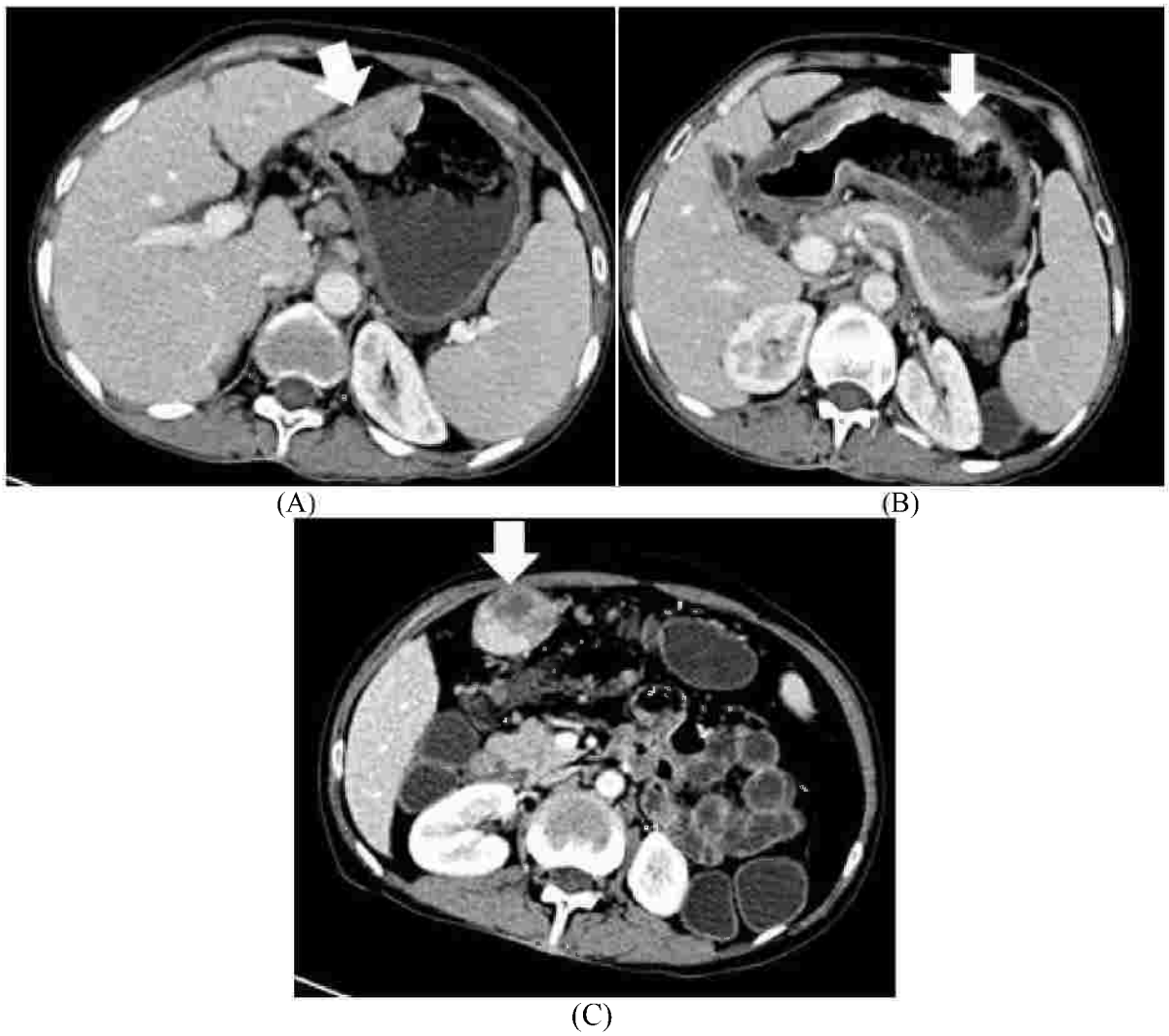


(A) (B)

(C)

Figure (29): 47 Years old male patient. CECT showed (A) gastric exophytic heterogeneously enhancing soft tissue mass(arrow).(B) mesenteric heterogeneously enhancing soft tissue mass with central necrosis(arrow).(C) hypoattenuating focal hepatic lesion. CT diagnosis was gastric and mesenteric GIST with liver metastasis. Endoscopic biopsy from the gastric mass was done and pathologically proved to be gastric GIST.

Case (6):



Figure(30): 36 years old female presented by gastric adenocarcinoma proved by endoscopic biopsy, CECT for staging was done showed (A)&(B) irregular mural thickening with endophytic soft tissue mass(arrows) (C) omental mass showing heterogonous enhancement and central breaking down (arrow). CT diagnosis was stomach cancer with greater omental deposit.

Case (7):

