

Clinics In Diagnostic Imaging (22)

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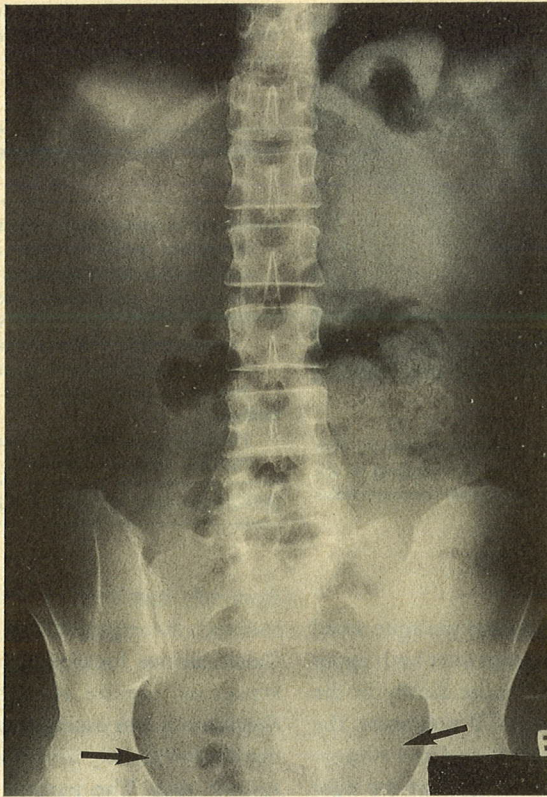


Fig 1 - Abdominal radiograph.

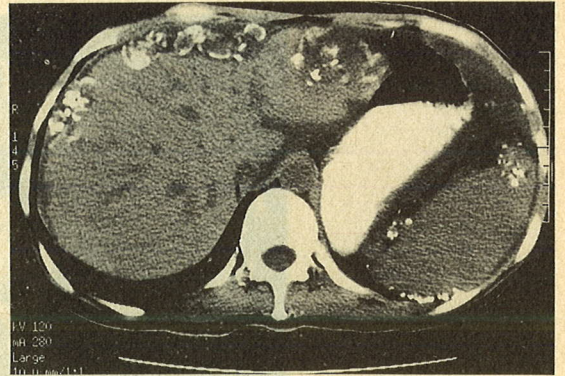


Fig 2 - CT of the upper abdomen (no contrast).

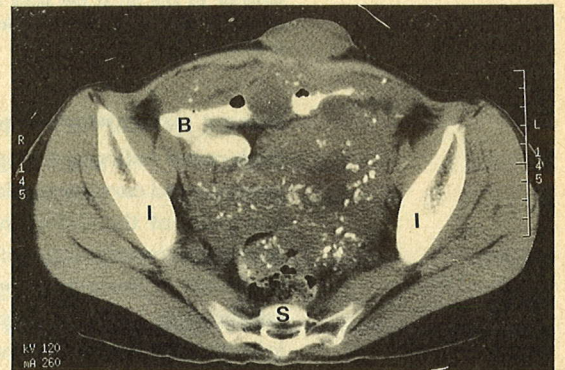


Fig 3 - CT of the midpelvis (no contrast).
[I=Iliac bone, S=sacrum, B=bowel loops opacified by oral contrast].

CASE REPORT

A 37-year-old woman presented with a 5-month history of menorrhagia and vaginal discharge. Three years previously, she underwent palliative colectomy and right oophorectomy for mucinous adenocarcinoma of the distal transverse colon with transverse mesocolon involvement. She was followed-up clinically for one year before she defaulted.

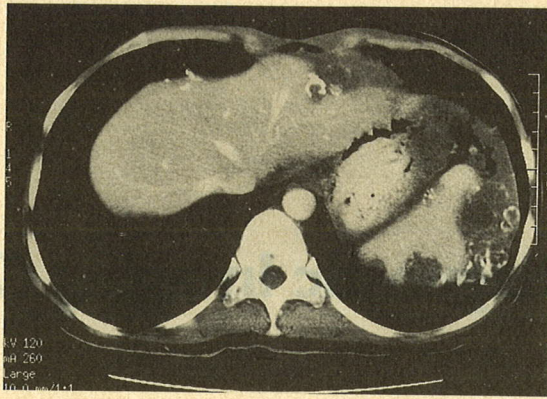
Abdominal examination showed an ulcerative suprapubic mass at the lower end of the previous abdominal surgical scar. A left pelvic mass was palpable on vaginal examination. Plain abdominal radiographs (Fig 1) and abdominal and pelvic computed tomography (CT) scans (Figs 2 and 3) were performed. What do these show? What is the diagnosis?

