

By the Name of ALLAH the Most Gracious the Most Merciful



The peritoneum, mesentery, greater omentum and retroperitoneal space Part I

د . أحمد اسامة حسن

Specialist in General Surgery & Laparoscopic Surgery

25th ,September , 2023

To be read in

Bailey & Love's Short Practice of Surgery 27th Edition.

Ch 65.

Objectives

To understand:

- The development and anatomy of the mesentery and peritoneum.
- Surgical conditions of the peritoneum, mesentery, greater omentum and retroperitoneal space

Part I

- Definition
- Peritonism
- Peritonitis :
 - Localized
 - Generalized
 - (bacterial, bile, TB)
- Intraperitoneal abscess (Subphrenic , Pelvic)

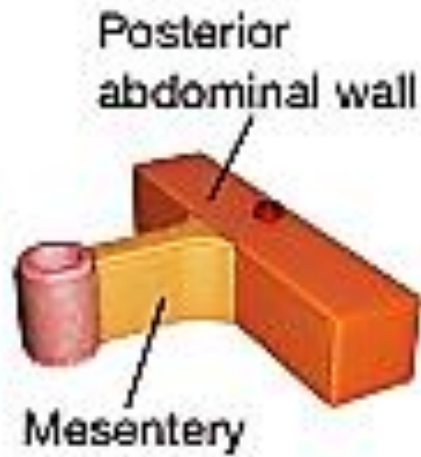
The Peritoneum

MESENTERY and PERITONEUM

(a)



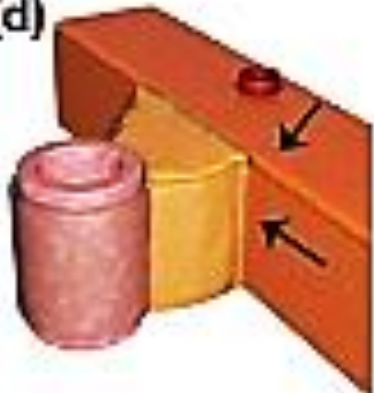
(b)



(c)



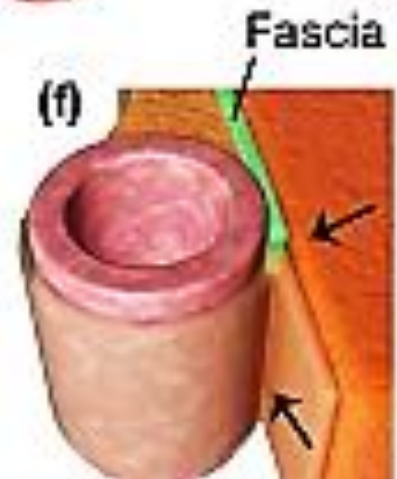
(d)



(e)



(f)



- Peritoneal membrane (a sheet of mesothelial cells).
- Mesentery (lined on either side by a sheet of mesothelial cells, enclosing blood supply of the viscera).
- Omentum ((lined on either side by a sheet of mesothelial cells, enclosing fat deposition (Greater & Lesser))).
- Failure of **switch** formation occurs in malrotation (**Rotational disorders**) .
- Incomplete **adhesion** of the mid-region fold is associated with increased **mobility** of the ileocaecal region and volvulus (see **Volvulus of the intestine and adjoining mesentery**).
- The adult abdomen comprises two discrete anatomical compartments: the mesenteric (**visceral**) and non-mesenteric (**parietal**) domains.

Mobility

- The small intestinal region of mesentery, transverse mesocolon and lateral mesosigmoidal mesentery are **not adherent** and thus are mobile.
- The dorsal mesogastrium, mesoduodenum, right and left mesocolon and mesorectum are anchored (**adherent**) to the subjacent abdominal wall (or pelvic side wall).
- The peritoneum thus comprises **visceral** peritoneum (corresponding to the surface lining of the mesenteric domain), **parietal** peritoneum (corresponding to the surface lining of the non-mesenteric domain) and the reflection joining both.