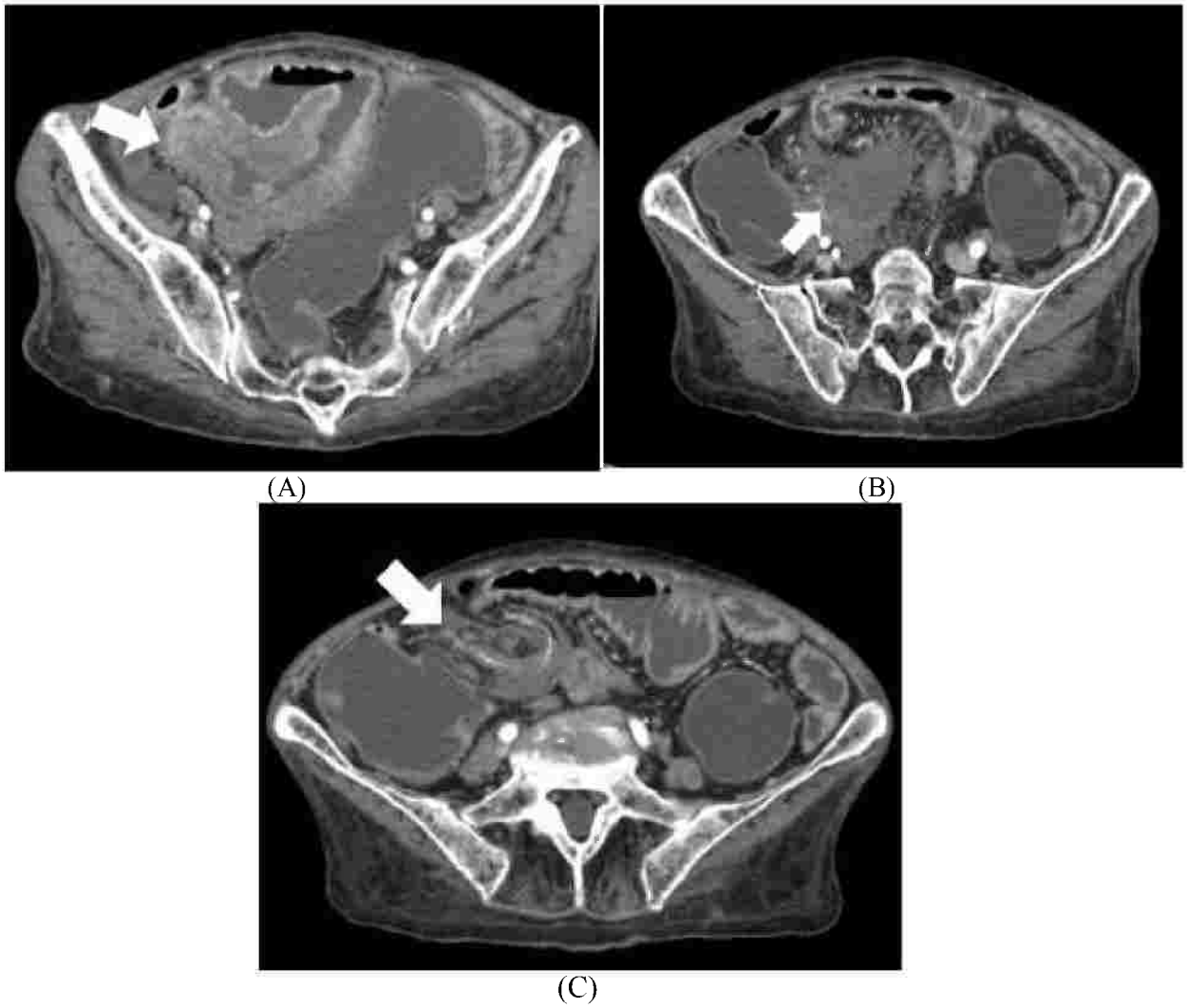


Figure (31): 43 Years old female presented by diarrhea and weight loss, CECT showed (A) circumferential wall thickening of an ileal bowel loop(arrow) (B)&(C) infiltration of the related mesentery in the form of mesenteric soft tissue mass and mesenteric lymphadenopathy (arrows). CT diagnosis was ileal malignant neoplastic lesion with mesenteric infiltration, surgical resection and anastomosis was done and proved pathologically to be small bowel adenocarcinoma.

Case (8):

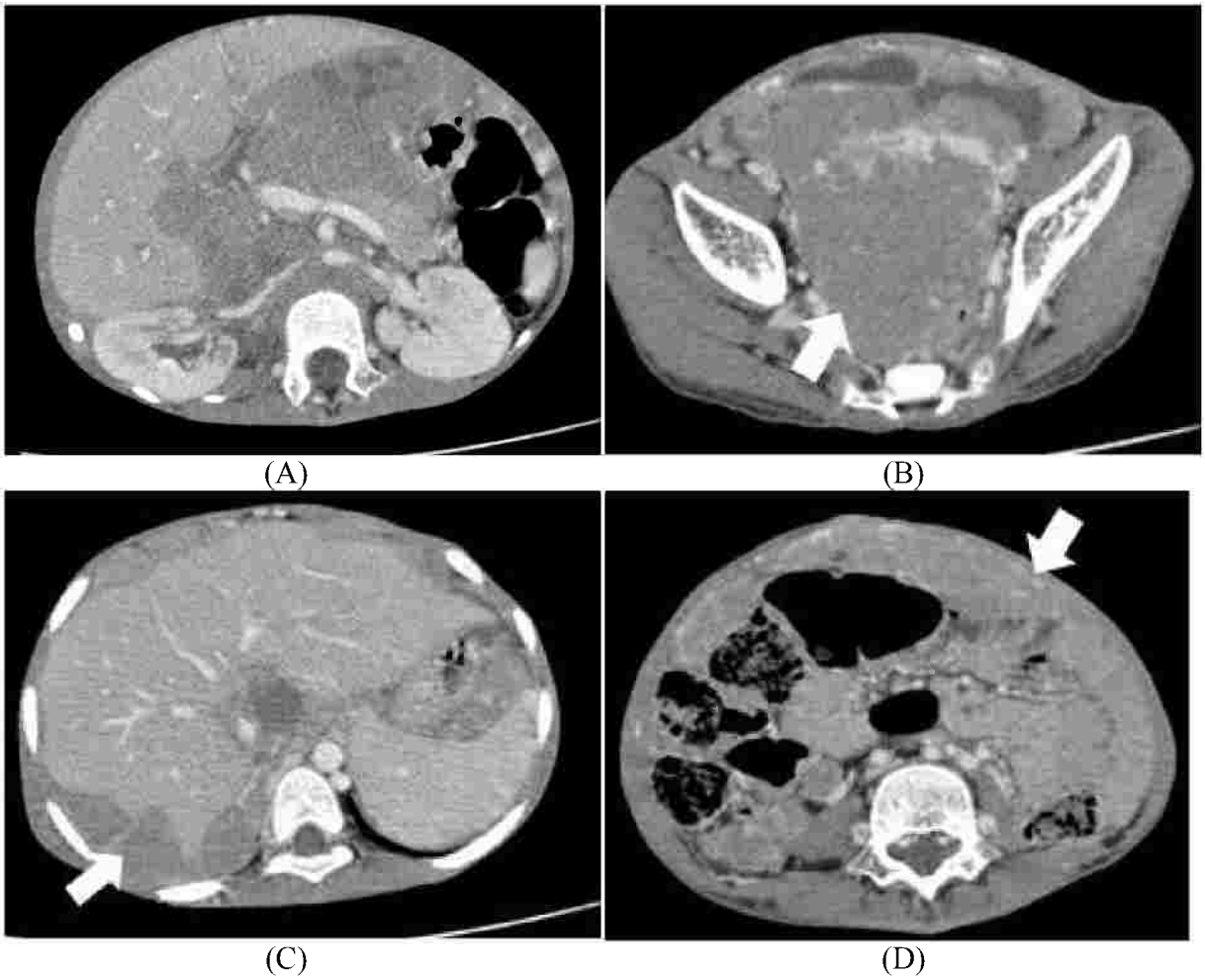
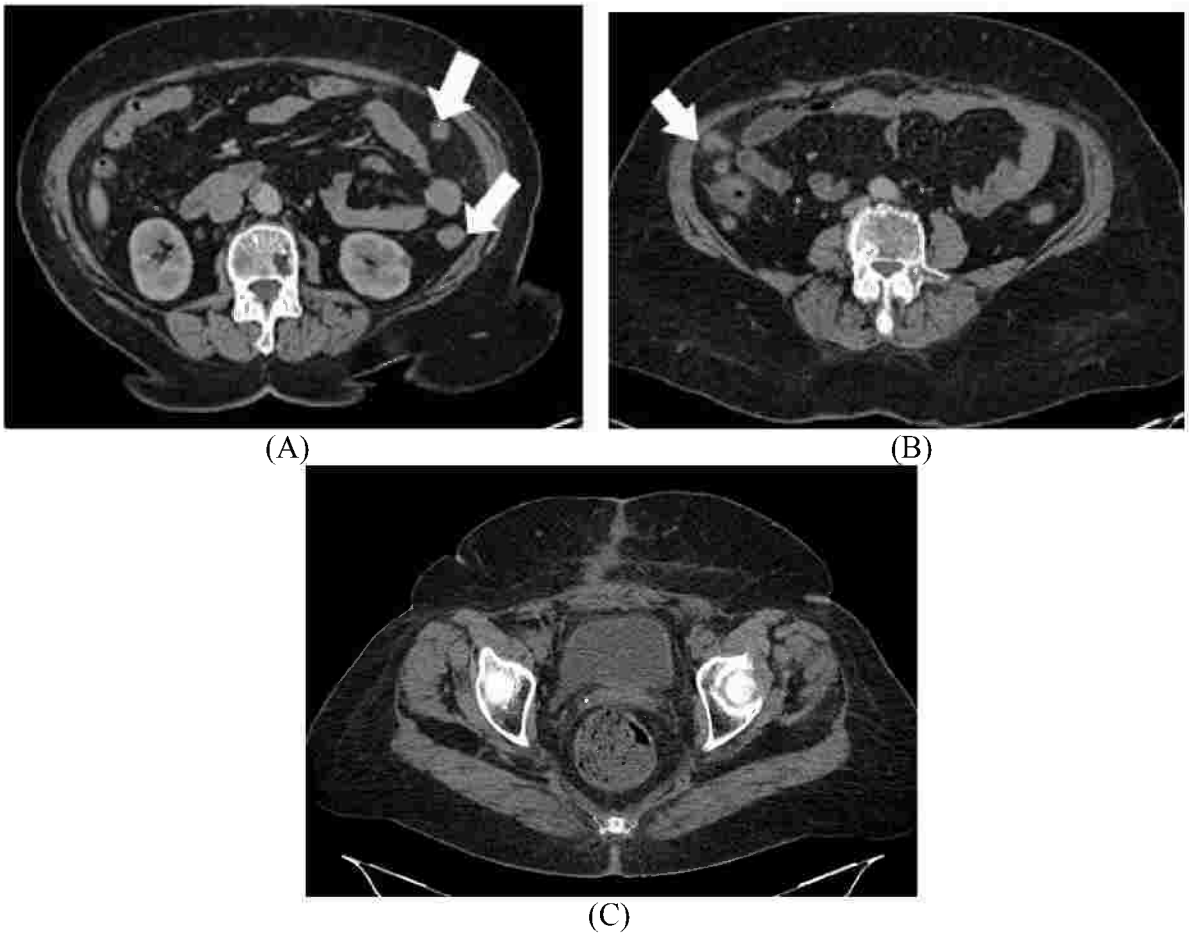