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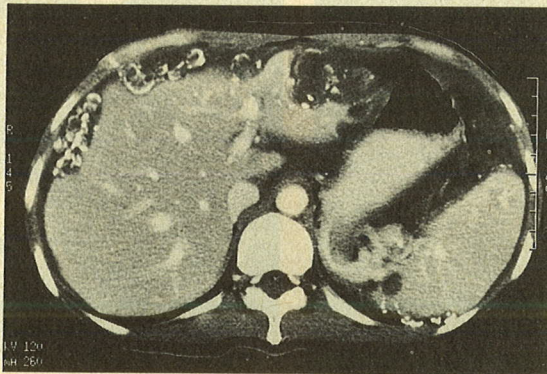
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(a)



(b)

Fig 4 - Post-contrast CT of the upper abdomen taken (a) 3cm superior to and (b) at the same level as Fig 2. Scalloping of the enhanced liver and spleen by calcified peritoneal carcinomatosis is demonstrated.

IMAGE INTERPRETATION

Abdominal radiograph (Fig 1) shows multiple small flake-like and curvilinear calcifications over both upper quadrants of the abdomen and more faintly in the pelvis (arrowed). Pre-contrast CT confirms the presence of numerous speckled and curvilinear calcifications which scallop the margins of the right lobe and the lateral segment of the left lobe of the liver and surround the spleen (Fig 2). The scalloping effect of these soft tissue masses upon the solid organs are accentuated on postcontrast CT scans (Fig 4). Similar calcified intraperitoneal masses are present in the pelvis (Fig 3). A heterogeneously-enhancing ovoid mass consistent with an implanted scar tumour, is located subcutaneously in the anterior abdominal wall. The uterus is eroded by surrounding peritoneal tumour (Fig 5).

DIAGNOSIS

Calcified peritoneal carcinomatosis.

CLINICAL COURSE

Patient declined further surgical excision. Palliative radiotherapy was given to the pelvic area with good response. At last clinical follow-up, the patient remained relatively well.

DISCUSSION

Calcifications are often seen on plain abdominal radiographs. Interpretation of these calcifications can be approached by categorising them as being

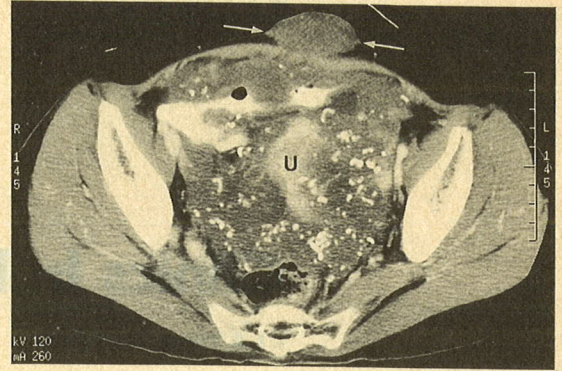


Fig 5 - Post-contrast CT of the pelvis, taken at the level corresponding to Fig 3. There is heterogeneous enhancement of a subcutaneous tumour deposit (arrows) located anterior to the rectus muscles. Peritoneal carcinomatosis surrounds and scallops the enhanced uterus [U].

