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Department of surgical diseases No. 2

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PERITONITIS

Textbook for students of the 4th year

of the Faculty of Dentistry in the discipline "Surgical Diseases"

Vladikavkaz

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Peritonitis: teaching guide for students, Textbook for students of the 4th year of the Faculty of Dentistry in the discipline "Surgical Diseases"- North Ossetian state medical academy. - Vladikavkaz, 2022. - 19 sh.

This teaching guide covers main issues about etiology, pathogenesis, clinical features, laboratory and instrumental diagnostics and complications of Peritonitis.

Teaching guide “Peritonitis” is made for “Surgical Diseases” discipline in accordance with requirements of FSES HE, and is intended for students from medical universities and faculties, studying for specialty 31.05.03 Dentistry.

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Introduction

Peritoneal cavity is the largest cavity in the body accommodating various viscera. It is divided into greater and lesser sac (omental bursa) which communicate through the foramen of Winslow or epiploic foramen. The peritoneum lining inner side of the parietes is called parietal peritoneum.
It is very sensitive and is innervated by both somatic and visceral afferent nerves. This explains the sharp, localised, cutting pain of peritonitis.
Diaphragm and central part of the peritoneum is supplied by phrenic nerve (C4) and partly by intercostal nerves. Rest of the peritoneum is supplied by intercostal nerves and lumbar nerves. Lesser omentum: It is also called hepatoduodenal ligament. It extends from the duodenum to the liver. This has two layers and within these layers are the common bile duct, hepatic artery and hepatic portal vein.

THE PERITONEUM

Lining of peritoneum

The peritoneum is lined by a single layer of flattened cells and a thin layer of fibroelastic tissue. It is parietal peritoneum. A large peritoneal defect heals within a few hours because of these mesenchymal cells (flattened polyhedral cells- mesothelium). Applying this principle, some surgeons do not close the peritoneal layer after laparotomy. When parietal peritoneum is reflected into viscera, it is called visceral peritoneum. It covers viscera and is supplied by autonomic nervous system. Hence, it is not sensitive. Thus, gastrojejunostomy can be done under local anaesthesia but distension and traction to the bowel causes pain. During herniorrhaphy under spinal anaesthesia, handling of bowel or traction on the bowel can produce uncomfortable upper abdominal pain.

Fluid

Peritoneal surface is a semipermeable membrane with an area comparable to that of cutaneous body surace. Nearly 1 m2 of the total 1.7 m2 area participates in fluid exchange with extracellular fluid space at the rate of 500 ml or more per hour. It normally contains less than 50 ml fluid. When it is insulted by infection, a large amount of fluid can collect in this space giving rise to severe fluid and electrolyte imbalance. This is described as III space loss, e.g. peritonitis,pancreatitis. Peritoneal fluid helps in smooth gliding of intestines. Absorption of fluid and secretion of fluid are some important functions of peritoneum.

NORMAL PERITONEAL FLUID—TRANSUDATE

- Specific gravity below 1016
- Protein concentration less than 3 gm/dL
- White blood cell count less than 3000/µL
- Complement mediated bacterial activity
- Lack of fibrinogen related clot formation