Figure (32): 5 years old girl ,pathologically proved to be neuroblastoma, on follow up CECT showed (A) retroperitoneal large tumefactive mass encasing celiac artery and its branches, renal vessels with intraperitoneal component displacing stomach, liver and pancreas. (B) rectovaginal soft tissue mass displacing and abutting the rectum and posterior wall of the urinary bladder(arrow), (C) subcapsular hepatic deposits(arrow), (D) greater omental soft tissue deposits (omental cake)(arrow).Open surgery was done for debulking and pathological correlation revealed neuroblastoma with peritoneal and omental carcinomatosis.

Case (9):

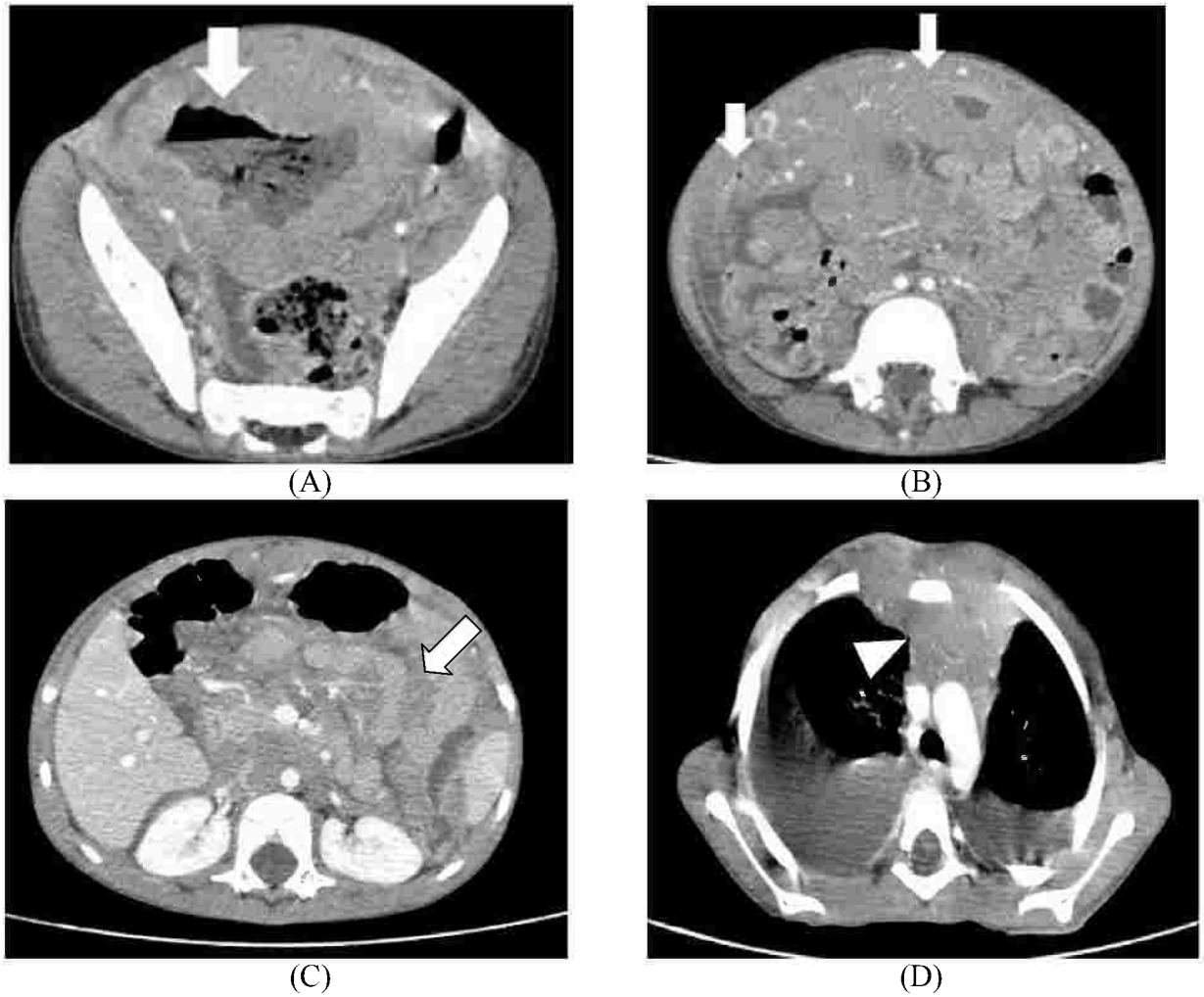


(A) (B)