- The surface contours generated by the organisation of the domains and the peritoneum explains the sacs, recesses, fossae and pouches in which abnormal fluid collections arise in the abdomen.
- In the **male**, the peritoneal cavity is normally **closed**. In the **female**, the peritoneal cavity is open to the environment at the fimbrial entrance to the fallopian tubes.
- **In both sexes** (but more frequently in the male) a peritoneal tube (processus vaginalis) can persist at the deep inguinal ring and predispose to inguinal hernia formation.

The Retroperitoneum

- The interface between adherent regions of the mesenteric and non-mesenteric domains is termed the retroperitoneal space .
- The retroperitoneal **space** normally contains connective tissue fascia. The space (and fascia) continues into the thorax superiorly and into the pelvis inferiorly. The **retroperitoneum** is deep to the retroperitoneal space. It **includes** the kidneys, ureters, gonadal vessels, lumbosacral plexus and the musculoskeletal frame of the posterior abdominal wall and major vessels.

Vascular Supply

- The arterial inflow to the mesenteric domain is limited to the **coeliac trunk** and **superior** and **inferior mesenteric** arteries.
- The venous drainage of the mesenteric domain occurs via the hepatic veins at the junction of these and the inferior vena cava (**portal vein**).
- In between the arterial inflow and venous drainage, the vasculature of the abdominal digestive organs is entirely intramesenteric and aligned with the mesenteric regional anatomy.
- The limited routes of arterial inflow and venous drainage have significant implications when these are affected by pathology (discussed in Vascular abnormalities of the mesentery).

THE PERITONEUM

- The peritoneal membrane is composed of flattened polyhedral cells (mesothelium), one layer thick, resting on a thin layer of fibroelastic tissue.
- Beneath the peritoneum, supported by a small amount of areolar tissue, lies a network of lymphatic vessels and a rich plexus of capillary blood vessels from which all absorption and exudation must occur. In health, only a few millilitres of peritoneal fluid are found in the peritoneal cavity.
- The fluid is pale yellow, somewhat viscid and contains lymphocytes and other leukocytes; it lubricates the viscera, allowing easy movement and peristalsis.
- The parietal portion is richly innervated and, when irritated, causes severe pain that is accurately localised to the affected area. The visceral peritoneum, in contrast, is poorly innervated and irritation causes pain that is usually poorly localised to the midline.

Functions of the peritoneum

In health

- Visceral lubrication.
- Fluid and particulate absorption .

In disease

- Pain perception (mainly parietal).
- Inflammatory and immune responses.
- Fibrinolytic activity.

- The peritoneum has the capacity to **absorb** large volumes of fluid; however, the peritoneum can also **produce** large volumes of fluid (ascites) and an inflammatory **exudate / exudate** when injured (seen in peritonitis).
- During expiration, intra-abdominal pressure is reduced and peritoneal fluid, aided by capillary attraction, travels in an upward direction towards the diaphragm. Particulate matter and bacteria are absorbed within a few minutes into the lymphatic network through a number of ‘pores’ in the diaphragmatic peritoneum (**pleural effusion**).
- The circulation of peritoneal fluids may be responsible for the occurrence of abscesses anatomically remote from primary disease. The two sites most prone to collection are the pelvis and subdiaphragmatic areas, reflecting the effects of gravity while standing and lying, respectively .

PERITONITIS

Peritonitis is inflammation of the peritoneum and can be categorized as

- localized or diffuse (clinically).
- acute or chronic or according to the primary underlying pathology.