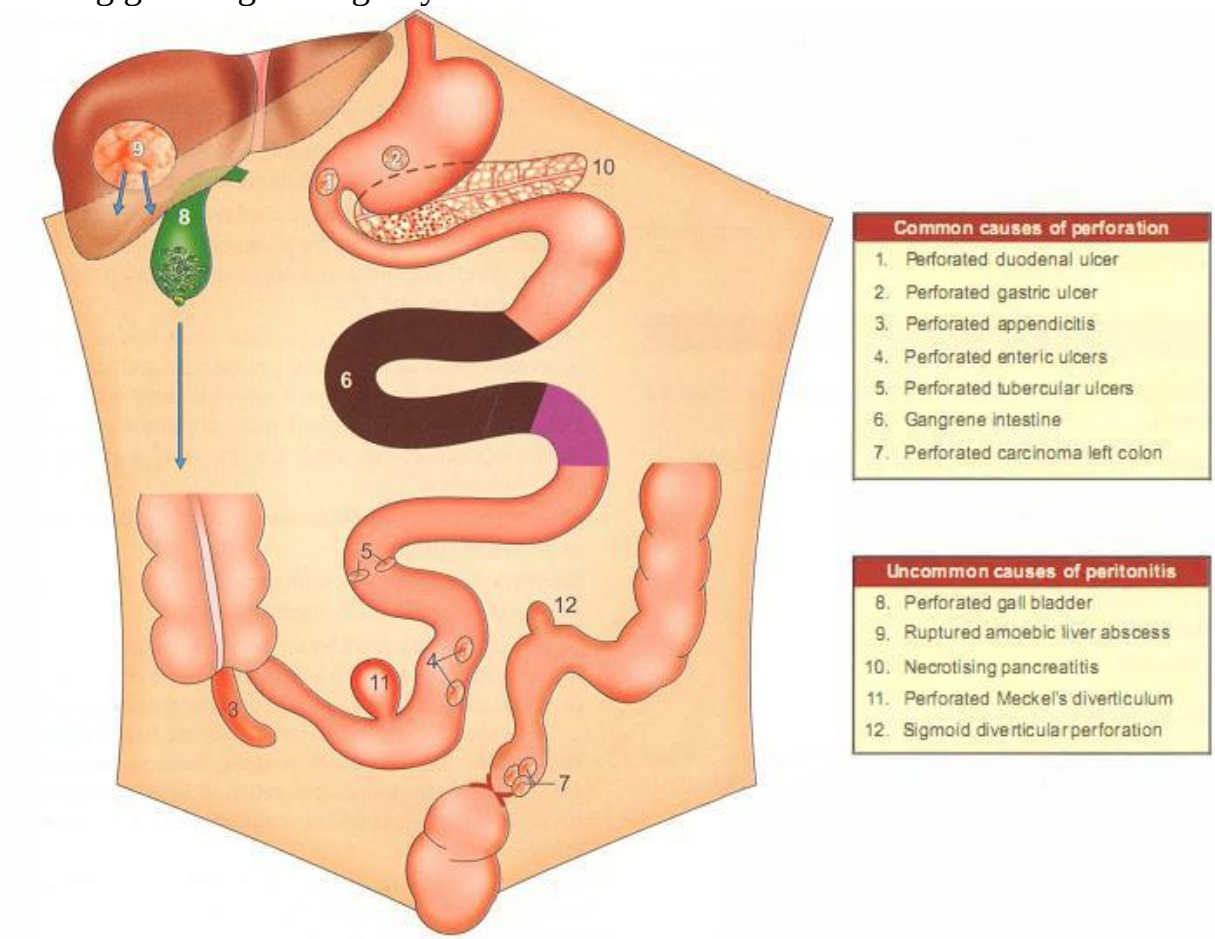
Absorption and exudation
This takes place through capillaries and lymphatics present in between the two layers of peritoneum. This principle is applied in dialysis. The direction of circulation is towards subdiaphragmatic lymphatics.

Protective function
It secretes prostaglandins, interferons and free radicals which help in some protection against peritonitis.

ACUTE PERITONITIS

Definition: Inflammation of the peritoneum is called peritonitis.
Causes: They can be classified into primary or secondary.
I. Primary peritonitis
• Spontaneous peritonitis of childhood
• Spontaneous peritonitis of adults
• Tuberculous peritonitis
• Peritonitis associated with dialysis
II. Secondary peritonitis
This term refers to peritonitis from an intra-abdominal source and is the most common form of peritonitis. The following are the causes or secondary peritonitis (Fig. 1):
1. Perforation of a hollow viscus
• Perforated duodenal ulcer, gastric ulcer
• Perforated enteric ulcer, tubercular ulcer
• Perforated Meckel's diverticulum
• Perforated colonic ulcer
2. Direct spread: Post-inflammatory
• Acute cholecystitis-gangrenous
• Acute appendicitis
• Gangrene of the intestine
• Acute necrotizing pancreatitis
3. Penetrating injuries to the abdomen, where the organisms gain entry from outside.
4. Postoperative peritonitis is due to the introduction of infection during surgery which might be due to:
• Postoperative leaks
• Foreign body (mop) in the abdomen
5. Parturition peritonitis: It refers to peritonitis after pregnancy and delivery.
6. Blunt injuries to the abdomen