(C)

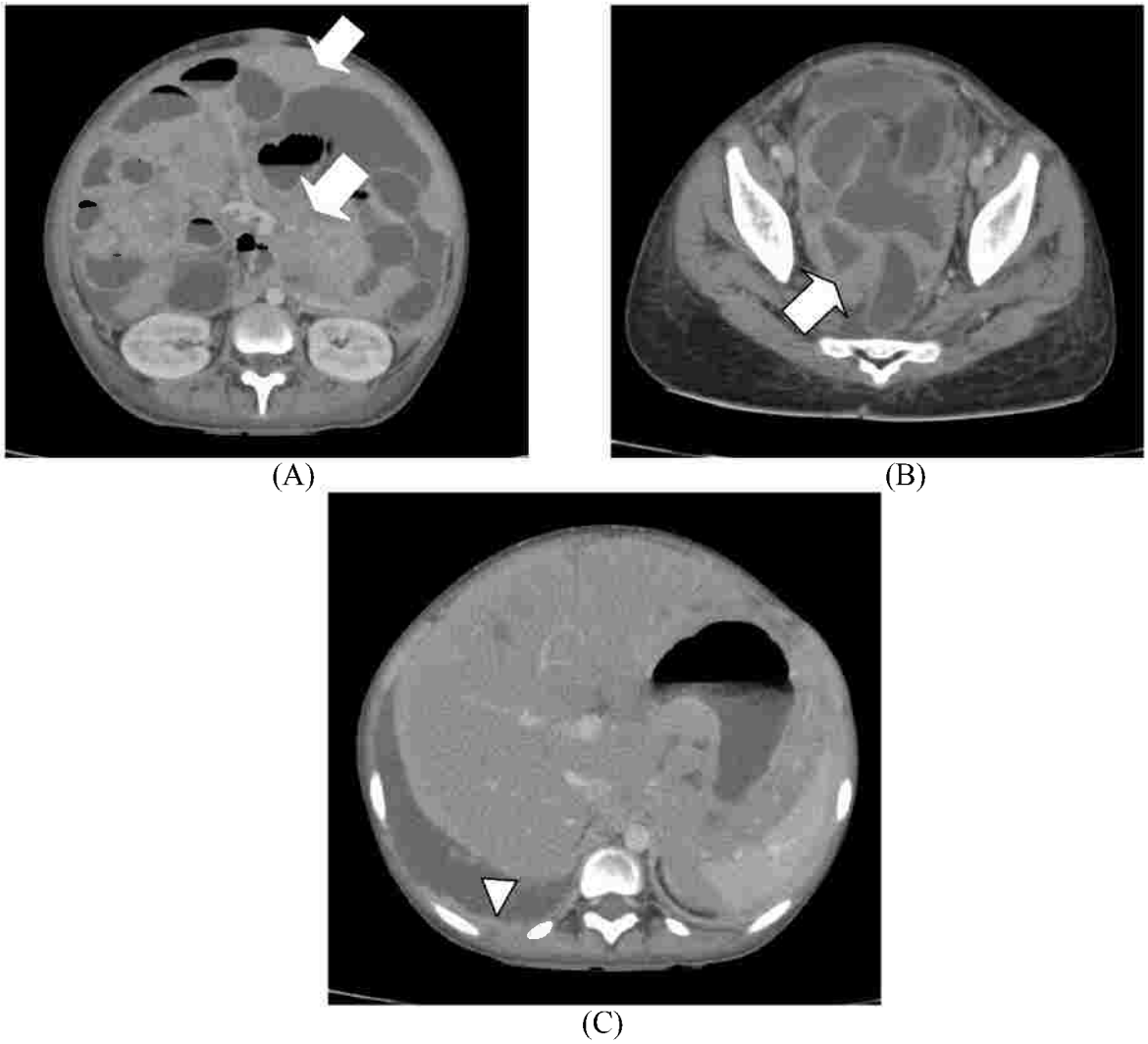
Figure (33): 70 years old female patient with known uterine carcinoma managed by TAH &BSO on follow up. CECT showed (A,B) small omental nodules at the right and left paracolic spaces(arrows), (C) clear surgical bed.

Case (10):



Figure(34): 6 years old male child presented by abdominal pain and pyrexia of unknown origin, ultrasound revealed thickened dilated bowel loop and ascites. CECT showed (A) circumferential wall thickening of an ileal bowel loop with aneurysmal dilatation of its lumen(arrow),(B)&(C) peritoneal and mesenteric enhanced soft tissue thickening and ascites(arrows), (D) amalgamated enlarged mediastinal nodes(arrow head). CT diagnosis was lymphoma of the small bowel with peritoneal lymphomatosis, proved pathologically by ultrasound guided biopsy of peritoneal masses to be peritoneal lymphomatosis.

Case (11):

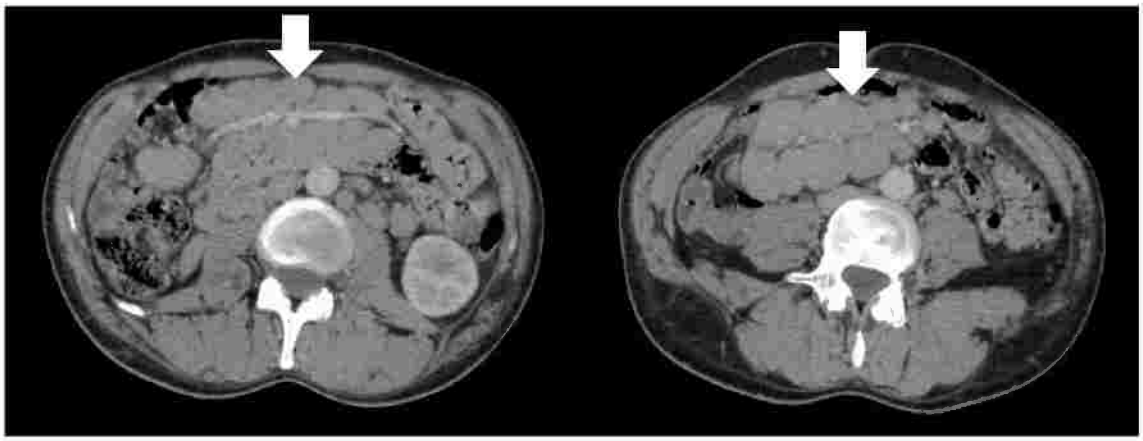


(A) (B)

(C)

Figure(35): 12 years old female presented by abdominal distension and fever. CECT abdomen showed (A) ill-defined extensive soft tissue masses infiltrating the root of mesentery and encasing mesenteric vessels with ascites(arrows),(B) involvement of the pelvic peritoneum(arrow),(C) pleural nodular thickening with pleural effusion(arrow head).CT diagnosis was Burkittt's lymphoma which was confirmed pathologically by ultrasound guided FNA from peritoneal soft tissue masses.