Paths to peritoneal infection

- ❖ **Gastrointestinal perforation**, e.g. perforated ulcer, appendix, diverticulum
- ❖ **Transmural translocation** (no perforation), e.g. pancreatitis, ischaemic bowel, primary bacterial peritonitis
- ❖ **Exogenous** contamination, e.g. drains, open surgery, trauma, peritoneal dialysis
- ❖ **Female genital** tract infection, e.g. pelvic inflammatory disease
- ❖ **Haematogenous** spread (rare), e.g. septicaemia

Causes of Peritoneal Inflammation

- **Bacterial:** gastrointestinal and non-gastrointestinal
- **Chemical :**Bile, barium
- **Allergic :** starch peritonitis
- **Traumatic :** Operative handling
- **Ischaemia :** Strangulated bowel, vascular occlusion
- **Miscellaneous :** Familial Mediterranean fever

Clinical features of peritonitis

- Abdominal pain, worse on movement, coughing and deep respiration
- Constitutional upset: anorexia, malaise, fever, lassitude ●
Gastrointestinal upset: nausea +/- vomiting
- Pyrexia (may be absent) .
- Raised pulse rate
- Tenderness +/- guarding/rigidity/rebound of abdominal wall
- Pain/tenderness on rectal/vaginal examination (pelvic peritonitis)
- Absent or reduced bowel sounds
- ‘Septic shock’ (systemic inflammatory response syndrome [SIRS] and multiorgan dysfunction syndrome [MODS]) in later stages

Localised Peritonitis

- If the parietal peritoneum is involved, the patient complains of pain (somatic pain) in the area affected.
- Vital signs may be normal, but tachycardia and pyrexia are common.
- Rebound tenderness & Tenderness (Guarding , rigidity).
- Peritonism and the patient is described as peritonitic.
- Under the diaphragm, shoulder tip pain.
- Pelvic peritonitis, e.g. from an inflamed appendix or salpingitis, abdominal signs may be limited; deepseated tenderness may be detected by digital rectal or vaginal examination.
- Signs may be limited in obese patients or in patients on immunosuppressive medications.

- Investigations : CBP, ESR, U/S. CT scan
- There is a reactionary, serous exudate (rich in leukocytes and plasma proteins) that gradually becomes turbid in appearance. The fluid may transform to frank pus if not evacuated.
- Plaques of yellow/white fibrin may be apparent, causing loops of intestine (and mesentery) to adhere to themselves and to the parietes.

Diffuse (generalised) peritonitis

- A life-threatening condition.
- Hemoperitoneum (ruptured aortic aneurysm) or perforated viscus i.e duodenal ulcer or anastomotic leak).
- The pain may be localised at first and then become diffuse. The patient is gravely ill looking (Hippocratic facies) and usually lies as still as possible .
- ('board-like' rigidity) scaphoid abdomen in thin patient .
- Vitally unstable with change level of consciousness.

Management of peritonitis

- General care of patient
 - . Correction of fluid and electrolyte imbalance
 - . Insertion of nasogastric drainage tube and urinary catheter
- Broad-spectrum antibiotic therapy
 - . Analgesia
 - . Vital system support
- Surgical treatment of cause when appropriate
 - . 'Source control' by removal or exclusion of the cause .
 - . Peritoneal lavage +/- drainage

Acute bacterial peritonitis

- Perforation of a viscus.
- Female genital tract (Chlamydia spp. and gonococci)
- Exogenous contamination.
Less common forms involve a primary ‘spontaneous’ peritonitis due to streptococcal, pneumococcal or Haemophilus infection.
- A variant of transperitoneal spread of such organisms is perihepatitis, which can cause scar tissue to form on Glisson’s capsule.
- Fungal peritonitis is rare but may complicate severely ill patients.

Primary Bacterial Peritonitis

Spontaneous bacterial peritonitis

- Gram-negative bacteria, usually *Escherichia coli*, and Gram-positive cocci (mainly streptococci and enterococci).
- Is an acute bacterial infection of ascitic fluid. There is often a history of cirrhosis and ascites. The clinical picture is highly variable as the patient may be asymptomatic. The course can be prolonged.
- Diagnosis is made by paracentesis (increased neutrophil count of $250/\text{mm}^3$)
- Culture of ascites is negative in 60%.
- Third-generation cephalosporin, e.g. cefotaxime, is a reasonable first-line treatment that avoids the renal toxicity of aminoglycosides. Alternatives are amoxicillin/clavulanic acid and quinolones such as ciprofloxacin.

