

Orenburg State Medical University
Surgery Department

Peritonitis



Signification

Peritonitis - is an acute inflammation of the peritoneum, with a heavy alteration of general symptoms and a systemic functional deficiency.

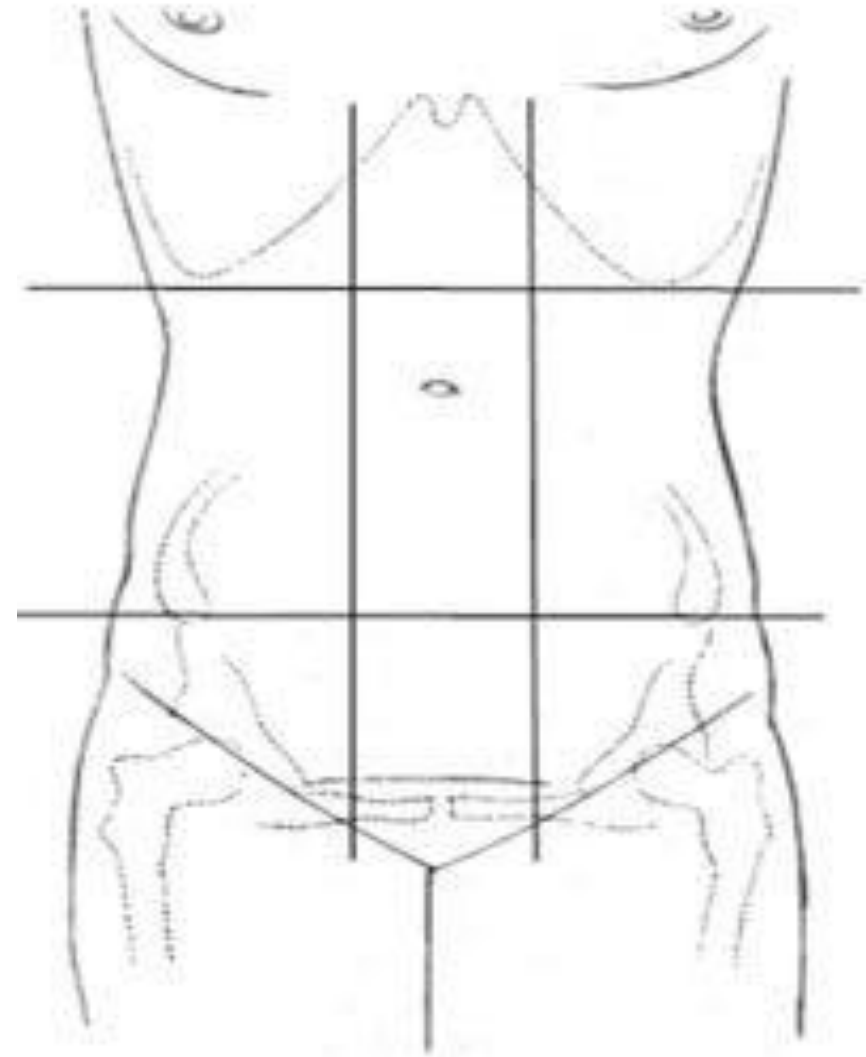
It is an apotheosis of an acute inflammatory condition or a trauma of the organs situated in the abdominal cavity.