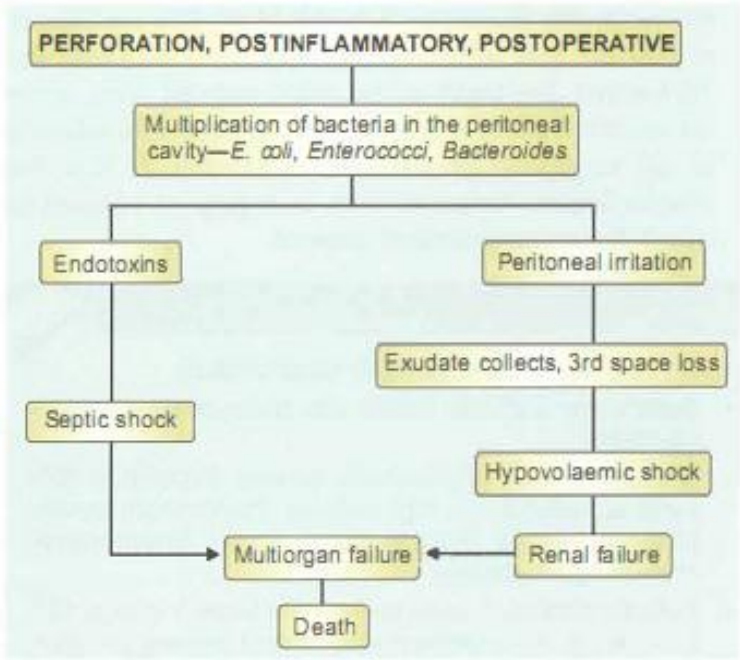
• Fluid which is spilled into the peritoneal cavity (example: Blood and bile can travel along paracolic gutter and manifest as pain in the right iliac fossa, causing guarding and rigidity.



Common causes of generalised peritonitis

(Fig. 1)

PATHOGENESIS (Fig. 2)



Pathophysiology of peritonitis

(Fig. 2)

Due to any one of the reasons mentioned above, infection sets in and the causative organisms multiply in the peritoneal cavity.

• Gram-negative organisms: Escherichia coli (E. coli), Proteus, Klebsiella. They are present in the small and large bowel. They are the commonest organisms producing peritonitis.

ORGAN-SPECIFIC ORGANISMS

- **Gastric perforations:** Sterile with minimum gram-positive organisms.
- Ileal perforation, appendicitis—aerobic bacteria in 30% patients, anaerobic in 10% patients. Predominant aerobic bacteria include gram-negative *E.coli*, Streptococci, Proteus and Klebsiella.
- **Colonic-rectum:** Faecal spillage produces a load of 10^{12} or more—gram-negative and anaerobic bacteria per gram of stools.

• Enterococci: Streptococcus faecalis needs bile to grow. It is present in the urinary tract, genital tract and also in the intestines. However, both aerobic and anaerobic streptococci are the second most common organisms producing peritonitis. They are the chief organisms in puerperal sepsis.

• Bacteroides: They are anaerobic organisms, present mainly in the lower intestine.

• Bacteria from outside alimentary canal: Gonococci, pneumococci, tubercular organisms, etc.

• These organisms proliferate in the peritoneal cavity resulting in peritonitis. As a result of this, there is secretion of a large amount of fluid into the peritoneal cavity resulting in 3rd space loss which leads to severe hypovolaemic shock. This fluid is rich in proteins, bacteria and toxins. Due

to powerful endotoxins released by gram-negative bacteria, endotoxic shock or septic shock (refer to shock), ensues.

• The fluid is rich in fibrinogen which forms fibrin and helps in localisation of infection (Fig.3).

Fibrin plaques: Early cases of peritonitis with fibrin plaques all over the peritoneal cavity

(Fig.3)

• Peritoneum loses its shiny surface, becomes reddish and oedematous and is covered with thick fibrinous exudate.

• Omentum: It is a atty apron with rich blood supply. A mobile double-layered peritoneal fold acts like a policeman to seal the area of infection or peroration. Examples: Perforated duodenal ulcer, acute appendicitis, acute diverticulitis, etc. Probably it also serves to supply collateral blood supply to the ischaemic viscera. It also has immunological functions such as supply of phagocytes which destroy unopsonised bacteria.