Biliary Peritonitis

- After cholecystectomy and arises from slippage of a clip on the cystic duct, drainage of bile from an accessory cystic duct or perforation of the common bile or hepatic duct .
- After hepatectomy.
- Duodenal surgery, although this is unusual if a drain has been placed at the time of surgery.
- **Investigation** follows the principles and steps described in **Peritonitis**. The natural course varies depending on the volume of contamination. In severe contamination the patient will be extremely unwell and urgent intervention is required.
- **Localised collections** can be treated by percutaneous insertion of a drain followed by endoscopic retrograde pancreatography (ERCP) to identify the source of bile leak. ERCP enables placement of a stent across the source of the leak.
- Diffuse or high-volume contamination, or the presence of multiple separate locules, normally mandates surgical exploration with the aim being lavage and drainage.

Primary pneumococcal peritonitis

- It may complicate nephrotic syndrome or cirrhosis in children; however, otherwise healthy children may also be affected.
- In girls, the route of infection may be via the vagina and Fallopian tubes, while a blood-borne route secondary to respiratory tract or middle-ear disease is also possible.

- Sudden, localised pain to the lower half of the abdomen. Fever is up to 39°C or more and frequent vomiting.
- After 24–48 hours, profuse diarrhoea is characteristic. There is usually increased frequency of micturition.
- The last two symptoms are caused by severe pelvic peritonitis.

- On examination, peritonism is usually diffuse but less prominent than in cases of a perforated viscus, leading to peritonitis.
- Causative organisms include *Haemophilus* spp., group A streptococci and a few Gram-negative bacteria. Idiopathic streptococcal and staphylococcal peritonitis can also occur in adults.

- Antibiotic therapy , rehydration and electrolyte correction.
- Early surgery is required unless spontaneous infection of pre-existing ascites is strongly suspected, in which case a diagnostic peritoneal tap is useful and sent to the laboratory for microscopy, culture and sensitivity tests.
- Laparotomy or laparoscopy may be used (exudate is aspirated, thorough peritoneal lavage is carried out and the incision closed).
- Antibiotics and fluid replacement therapy are continued and recovery is usual.

Tuberculous peritonitis

- Includes intraperitoneal, gastrointestinal tract and solid organ disease forms. it is often diagnosed late.
- Source : GIT : (typically the ileocaecal region) via mesenteric lymph nodes or directly from the blood, usually from the ‘miliary’ but occasionally from the ‘cavitating’ form of pulmonary TB, lymph and the Fallopian tubes.
- Types : 90 % ascitis (generalised or loculated).
- Less common form fibrotic fixed loops of bowel and omentum are matted together and may present with subacute intestinal obstruction.
- Dry, plastic type.
- Presentation is often insidious with abdominal pain, weight loss and abdominal distension. Distinction from diffuse peritoneal metastases is difficult and may require biopsy.

Tuberculous peritonitis

- Diagnosis : abdominal ultrasonography or CT to detect ascites and lymphadenopathy with/without diffuse thickening of the peritoneum, mesentery and/or omentum.
- Ascitic fluid is typically a straw-coloured exudate (protein >25–30 g/L) with white cells >500/mL and lymphocytes >40%.
- Unfortunately, diagnostic smears for acid-fast bacilli are often not diagnostic and culture may take up to 4–8 weeks, so laparoscopy and peritoneal biopsy may thus be helpful to couple typical appearances with histology.
- PCR (polymerase chain r)

Tuberculous peritonitis

- Measurement of adenosine deaminase activity in ascitic fluid has a high sensitivity and specificity .
- Management is supportive (nutrition and hydration) and medical (systemic anti-TB therapy, noting that multidrug resistance may be higher for abdominal than for pulmonary TB), surgery is required for specific complications such as intestinal obstruction.