Some statistics

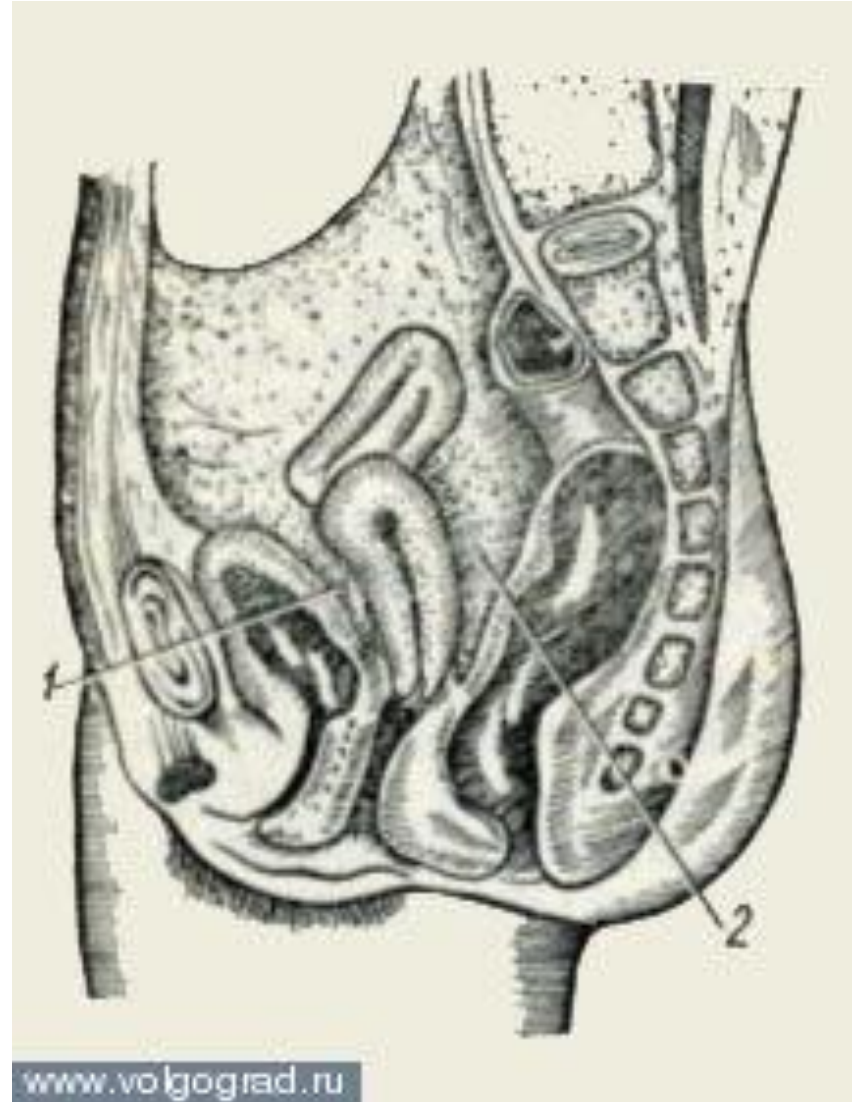
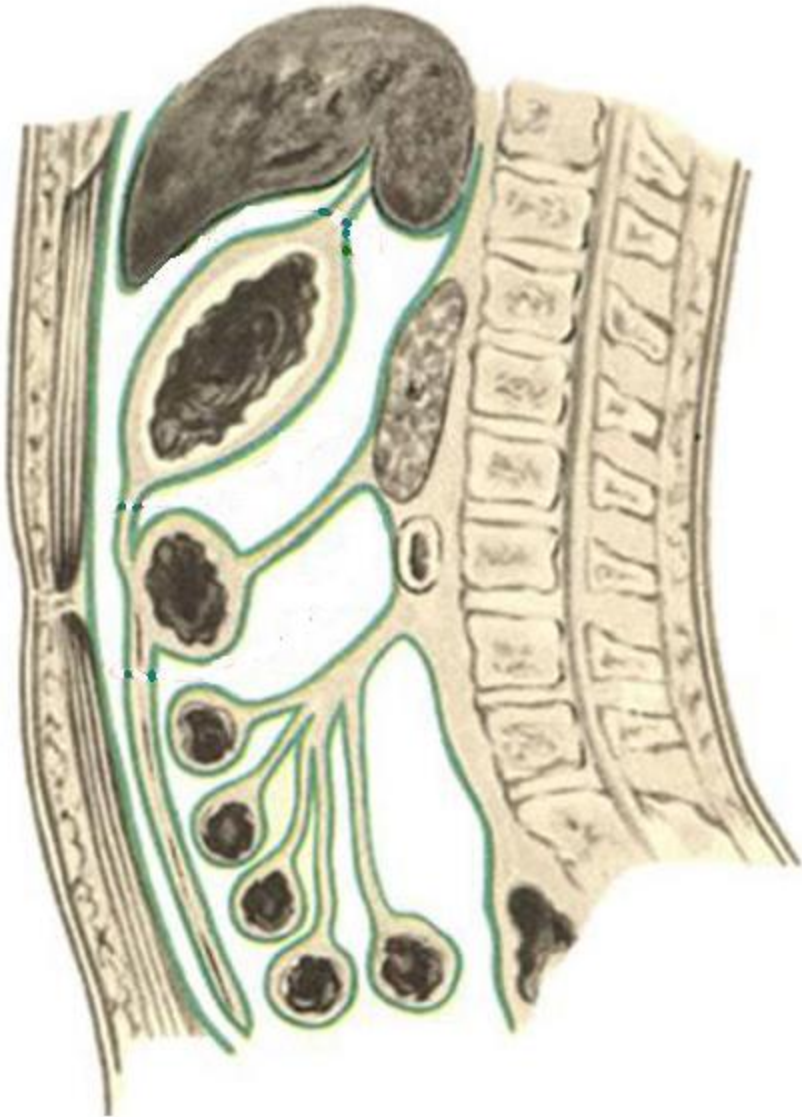
- The mortality rates rise to 20-30%
- During the most severe types of peritonitis (post-surgical cases) the mortality rates come to 40-50%.
- S.I. Spasokukotsky, 1926: « In peritonitis, surgical intervention during the first hours gives 90% of recovery, during the first day - up to 50%, after the third day - only 10% of recovery ».