TYPES OF PERITONITIS

A. Local peritonitis: Ifa perforation is small and if it is sealed of immediately by omentum, it will give rise to local peritonitis. Examples: Small gastric ulcer perforation or diverticular perforation, gallbladder perforation. Anatomical actors also play a role in local peritonitis. Examples: Retrocaecal appendicitis with perforation. It is behind the caecum and in retroperitonaeum. Signs are confined to right iliac fossa only. In posterior gastric perforations or acute pancreatitis, signs are limited to upper abdomen. Pelvic peritonitis is another example-occur following septic abortions or salpingo-oophoritis.

B. Generalised peritonitis: If the contents of the viscus leak into the peritoneal cavity with orce, as it occurs in intestinal perforation or due to perforation of a free lying organ- example: Meckel's diverticular perforation. Virulence of

bacteria is more as in colonic perforations with generalised peritonitis.
Duodenal ulcer perforation can manifest as severe pain in the right iliac fossa mimicking appendicitis. Many have been operated as appendicitis. Reason being a broad right paracolic gutter and the contents travel down into right iliac fossa. This has been referred to as Valentino syndrome

VALENTINO SYNDROME—VALENTINO APPENDIX

- **Rudolph Valentino** was an Italian actor who lived in early 20th century.
- On August 15, 1926, he was admitted with the diagnosis of appendicitis and gastric ulcers, with peritonitis.
- He underwent appendicectomy.
- Continued to have peritonitis
- He developed pleural effusion and sepsis
- Dies after a few days of surgery.
- In retrospect what he had was duodenal ulcer perforation.
- It is also called **Valentino syndrome** because in any inflammation of the upper abdominal viscera, contents can travel down the right paracolic gutter into the right iliac fossa resulting in pain and tenderness mimicking acute appendicitis.

FACTORS DECIDING THE SEVERITY OF PERITONITIS

• Clean perforation: Upper GI-Gastric juice remain sterile or 6-8 hours. Hence, in early stages, there will be mild chemical peritonitis and early treatment is give good results.

• Distal gut perforation and infected bile peritonitis: Very dangerous and severe, causing sepsis and septic shock early.

• Postoperative peritonitis that usually occurs due to anastomotic leak is also dangerous.

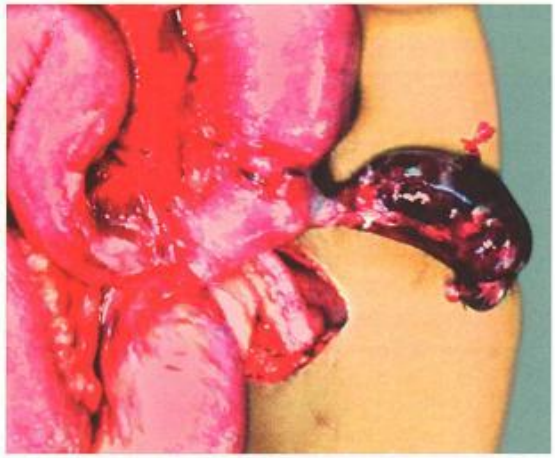
• A perforation sealed of early by omentum causes mild peri-tonitis. Retrocaecal appendicitis produces minimal local peritonitis

• On the other hand, perforated Meckel's diverticulitis produces diffuse peritonitis soon.

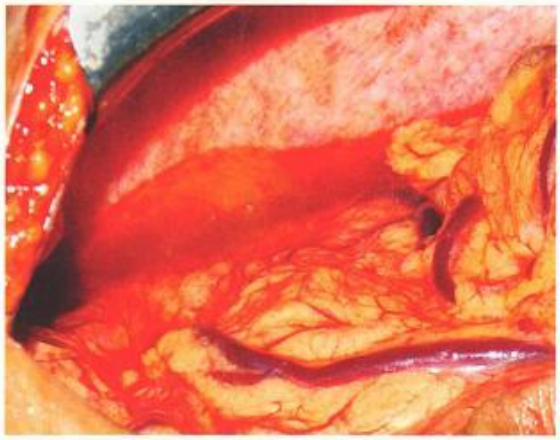
FACTORS AFFECTING DIFFUSE PERITONITIS

- Speed of peritoneal contamination, e.g. perforation of Meckel's diverticulum
- Stimulation by purgatives
- Virulence of organisms
- Perforation in a closed bop obstruction
- Immunocompromised status
- Young children. Omentum is thin and small