Familial Mediterranean fever

- An autosomal recessive inherited autoinflammatory syndrome .
- Episodic diffuse abdominal pain and tenderness, mild pyrexia and joint pain.
- DDX of acute appendicitis in in childhood
- Usually mild and resolve within 24–72 hours.
- Rarely pericardial or meningeal inflammation may occur. Amyloidosis is a long-term complication.
- Colchicine can be used to reduce the frequency and severity of attacks and to prevent development of amyloidosis.

INTRAPERITONEAL ABSCESS FORMATION

- An intraperitoneal abscess is a collection of pus in the peritoneal cavity. It normally arises secondary to another pathology. Inflammation of any viscus, if unresolved, will lead to hypersecretion of peritoneal fluid (exudate).
- A swinging pyrexia is strongly suggestive of intraperitoneal abscess formation.
- Atypical Inratperitoneal abscess (Subphrnic, lesser sac and pelvis).

Clinical features of an abdominal/pelvic abscess

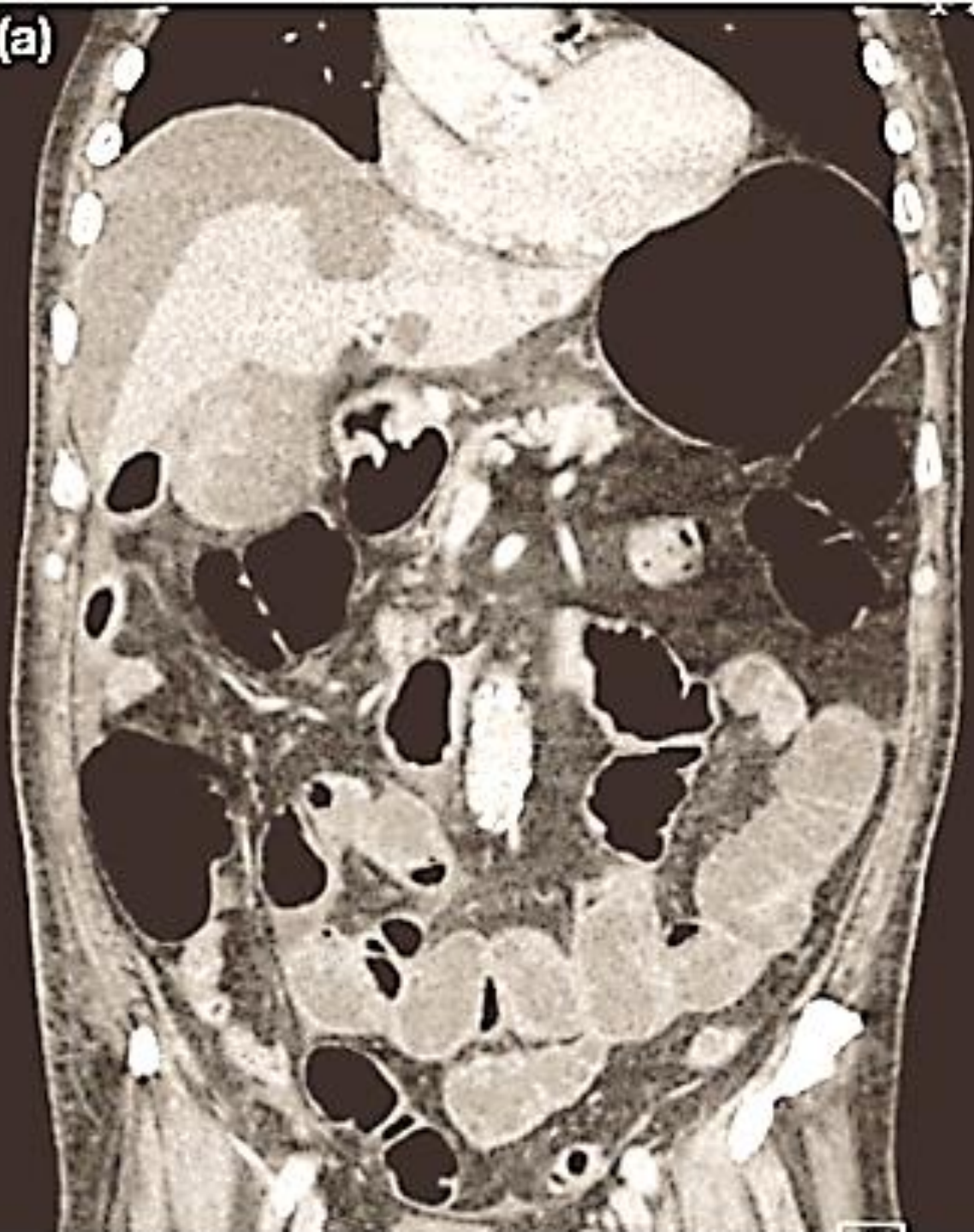
- Symptoms

- Malaise, lethargy – failure to recover from surgery as expected
- Anorexia and weight loss.
- Sweats +/- rigors
- Abdominal/pelvic pain
- Symptoms from local irritation, e.g. shoulder tip/hiccoughs (subphrenic), diarrhoea and mucus (pelvic), nausea and vomiting (any upper abdominal)

- Signs

- Increased temperature and pulse +/- swinging pyrexia
- Localised abdominal tenderness +/- mass (including on pelvic examination) . Digital R Exam tenderness.

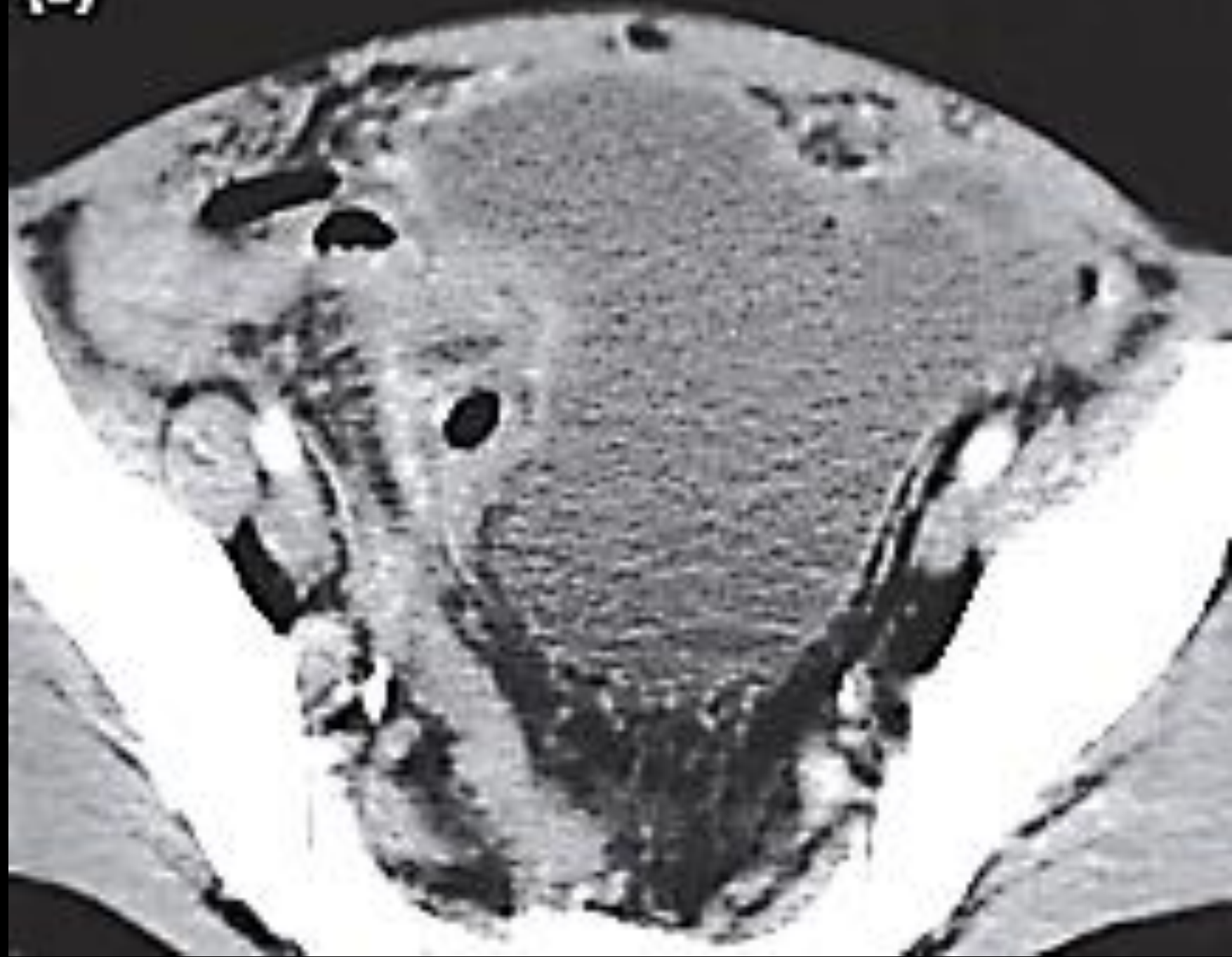
(a)