Anatomical marks

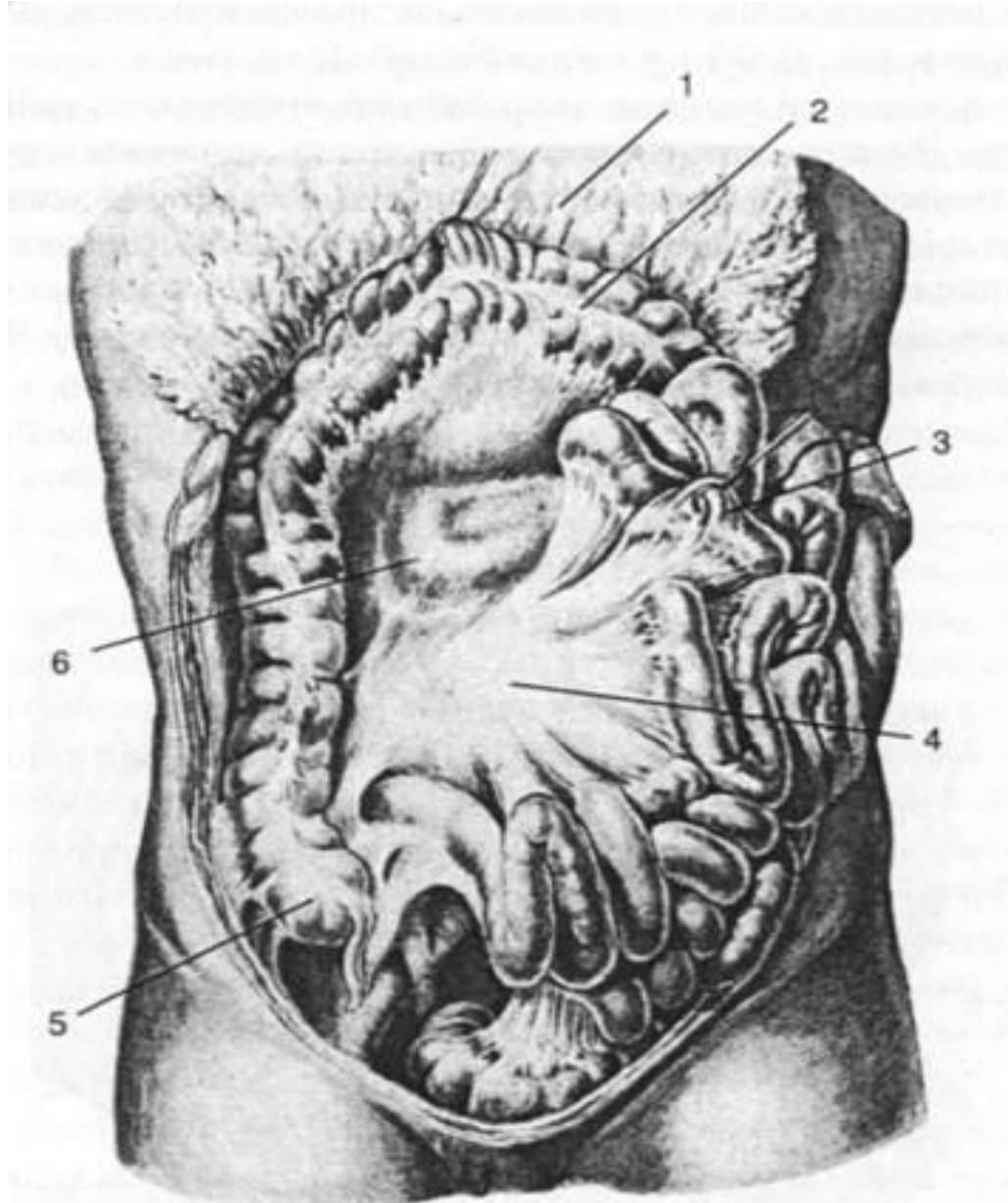
- Abdominal quadrants.
- Peritoneum surface area – 2 m².
- contains normally up to 20 ml of liquid.
- huge receptor zone.
- possibilities of secretion and resorption



Anatomy



Anatomy



SIRS (Consensus conference, Chicago, 1991)

SIRS – Systemic inflammatory response syndrome;

SIRS criteria:

Fever of more than 38°C (100.4°F) or less than 36°C (96.8°F)

Heart rate of more than 90 beats per minute

Respiratory rate of more than 20 breaths per minute or arterial carbon dioxide tension (PaCO₂) of less than 32 mm Hg

Abnormal white blood cell count (>12,000/μL or < 4,000/μL or >10% immature [band] forms)

SEPSIS = Infection + 2 of more SIRS criteria.

SEVERE SEPSIS = Sepsis + Organ Dysfunction, Hypotension, or Hypoperfusion.

SEPTIC SHOCK = Severe sepsis + Hypotension, despite adequate fluid resuscitation.

Abdominal sepsis

is a generalized infection in the abdominal cavity with the SIRS criteria.

Different types of abdominal sepsis:

1. *peritoneal* (generalized peritonitis),
2. *cholangiogenous* (*suppurated cholangitis*),
3. *pancreatogenous* (infected pancreonecrosis),
4. *intestinal* (acute intestinal blockage).

Classification of Peritonitis

(Y.M. Lopukhin, V.S. Saveliev)

1. Based on clinical condition:

- ✦ acute;
- ✦ chronic.