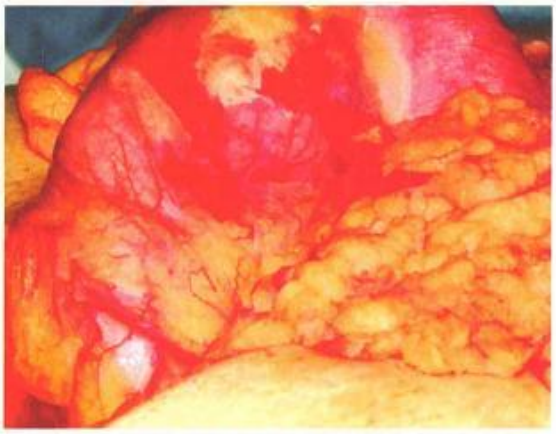
• A few causes of peritonitis are shown in Fig 4.



Meckel's diverticulitis



Peritonitis due to ileal perforation consequent to tuberculosis. Usually it is an ulcerative variety



Transverse colon injury due to steering wheel—simple closure in early cases without much peritonitis. Otherwise resection/closure with or without diversion ileostomy may be required

Enteric perforation which is 4 days old—very friable edges. Re-leak after suturing is common

(Fig. 4)

CLINICAL FEATURES

It depends upon whether 1t 1s localised peritonitis or generalised. In cases of retrocaecal appendicitis, the abdominal signs may be minimal but guarding and rigidity of the back muscles is characteristic. Features of generalised peritonitis are as follows:

• Severe abdominal pain which is cutting in nature, becomes worse on movement of the abdominal wall. Hence, the patient lies still on the bed.

• Persistent vomiting is due to irritation of parietal peritoneum.

• The pulse rate is increased. An increase in the pulse rate may be an early indication of peritonitis, in cases of gangrene of the bowel or peritonitis following perforation of bowel.

• High-grade fever with chills and rigors indicates a septicaemic process.

• Cough tenderness indicates parietal peritoneal infla-mmation. Abdominal tenderness is elicited in all quadrants of the abdomen.

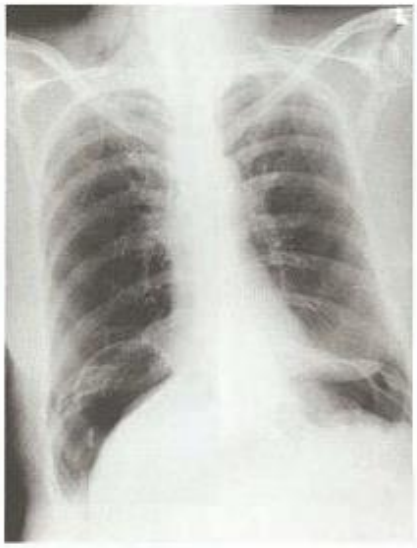
• Rebound tenderness (Blumberg's sign): Abdomen is pressed for a few seconds. The patient experiences pain. Sudden release of pressure causes severe pain. It is due to sudden movement of the sensitive parietal peritoneum.
• Guarding and rigidity of abdominal wall.
• Bowel sounds are absent. Distension of the abdomen occurs within a ew hours due to accumulation of fluid and paralytic ileus.
• End-stage disease: Hippocratic facies

HIPPOCRATIC FACIES

- Hollow, bright eyes
- Pale and pinched face
- Cold perspiration in the head and brows
- Blue lips
- Dry, cracked tongue

INVESTIGATIONS

1. Complete blood picture shows high total count with predominant neutrophil count.
2. Blood examination for sugar is done to rule out diabetes mellitus. Empyema gall bladder with or without perforation can present as septic shock. Often, they are diabetic.
3. Plain X-ray abdomen, chest and upright
• Gas under the diaphragm-perforation (Fig 5)



Chest X-ray showing free gas under diaphragm

(Fig 5

• Ground glass appearance-a smooth homogeneous appearance due to accumulation of fluid.
• Air in the bowel wall-gangrene.
• Obliteration of psoas shadow and preperitoneal at planes.