Table I - Sites of abdominal calcifications

Confined to abdominal organ or structure:

RUQ: liver, gallbladder, right adrenal gland, right kidney

LUQ: spleen, tail of pancreas, left adrenal gland, left kidney

Epigastrium: gallbladder, pancreas

Pelvis: bladder, lower end of ureter

female: uterus, fallopian tubes, ovary

male: prostate, seminal vesicles, vas deferens

Paraspinal: ureter, abdominal aorta, para-aortic lymph nodes

Diffuse:

Peritoneum, mesentery, omentum

Multiple organ involvement

[RUQ:right upper quadrant; LUQ:left upper quadrant]

discretely confined to a certain organ or diffusely located throughout the abdomen (Table I)^(1,2). Calcifications localised to an organ or anatomical structure can be recognised by their site and distribution. For example, pancreatic calcifications are distributed linearly from the epigastrium across to the splenic area. The pattern of calcification is often related to the underlying pathological process (Table II)^(1,2). Healed granulomas such as those secondary to tuberculosis or histoplasmosis usually appear as multiple, small, scattered rounded densities. In contrast, calcification occurring within the wall of a cyst, abscess, organised haematoma or hollow viscus such as the gallbladder tend to be curvilinear in shape. Phleboliths are typically small with a central lucency and are commonly situated in the pelvis.

When diffuse calcification is not confined to a single organ or anatomical structure, peritoneal calcifications should be considered. Causes of such calcifications include peritoneal metastases, tuberculous peritonitis or meconium peritonitis in children. Occasionally, pancreatitis with saponification can cause diffuse calcification and in such instances, the clinical history is important. Metabolic disease may cause calcifications within several organs; an example is hyperparathyroidism producing calcifications within the pancreas, kidneys and arteries. Although causes of calcifications seen on the abdominal radiograph may often be deduced by their site of involvement and morphology, in equivocal or bizarre patterns, CT is required for definite anatomical localisation

particularly in the peritoneum, omentum and mesentery. The spectrum of entities involving these structures can be further narrowed if they are categorised into three basic patterns of solid, cystic and infiltrative processes⁽³⁾.

Malignant tumoural seeding of the peritoneum (or peritoneal carcinomatosis) most frequently originate from primary ovarian, colonic and gastric tumours. Less common sites include the pancreas, uterus and bladder. Peritoneal carcinomatosis is demonstrated on CT as enhancing nodules, soft tissue masses along peritoneal surfaces and enhancing peritoneal thickening, frequently in association with ascites. Patterns of secondary tumour involvement of the omentum include a single solid mass described as an omental cake, multiple well-circumscribed solid masses and multiple small ill-defined solid nodules scattered throughout the omentum, causing it to appear thickened or smudged⁽³⁾. Metastatic disease involving the mesentery may appear as large soft tissue tumour deposits, or as subtle areas of discrete mesenteric lymphadenopathy. Patterns of peritoneal fluid flow are such that the small bowel mesentery in the right lower quadrant is a frequent site of intraperitoneal tumour deposition. Calcification within metastatic peritoneal implants may be seen in serous cystadenocarcinoma of the ovary. This may actually be a common finding seen on CT images in up to 40% of patients with stage III and IV disease⁽⁴⁾. These calcified metastatic implants may be subtle and difficult to distinguish from adjacent contrast-material-filled bowel.

Apart from metastatic processes, other disease processes can also lead to solid masses in the peritoneum. Peritoneal mesothelioma may appear as a solid mass with enhancing peritoneum, but there is usually minimal ascites compared to secondary neoplasm. Tuberculosis can closely mimic peritoneal

carcinomatosis radiographically and clinical information is important in its differentiation. Lymphadenopathy, disproportionately involving the mesentery, is suggestive of tuberculosis. Abdominal involvement by tuberculosis may be seen in up to 38% of patients with pulmonary tuberculosis⁽⁵⁾. Specific populations found to be at greater risks for abdominal tuberculosis include immunocompromised patients (such as those infected with HIV or undergoing steroid therapy), patients with cirrhosis, alcoholics and intravenous drugs abusers. The presence of substantial retroperitoneal lymphadenopathy in association with mesenteric lymphadenopathy should raise the suspicion of lymphoma, especially in Non-Hodgkin lymphoma as more than 50% of patients have this as their first presentation. Both metastatic deposits and Non-Hodgkin lymphoma have an irregular shape but lymphoma generally demonstrates more homogeneous attenuation compared to metastasis. When cystic intraperitoneal masses are encountered, the diagnosis of pseudomyxoma peritonei resulting from dissemination of ruptured mucinous cystadenoma or cystadenocarcinoma of the ovary or appendix should be considered^(5,6).