(b)



(c)



Treatment

- Abscesses less than 5 cm in diameter normally resolve with intravenous antibiotic treatment.
- Abscesses greater than 5 cm require either percutaneous aspiration/drainage or surgical intervention.
- laparoscopically (laparoscopic lavage) or via an open approach.
- The bowel may be matted , any residual collections. residual interloop abscesses.

Prevention of abscess formation after appendicitis

- Following appendectomy for a perforated appendix , it is important to aspirate the pelvic, paracolic and subhepatic spaces prior to closure of the abdominal wall

Abscess formation following intestinal surgery and anastomosis

- Locules of gas or free contrast (Gastrografin) on CT support anastomotic leak.
- Pelvic abscess formation is not uncommon following excision of the rectum and formation of a pelvic anastomosis.

Subphrenic abscess

- Patients may complain of shoulder tip pain. The diaphragm also develops at the same level as the C5 dermatome. If the parietal peritoneum under the diaphragm is irritated, pain is referred to the shoulder tip.
- Shoulder tip pain following laparoscopic or robotic surgery).
- In the era preceding that of cross-sectional imaging via CT, the adage ‘pus somewhere, pus nowhere, pus under the diaphragm’ was useful.
- Tx:
Ressuscitation, ABCs, Drainage under imaging / laparotomy / laparoscopy with tube drain and irrigation.

Pelvic abscess

- Is the most common site of abscess formation because :
- The vermiform appendix is often pelvic in position .
- The Fallopian tubes are also frequent sites of infection.
- As a sequel to diffuse peritonitis .
- After anastomotic leakage following colorectal surgery.

Clinical features

- Pelvic pain, diarrhoea and passage of mucus in the stools.
- Lower back pain or a pressure sensation in the pelvis. This symptom can be quite severe in intensity.
- The abscess may discharge into the anal canal as the pelvic collection points through an anastomotic leak (the point of least resistance).
- Rectal or vaginal examination can be extremely uncomfortable for the patient .

Investigation and management

- Should be confirmed by ultrasonography or CT scanning.
- Antibiotics.
- Pelvic abscesses can be drained transanally or transgluteally.
- *The past vogue for transintestinal drainage is no longer practised because of the high incidence of complications such as fistulae.*
- Laparotomy may sometimes be indicated.

حَمْدُ اللَّهِ

PRAISE BE TO ALLAH