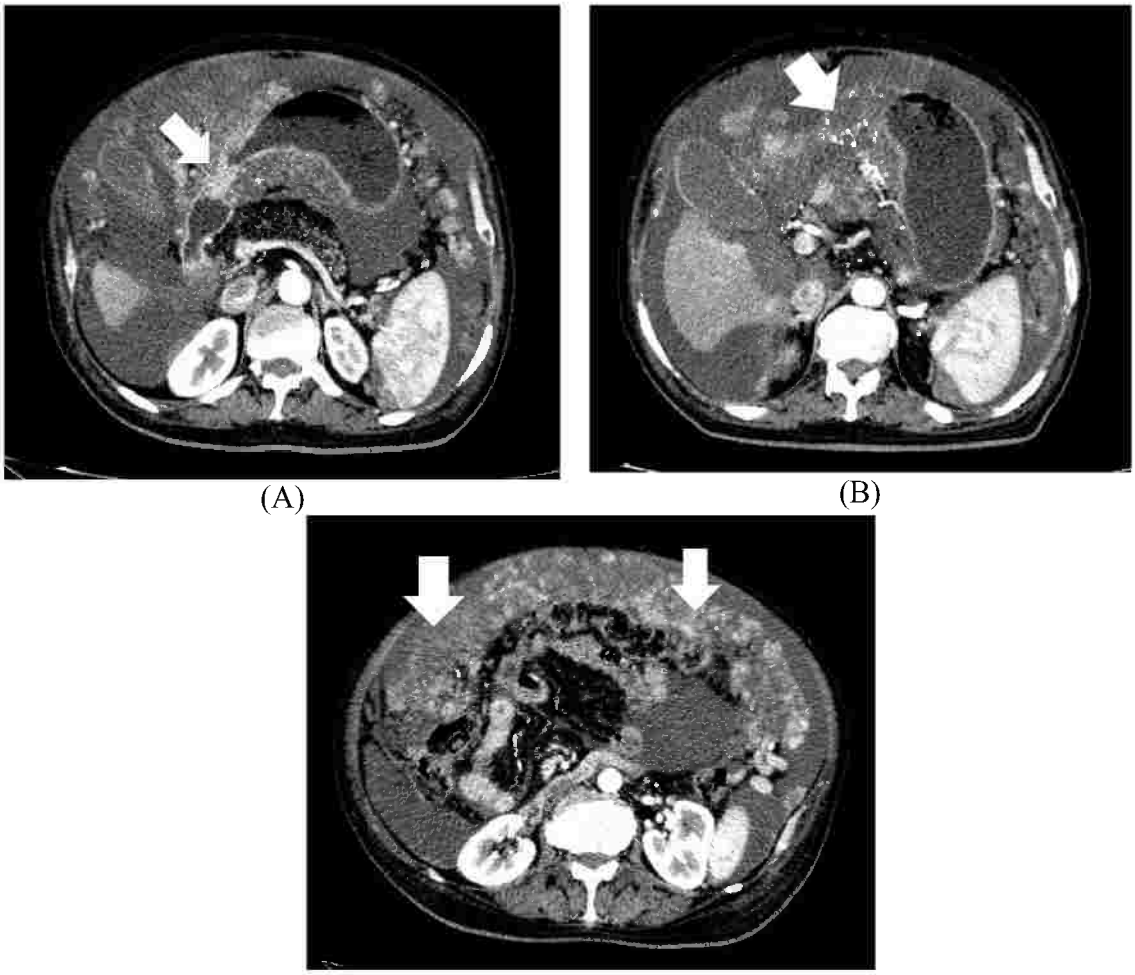
Case (12):



(A) (B)

Figure(36): 55 years old male, presented by fever and multiple enlarged cervical and axillary lymph nodes. CT abdomen showed (A,B) multiple pathologically enlarged mesenteric lymph nodes, encasing mesenteric vessels giving (sandwish sign) in image (A) (arrow), CT diagnosis was lymphoma which was confirmed pathologically .

Case (13):



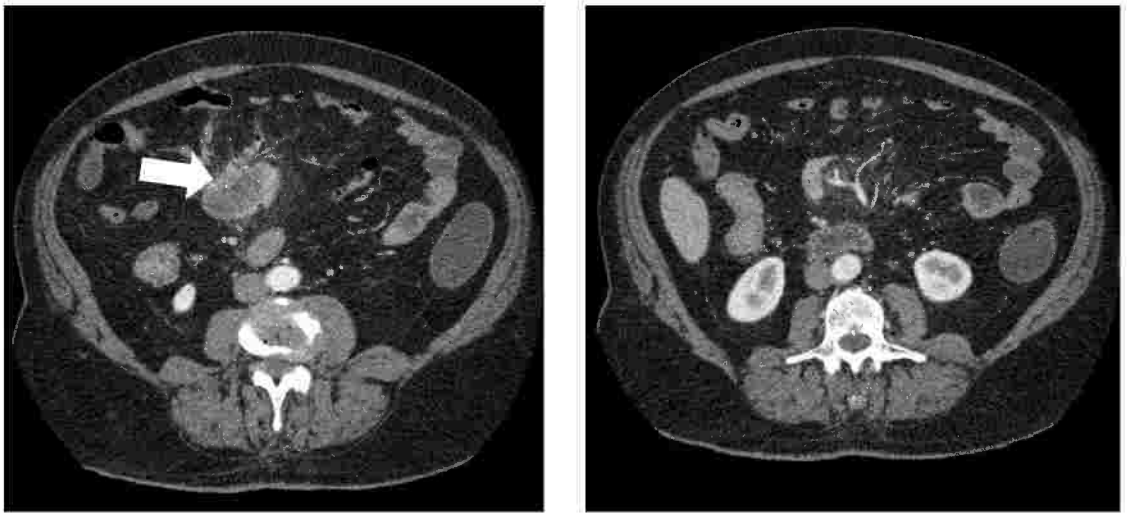
(A) (B)

(C)

Figure(37): 49 years old male recently diagnosed by endoscopic biopsy as signet cell gastric adenocarcinoma, CECT abdomen was done for staging, showed (A) thickened wall at the pylorus with hyperenhancing mucosa(arrow), (B) omental soft tissue deposits showing calcifications. (arrow), (C) large omental soft tissue deposits(omental cake) at greater omentum (arrows) consistent with peritoneal deposits, pathological analysis revealed pseudomyxoma peritonei.