Recurrence of ovarian and gastrointestinal tumours tend to occur at resection sites and/or along peritoneal surfaces. There are two main postulated explanations for these sites⁽⁷⁾. Firstly, penetration of ovarian tumours through the capsule, and of gastrointestinal tumours through the bowel wall, results in seeding of the peritoneal cavity with tumour cells. Secondly, during surgical resection of primary tumour, numerous lymphatic channels are transected. Since tumour microemboli are present in these channels, spillage of tumour cells into the peritoneal cavity may occur at the time of surgery, or retrograde leakage may occur in the immediate post-operative period. This latter phenomenon is particularly

Table II - Aetiology and features of abdominal calcifications

Aetiology with examples	Calcification characteristics
Congenital: meconium peritonitis	usually diffuse, in newborn
Traumatic: organised haematoma	curvilinear; dense and irregular when contracted
Iatrogenic: intramuscular injections in buttocks	
Neoplastic: primary or secondary mucinous primary of colon, breast, cystadenocarcinoma of ovary (common)	variable; ill-defined and irregular; multiple nodules; diffuse amorphous
Inflammatory: acute pancreatitis with saponification chronic pancreatitis	
Infective: healed granuloma eg tuberculosis, histoplasmosis, brucellosis infected cyst or abscess eg hydatid cyst parasitic infestations: cysticerci guinea worm armillifer armillatus	multiple small scattered densities curvilinear oval shape with lucent centre irregular coiled comma shaped
Vascular: arteriosclerosis, aneurysm healed infarct phleboliths organised haematoma	curvilinear solitary rounded small, round with lucent centre curvilinear
Metabolic/toxic calculi--gallbladder, urinary tract hyperparathyroidism haemochromatosis sickle cell anaemia	diffuse increased density in involved organ fine granular splenic calcification
Idiopathic	

important for tumours that tend to metastasize along lymphatic channels such as tumours of the colon, stomach and pancreas.

Tumours tend to be deposited at sites that coincide with the natural flow of peritoneal fluid⁽⁸⁾. These sites include the superior aspect of terminal ileum, the medial aspect of the caecum, or the superior aspect of the sigmoid colon, the pelvis, the paracolic gutter, and the subhepatic and right subphrenic spaces. The left subphrenic space may be excluded from disease by the phrenicocolic ligament, unless the ligament had been released surgically. Metastases to peritoneal surfaces of the diaphragm, liver and spleen are common and are seen as low attenuation masses that cause a concave or scalloped defect on the adjacent hepatic and splenic parenchyma⁽⁵⁾. These findings were observed in this case. With further invagination, extrahepatic masses may have an intraparenchymal appearance.

The overall sensitivity of CT in detecting peritoneal metastasis is relatively low (38%-64%) while the specificity is relatively high (77%-100%). The low sensitivity is primarily due to the inability of CT to depict small volume disease, with the greatest inaccuracies recorded in the pelvis, small bowel mesentery and the greater omentum. The sensitivity also varies according to the site of peritoneal metastases^(7,9). Despite these limitations, CT is still superior to clinical examination for determination of disease extent and planning of patient management. In patients with treated gastrointestinal or ovarian cancers, CT is indicated when patients become symptomatic, show a progressive rise in tumour markers or have other clinical evidence of recurrent disease, especially if reoperation or palliative chemotherapy is being considered⁽⁹⁾. The selective use of cytoreductive surgery and intraperitoneal chemotherapy in patients with peritoneal carcinomatosis from colorectal or appendiceal cancers has been found to be effective⁽¹⁰⁾.

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ABSTRACT

A 37-year-old woman, with previously resected mucinous adenocarcinoma of the colon, presented with menorrhagia and a palpable pelvic mass. Radiographs and computed tomography (CT) demonstrated calcified peritoneal carcinomatosis in the abdomen and pelvis. Types of abdominal calcifications and imaging of intraperitoneal masses, particularly of peritoneal tumours, are discussed.

Keywords: abdominal calcifications, abdominal malignancy; calcified tumours; colon tumours, computed tomography; peritoneal carcinomatosis.