2. Based on etiology:

- ✦ primary (hematogenous or lymphogenous);
- ✦ secondary (trauma and surgical conditions of the abdominal cavity):
 - infectious inflammatory peritonitis;
 - perforative peritonitis;
 - traumatic peritonitis;
 - post-surgical peritonitis
- ✦ tertiary (persistent, sluggish)

Classification of Peritonitis

3. Based on it's limitation and abundance:

- ✦ limited (infiltration or abscess);
- ✦ unlimited — doesn't have any limits:
 - located (less than 3 of 9 abdominal quadrants);
 - generalized (3 and more abdominal quadrants);

4. Based on exudate type:

- ✦ serous;
- ✦ sero-fibrinous
- ✦ fibrinous;
- ✦ fibrino-purulent
- ✦ purulent;
- ✦ fecal;
- ✦ hemorrhagic;
- ✦ chemical

Classification of Peritonitis

5. Based on it's microbiological characteristics:

✦ non specific (intestinal flora):

aerobic Gram - (E. coli, pseudomonas aeruginosa, proteus, klebsiellae, enterobacter);

aerobic Gram + (staphilococci, streptococci);

anaerobic Gram - (bacteroids, fusobacreria, veilonella);

anaerobic Gram + (clostridia, eubacteria, lactobacteria, peptococci, peptostreptococci).

✦ specific (S. gonorrei, hemolytic streptococcus, mycobacteria TB).

Classification of Peritonitis

6. Based on the heaviness of clinical status

Y.M. Lopukhin, V.S. Saveliev Phase:	K.S. Simonian, 1971 Phase:
1. absence of septic criteria	1. Reactive (first 24 hours, 12 hours for the perforative peritonitis)
2. sepsis	2. Toxic (24-72 hours, 12-24 hours for the perforative peritonitis)
3. severe sepsis (polyorganic failure)	3. Terminal (more than 72 hours,
4. septic shock	more than 24 hours for the perforative peritonitis)

Classification of Peritonitis

7. Based on presence and character of complications:

- ✦intraabdominal complications;
- ✦wound infection;
- ✦respiratory tract infection (bronchitis, pneumonia);
- ✦angiogenous infection (bacterial endocarditis);
- ✦urinary infection.

Etiology

- **Primary peritonitis (1 %):**
- takes place without organ destruction
- hematogenous or lymphogenous infection, through uterus tubes.
- spontaneous peritonitis in children , ascitis-peritonitis during liver cirrhosis

Peritonitis' etiology

Secondary peritonitis (95-97%) – microflora's penetration during acute surgical conditions or traumas of abdominal cavity organs.

1. Infectious inflammatory peritonitis – during acute diseases of abdominal cavity organs: (acute appendicitis, acute cholecystitis, acute intestinal blockage, acute pancreatitis, intestinal tumors, diverticulitis, gynecological diseases);

2. Perforative peritonitis – perforation of gastroduodenal ulcers, intestinal ulcers (acute ulcers, abdominal typhus, dysentery, tuberculosis), tumor lyse, intestinal perforation in necrotic region during intestinal blockage, blocked hernia, thromboemboly of mesenteric vessels.

Peritonitis' etiology

3. Traumatic peritonitis - open and closed traumas of abdominal organs with and without their lesion.

4. Post-surgical peritonitis - anastomosis' deficiency, abdominal cavity infection during the surgery, omentum stitches' deficiency with a distal necrosis, mechanical lesion of the peritoneum, hemoperitoneum if deficient hemostasis, not adequate sanitation of the abdominal cavity.

Peritonitis' etiology

Tertiary peritonitis (1-5%) – progressive, slow, persistent, it is the result of defense mechanisms failure, of an anergic response during:

- **immunodepression,**
- **refracting endotoxiosis,**
- **multiple organ failure.**

Pathogenesis

Inflammatory reaction is the front line of organism's defense:

1. Prevention of the inflammation's spread in the abdominal cavity;
2. Defense reaction on a infectious destructive lesion.

Enterol failure – failure of all intestinal functions (propulsive, digestive, barrier) - trigger for the endotoxiosis:

Mechanism: inflammation – oedema – peristaltic inhibition:

- motor and secreto-resorbative dysfunction - liquid sequestration (6-8 L) in the intestins, abdominal cavity, liquid loss during vomiting.
- dilatation of the intestinal anses.
- dysfunction of the mural blood flow, ischemic process, toxins sequestration and pathogenic bacteria multiplication.
- alteration of the barrier function - toxins and bacteria translocation.