B) Primary peritoneal and mesenteric tumors:

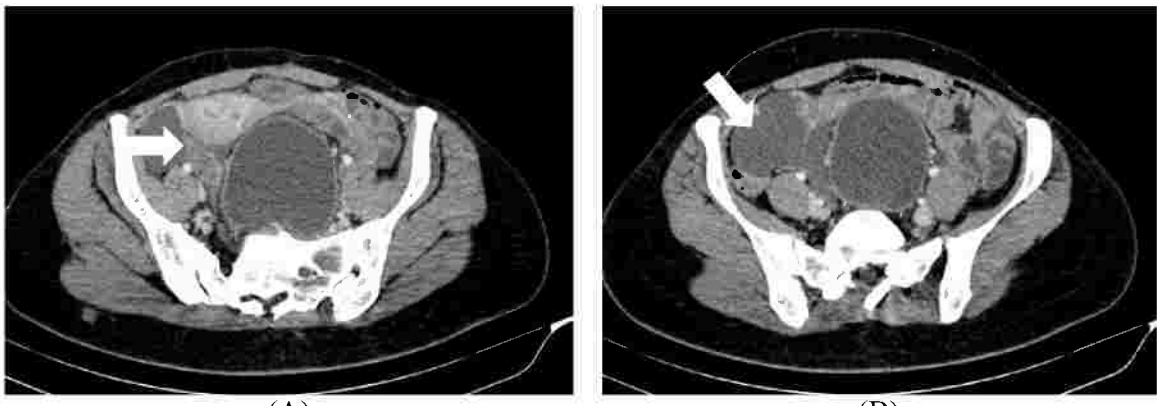
Case (14):



(A) (B)

Figure(38): 50 years old male presented by abdominal pain and diarrhea. CECT showed a mesenteric soft tissue mass with necrotic center and calcifications surrounded by desmoplastic reaction(arrow). CT diagnosis was carcinoid tumor which was pathologically proved.

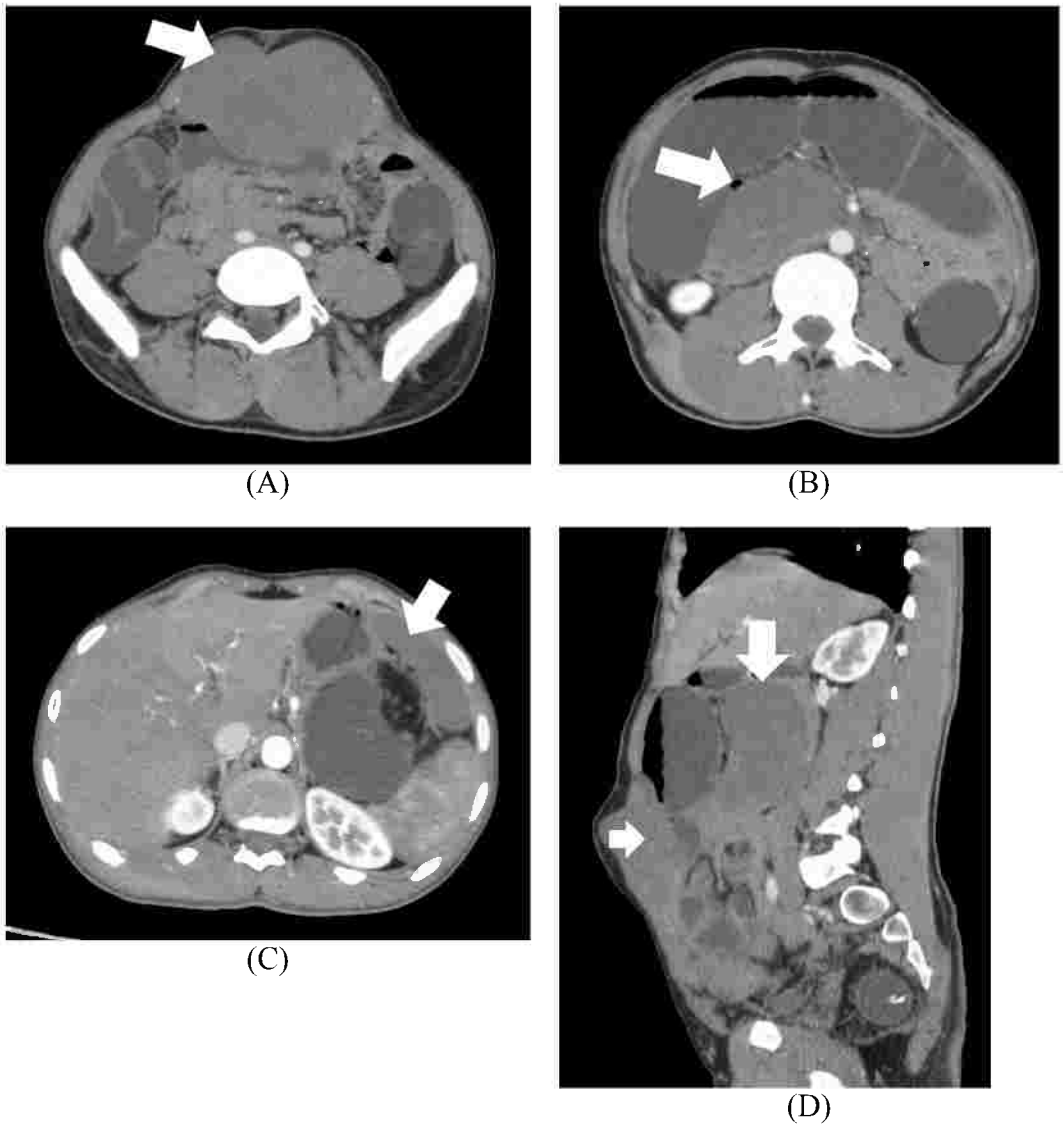
Case(15):



(A) (B)

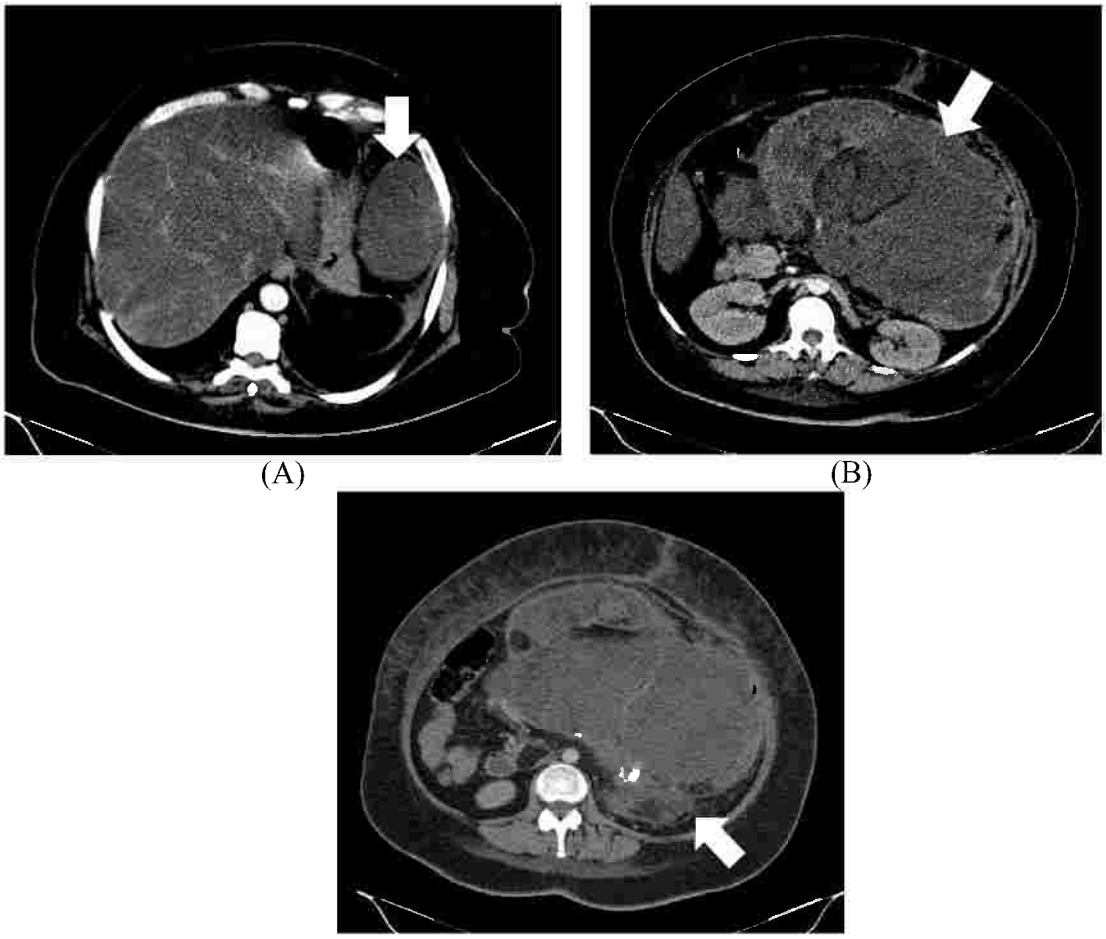
Figure(39): 35 years old female patient with history of previous right ovarian cystectomy for persistant cyst, CECT abdomen showed(A) normal right ovary(arrow).(B) a multiloculer cystic lesion at the right side of the pelvis with thin wall and thin septae, diagnosed as benign cystic mesothelioma (inclusion cyst)(arrow).