4. Abdominal USG to detect fluid in the abdomen.
Following are different fluids which may give clue to the diagnosis
• Frank pus-peritonitis of more than 48 hours old
• Bile-green coloured-duodenum, stomach, gall bladder perforation
• Faeculent-dark green coloured thick aspirate with faecal odour-ileac perforations, postoperative anastomotic leaks
• Serous-exudative-early acute pancreatitis, tuberculous peritonitis
• Haemorrhagic-haemorrhagic pancreatitis
• Food particles-hollow viscus perforation
Thus ultrasound has so many advantages even though it may not point at the specific site. However, probe tenderness with fluid in the right iliac fossa may suggest acute appendicular perforation. Very thick contents such as anchovy sauce from ruptured amoebic liver abscess cannot be aspirated. However, ultrasound will give clue about the liver abscess.
5. Abdominal tap
• Aspiration of blood indicates haemoperitoneum or gangrene of the bowel.
• Aspiration of bile indicates biliary peritonitis due to perforation of duodenal ulcer, gall bladder or intestine.
• Aspiration of frank pus indicates peritonitis due to gram-negative bacteria. Foul-smelling pus is due to anaerobic bacteria producing free fatty acids and their esters. Always send the fluid for culture sensitivity.
• Amylase estimation should be done to rule out pancreatitis.
6. Contrast-enhanced CT scan
• When the signs and symptoms are equivocal, CT is the ideal investigation.
• CT can diagnose hollow viscus perforation, especially when there is no gas under the diaphragm.
• CT can detect ischaemic changes due to gangrene of the bowel-gas in the bowel wall.
• CT can diagnose unsuspected and unexpected lesions in the abdomen including diverticular perforations, internal herniation and gangrene, acute pancreatitis, etc.
• Adequate hydration and normal renal function (as indicated by normal creatinine values) are important before a contrast-enhanced CT scan.
7. Diagnostic laparoscopy can be used in suspected cases of peritonitis.

DIAGNOSTIC LAPAROSCOPY

- It can be used to reconfirm peritonitis
- It can diagnose pancreatitis (laparotomy may be avoided)
- It can also treat primary cause, e.g. laparoscopic closure of duodenal ulcer perforation
- Peritoneal toilet can be given
- It can rule out other causes
- In blunt injury, **it can detect diaphragmatic injury**—herniation of bowel, etc.

TREATMENT

1. Aspiration: Nasogastric aspiration with Ryle's tube helps in decreasing gastrointestinal secretion. Thus it reduces abdominal distension. It also prevents vomiting and gives rest to the gut. Indirectly it reduces 'bacterial load' contaminating peritoneum.
2. Bowel care and blood: Purgatives should not be given as it may result in peroration. Blood is arranged for surgery.
3. Charts: Temperature, pulse rate, respiratory rate, intake- output charts are maintained.
4. Drugs are given against gram-positive, gram-negative and anaerobic organisms.

SELECTION OF ANTIBIOTICS

- 2nd or 3rd generation cephalosporins should be started as early as possible
- Once culture and sensitivity reports are available (after surgery), antibiotics can be changed
- Antibiotics should also cover aerobes and anaerobes
- Should not have serious toxicity, especially amikacin which has nephrotoxicity. Hence, to be used carefully (check creatinine)

EARLY AGGRESSIVE RESUSCITATION

- **Restore** intravascular volume. **Crystalloids:** Ringer lactate or isotonic saline stay in the intravascular space for a short period, larger volumes required
  Colloids: Longer duration of action, smaller volumes are sufficient and can be used in cardiac patients
- **Restore** oxygenation by face mask or mechanical ventilation, as necessary
- **Restore** perfusion: Dopamine/dobutamine/noradrenaline.
- **Restore** normality by 'war' against sepsis—**ANTIBIOTICS** and surgical removal of **SEPSIS**

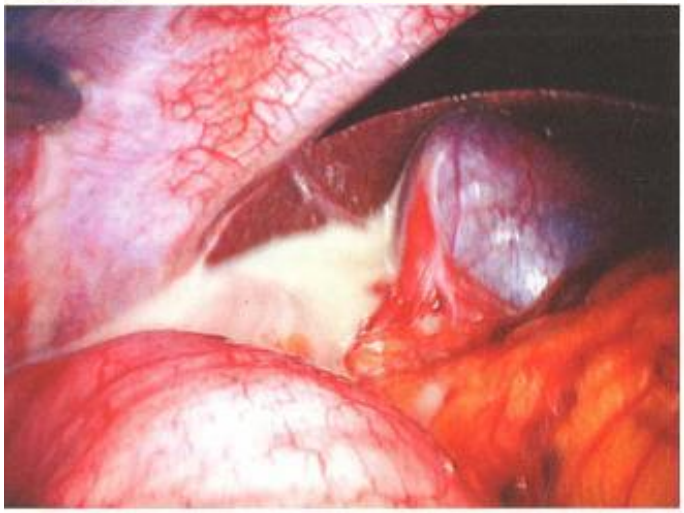
5. Exploratory laparotomy and appropriate surgery is done followed by thorough peritoneal toilet/wash with normal saline.
6. Fluids-IV fluids are given before, during and after surgery. Central venous cannulation and measurement of central venous pressure (CVP) is indicated in unstable patients to guide fluid therapy. If not possible, an emergency cut down (venesection)-cephalic or basilic vein, is done followed by fluid infusion. Preoperatively the aim is to maintain at least 30 ml/hr of urine output.