Pathogenesis

Toxic pools:

1. Normal metabolism products in high concentrations (lactate, pyruvate, uric acid, urea, creatinine, bilirubin, etc.);
2. Substances created in abnormal concentration during altern metabolic paths (ketons, aldehydes, alcohols, carbonic acids, ammoniac, etc)
3. Products of the cellular and tissular lysis during tissue destruction and/or during alteration of the intestine's barrier function (cationic proteins, myoglobin, indol, phenol...)
4. Active substances created during lipids' oxydation.

Pathogenesis

Pools of toxins:

5. Components and effectors of the regulatory systems of the body in abnormal concentrations:

5.1 activated ferments (lysosomal, proteolytic, system of blood coagulation and fibrinolysis);

5.2 inflammatory mediators, биогенные амины, cytokines, PGs, LT, proteins of the acute phase and the biologically active substances;

6. Bacterial toxins (exo- and endotoxins) and other pathogenic bacterial factors (pathogenic, conditionnaly-pathogenic, not pathogenic);

7. antigens and aggressive immune complexes.

Pathogenesis

Dehydration mechanisms

1. Peritoneal effusion;
2. Liquid sequestration in the intestinal lumen,
3. Vomiting;
4. Absence of hydration (normal daily need 30 ml/kg);
5. Perspiration loss (breathed air, dyspnea):
6. Sweat loss (hyperthermia).

Pathogenesis

Two components: Dehydration and intoxication

Different « waves »

- **First wave** – primary source of the peritonitis and exudate of the abdominal cavity (2 m² of peritoneum);
- **Second wave** – parietic intestine: enteric dysfunction, intraabdominal hypertension syndrome;
- **Third wave** – endotoxemia implementation because of the autocatalytic processes and metabolism's alternations in other organs and systems.

Symptoms

Anorexia 100%;

nausea, vomiting (40-50%) multiple times

The tongue is wet during the first hours, then dry

NB! dry tongue is the sign of dehydration

Stool:

- Can be liquid during the first moments because of the intestinal aggression
- If peritonitis progresses, there is no stool because of the intestinal paralysis
- Diuresis: oliguria because of dehydration

Symptoms

Tachycardia (100%) and **hyperthermia** ($\approx 80\%$) - inflammatory process (SIRS criteria)

NB! Tachycardia is an intoxication sign

NB! normally, during 1 degree Celsius body temperature rise, the heart rate rises for 10 heart beats/min.

Hyperthermia is not a constant sign and can be absent in elderly patients.

NB! if not adequate variation of body temperature and heart rate (tachycardia while normal t)

Symptoms

Peritoneal symptoms

- 1. Voskresensky's symptom** —pain (skin hyperesthesia) above the irritated zone during sliding movements on the abdominal wall.
- 2. Razdolsky's symptom**— pain during anterior abdominal wall percussion.
- 3. Blumberg's symptom** - Pain increasing while removing the hand after abdominal palpation.
- 4. Abdominal guarding** (defense musculaire, muscular protection).

The main sign - sign of all abdominal catastrophes.

At it's maximum - desk-like abdomen.

Can be absent if multipare, obese or elderly patient.

Symptoms

- **Reactive phase (without sepsis)** – prevalence of the localized phenomena;
- **Toxic phase (sepsis)**– inhibition of local signs, loss of biological barriers, generalization of the process, clinical signs of dehydration and intoxication;
- **Terminal phase (severe sepsis, septic shock)** – irrecoverable loss of defense mechanisms.