Case(16):



Figure(40): 42 years old male presented by anterior abdominal wall mass ,CECT showed (A) well defined hypoattenuating homogenous mass in the anterior abdominal wall(arrow) ,(B) smaller mesenteric lesion with similar CT features indenting the duodenum(arrow),(C)a similar left subdiaphragmatic lesion(arrow).(D) sagittal cut showed the parietal and mesenteric lesions. CT diagnosis was mesenteric and parietal desmoid tumors which was proved pathologically .

Case (17):



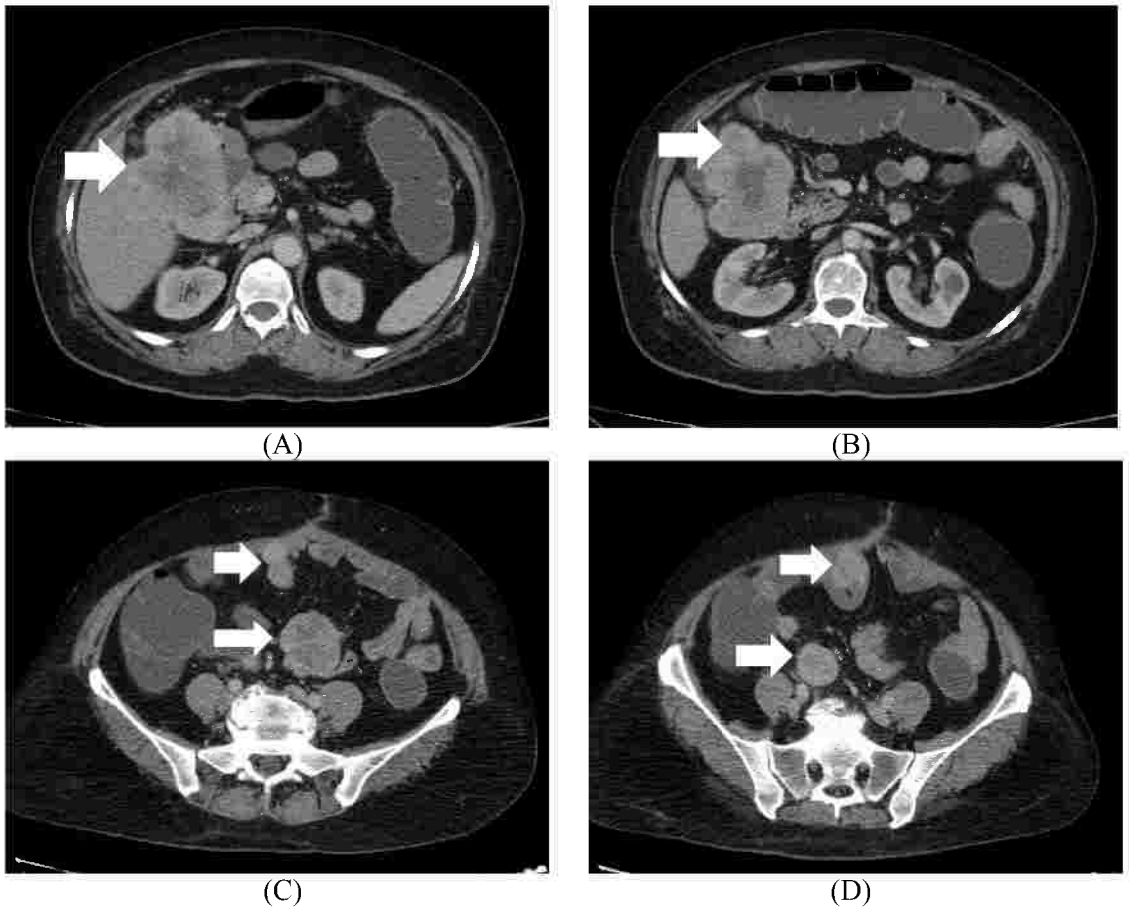
(A) (B)

(C)

Figure (41): 45 years old female presented by abdominal pain and distension. CECT showed (A,B) a sizable intraperitoneal soft tissue mass with fat density has compressing the gastric fundus &body and the colon(arrow), (C)small retroperitoneal extension (arrow) .CT diagnosis was liposarcoma which was proved pathologically.

C) Four misdiagnosed cases by CT :

Case (18):



(A) (B)

(C) (D)

Figure(42): 51 years old female patient presented by vague abdominal pain. CECT showed multiple variable sized well circumscribed soft tissue masses, some of them showed heterogenous enhancement and central necrosis(arrows), CT diagnosis was metastesis from unknown primary, however pathological diagnosis was leiomyomatosis peritonealis disseminata.

Case (19):

Figure(43): 43 years old male presented by abdominal pain, CECT showed stellate shaped homogenously enhancing mesenteric mass(arrow), CT diagnosis was mesenteric carcinoid, excisional biopsy revealed desmoid tumor.