- Ringer lactate solution is an ideal replacement.

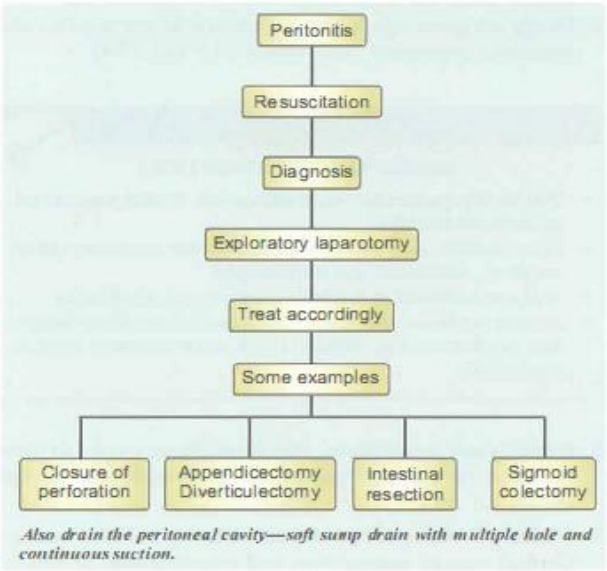
PRINCIPLES OF SURGERY FOR PERITONITIS (Figs 6, 7)

PRINCIPLES OF SURGERY

- Incision
- Establish the diagnosis
- Exploration
- Pus culture and sensitivity
- Treat the cause—control of sepsis
- Peritoneal toilet
- Drain
- Closure



Laparoscopy showing pus



Principles of management of peritonitis—identifying the source of sepsis and elimination is the key to success

(Figs 6, 7)

1. Generous incision is used
2. As soon as the peritoneal cavity is opened, purulent fluid comes out. The fluid is collected and sent or culture and sensitivity. Greenish fluid indicates a hollow viscus perforation. All the fluid is drained, the source of peritonitis is identified and appropriate surgical procedure is done.

Examples are

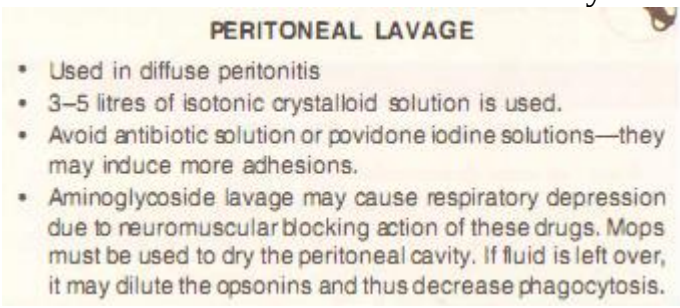
• Appendicectomy for appendicitis.

• Closure of perforated or perforated peptic ulcer.
• Closure or resection for ileal perforation.
• Resection of the bowel for gangrene.

Control of sepsis: This is the most important step of treatment of peritonitis. Removal of septic ocus is a primary aim-examples: Appendicectomy, perforation closures (dudodenal ulcer) or resection (intestinal or colonic perforation) or cholecystostomy in difficult perforated gall bladder diseases. However, all the septic foci in the abdomen have to be removed-necrotic material, pus pockets and food particles. Thorough irrigation with warm saline cleans up subhepatic spaces, pelvic spaces and interloop collections. Primary anastomosis in presence of sepsis may result in leak and postoperative peritonitis. It is better to do colostomy or ileostomy in such cases. Incision can be partially closed leaving the skin open-sutures can be tied
after 2 days in the ward. In a few cases, laparostomy is done if you suspect abdominal compartment syndrome.