Case (20):

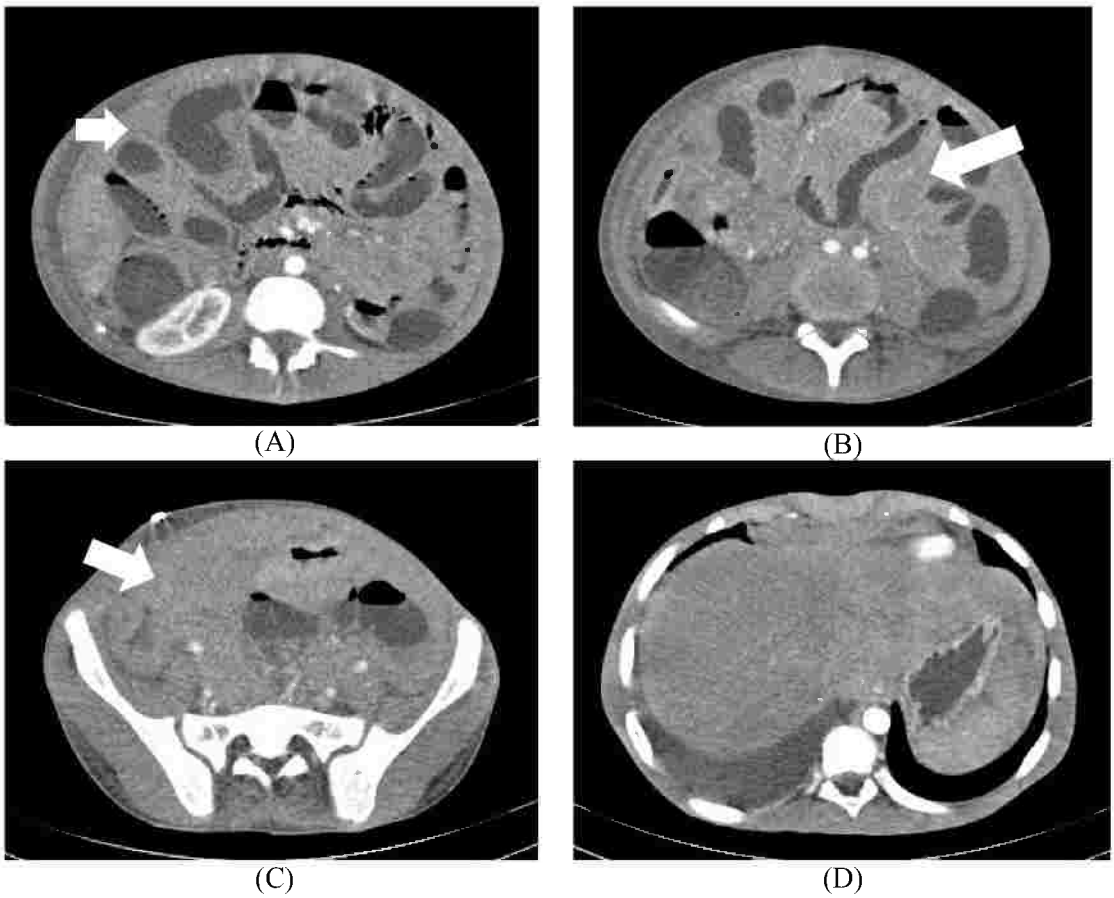
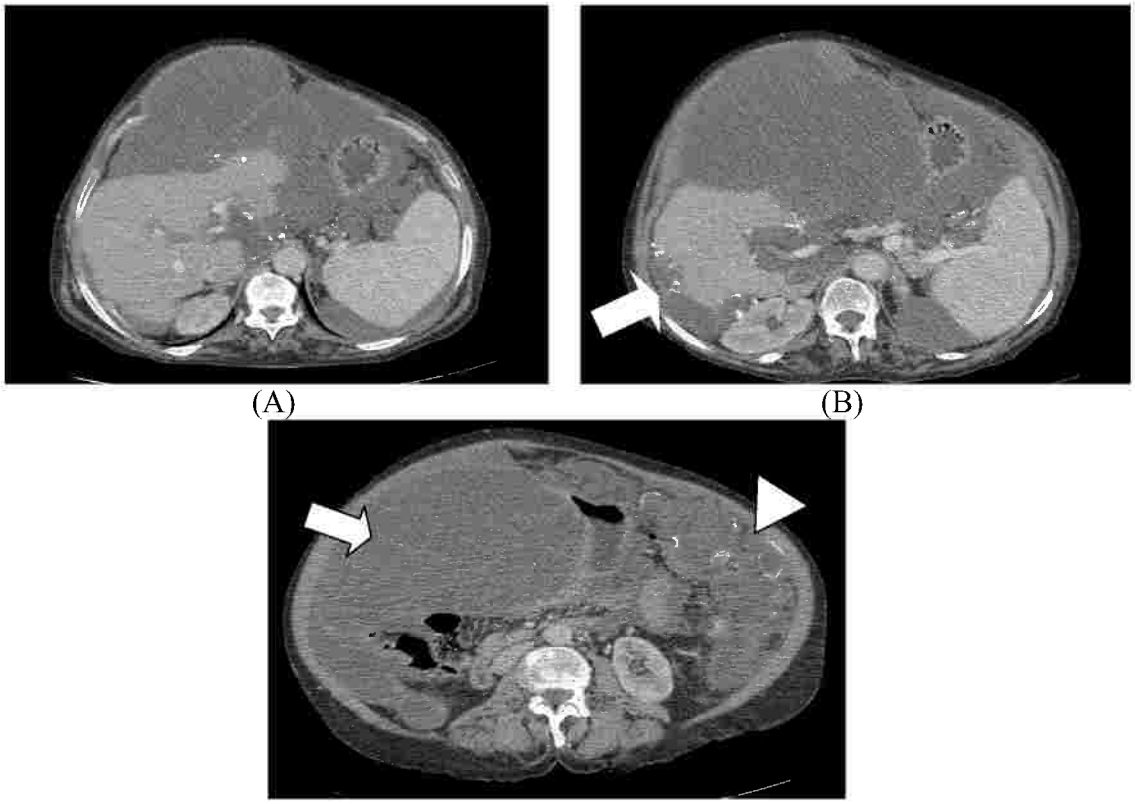


Figure (44): 20 years old male patient presented by abdominal distension, dyspnea and cough. CECT of the abdomen showed (A,B,C) ill-defined diffuse omento-peritoneal and mesenteric soft tissue(arrows),(D)basal chest scan showed right pleural effusion. with patient history of dyspnea and cough. CT diagnosis was granulomatous (TB) peritonitis however ultrasound guided biopsy from peritoneum revealed Burkitt's lymphoma.

Case (21):



(A) (B)

(C)

Figure (45): 42 years old Female with known history of ovarian neoplasm managed by TAH&BSO. CECT abdomen showed (A)&(B)cystic ascites showing scalloping of liver surface with calcifications, (C) peritoneal soft tissue masses, some of them show calcifications at the greater omentum (arrow head) associated with loculated ascites(arrow), these CT findings consistent with pseudomyxoma peritonie of ovarian origin. Omentectomy was done for debulking , pathological and immunohistochemical analysis revealed pseudomyxoma peritonie from ruptured mucinous cystadenocarcinoma of the appendix.