3. It is better to use nonabsorbable suture material such as silk to do an intestinal anastomosis or or closure of perforation. In the presence of infection, absorbable sutures such as catgut get absorbed very fast.

4. A thorough peritoneal wash/lavage is given by using warm saline (up to 3-5 litres) to avoid intraperitoneal abscesses. Antiseptic agent such as betadine solution should be avoided because they can cause adhesions.



PERITONEAL LAVAGE

- Used in diffuse peritonitis
- 3–5 litres of isotonic crystalloid solution is used.
- Avoid antibiotic solution or povidone iodine solutions—they may induce more adhesions.
- Aminoglycoside lavage may cause respiratory depression due to neuromuscular blocking action of these drugs. Mops must be used to dry the peritoneal cavity. If fluid is left over, it may dilute the opsonins and thus decrease phagocytosis.

5. Peritoneal cavity is drained to the exterior by using tube drains. These are kept in the subhepatic space and in the pelvic cavity.

6. The wound is irrigated with antiseptic agents.

7. Tension sutures are put depending upon the severity of the peritonitis to prevent burst abdomen.

8. Laparostomy (vide infra): This method of exposing the peritoneal cavity can be done in selected cases, if you suspect abdominal compartment syndrome.

LAPAROSTOMY

This refers to leaving peritoneal cavity exposed to outside without approximation of the anterior abdominal wall. Some situations arise, especially

in emergency cases, where this is required. Hence, it is important to know how to deal with this situation.

Types

1. Open laparostomy: Abdominal fascia and peritoneum are not sutured.

Advantages: Abdominal compartment syndrome can be prevented. Details are given later.

Disadvantages: Significant fluid loss and secondary infection.

2. Closed laparostomy or mesh laparostomy: Here the fascial layer is closed by using marlex mesh or prolene mesh or even a zip to protect exposed viscera.

Advantages: One can minimise infection.

Disadvantages: Abdominal compartment syndrome and perforation of bowel can occur.

Indications of laparostomy

When a second look procedure is contemplated, e.g. acute pancreatitis, mesenteric ischaemia.

Nonoperative treatment

1. Too sick a patient to tolerate the surgical procedure.
2. Sealed perforation
3. Localised peritonitis-may resolve with treatment.

1. One need not close peritoneal layer after laparotomy because:
   - A. The peritoneum can get stuck to the bowel
   - B. Flattened mesothelial cells heal within a few hours
   - C. The peritoneum tears when closure is attempted
   - D. It is very painful postoperatively
2. Peritoneum can be used or dialysis because:
   - A. It is close to kidney
   - B. It is faster than haemodialysis
   - C. Capillaries and lymphatics between two layers of peritoneum help in absorption and exudation
   - D. It covers entire abdomen
3. Which of the following is an example of primary peritonitis?

A. Tuberculous peritonitis
B. Peroration peritonitis
C. Postoperative peritonitis
D. Parturition peritonitis

4. Which of the following organisms are most commonly involved in secondary peritonitis?

A. Enterococci
B. Streptococci
C. Staphylococci
D. Pneumococci

5. The following are the typical features of acute generalized peritonitis except:

A. Abdominal pain
B. Persistent vomiting
C. Bradycardia
D. High-grade fever with chills

6. Abdominal tap is done in peritonitis for all of the following roles except:

A. Aspiration of blood to indicate haemoperitoneum
B. Aspiration of pus indicating infection with gram-negative bacteria
C. Aspiration of bile indicating biliary peritonitis
D. Aspiration of urine indicating ureterocoele

7. The following suture material is best suited for closure of bowel perforation:

A. Silk
C. Nylon
B. Catgut
D. Thread

8. History of discharge per rectum or the first time in a patient who is recovering from peritonitis suggests:

A. Anal prolapse B. Pelvic abscess
C. Proctitis D. Colitis

9. What forms the anterior relationship of Rutherford Morrison's space?

A. Liver B. Kidney
C. Diaphragm D. Duodenum

10. Subphrenic abscess is common on the right side because of the following reasons except:

A. Majority of the diseases affect right side
B. Right lung is larger
C. Left paracolic gutter is narrow and colophrenic ligament is present on the left side
D. Right paracolic gutter is large and colophrenic ligament is absent on the right side

ANSWERS: 1-B 2-C 3-A 4-A 5-C 6-D 7-A 8-B 9-D 10-B

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