Reactive phase

- **Acute pain**, local symptoms of the causal lesion;
- Present peritoneal symptoms;
- **Inhibition of the intestinal peristaltic.**

General symptoms :

- **agitation**, changing for confusion;
- **tachycardia**, in parallel to the body temperature rise;
- firstly high arterial pressure, then low arterial pressure ;
- **sub febrile body temperature**;
- reflex vomiting;
- **leucocytosis** with PNN increase

Toxic phase

Local symptoms are less present

Mild abdominal pain, hiding the causal disease;

Present peritoneal symptoms;

intestinal paralysis (paralytic intestinal blockage):

abdominal distention; absence of peristaltic sounds; splashing

sounds.

General reaction of the organism (dehydration and intoxication):

Hypotony, tachycardia;

Febrile hyperthermia;

earthy skin color;

skin turgor's decrease;

Dry tongue, with brown bloom, dry cracked lips;

Vomiting with the stomach's content;

Oliguria.

Terminal phase

Prevalence of the general symptoms

Adynamy;

Confusion

Hippocrate's facies

Earthy skin color, decrease of the skin turgor;

Hypotony,

Tachycardia, before the body t increase;

tachypnea;

Fecaloid vomit

anuria.

Local symptoms are the same as during the toxic phase, their expression is inhibited.

Diagnostic procedures

1. Diagnosis, finding the causal disease.
2. Appreciation of the patient's functional status and his homeostatic alternation (SAPS, SOFA, APACHE II) for the further surgical procedure management.

Secondary post-surgical and tertiary peritonitis have a milder clinical expression, diagnosis is usually made during the intoxication progression.

Laboratory diagnostics

Hemogram and white blood cell formula (white blood) – leucocytosis with PNN increase.

during the peritonitis progress, implementation of the leucocytosis и PNN count

NB! Leucocytosis doesn't have a clinical meaning without other clinical components.

NB! Нормальное или сниженное количество лейкоцитов со сдвигом формулы влево – **вторые токсические ножницы** (у лиц с гипоэргическим иммунным ответом, в т.ч **пожилых**; при токсической и терминальной фазах перитонита)

Always take in consideration the WBC formula!

Hemogram (red blood):

- Hb rises because of the dehydration during the active phase;

During the toxic and terminal phases – progressive anemia – toxic hemolysis, токсический панмиелофтиз.

Laboratory analyses

Appreciation of the hemostasis alternations:

Bilirubin ,

ASAT, ALAT – rise (toxic hepatitis, cytolysis, progressive decrease of the liver function);

Proteins – falls because of the albumine loss (hypercatabolism, decrease of the liver production);

Urea, creatinine – rise (renal failure);

pH – acidosis (anaeroby glycolyse – lactate);

Blood gaz – less O₂

Diagnosis

Algover's shock index = pulse/syst. blood pressure

N= 0,5

index	volume of the lost liquid
0,8 and less	10
0,9—1,2	20
1,3—1,4	30
1,5 and more	40

Diagnosis

Leucocyte intoxication index

(Я.Я.Кальф-Калиф, 1942)

$$\text{ЛИИ} = \frac{(4 \text{ мц.} + 3 \text{ ю.} + 2 \text{ п.} + \text{с.}) \times (\text{пл.кл.} + 1)}{(\text{лимф.} + \text{мон.}) \times (\text{э.} + 1)}$$

0,6-1,6 – норма;

2,7–3,7 – легкая степень интоксикации;

3,6–4,8 – средняя степень;

5,8–8,5 – тяжелая степень;

ЛИИ выше 6,9 – высокая вероятность летального исхода;

ЛИИ 2–3 – интоксикация продуктами аутолиза;

ЛИИ 4–9 – бактериальные токсины.

Шкала Глазго (баллы):

Лейкоцитоз ($\times 10^6/\text{л}$):

Возраст:

Калий (ммоль/л):

ЧСС:

Натрий (ммоль/л):

Артериальное давление:

Бикарбонат (ммоль/л):

Температура тела:

Билирубин (мкмоль/л):

Если на ИВЛ или CPAP - $\text{PaO}_2/\text{FiO}_2$:

Хронические заболевания:

Мочевина (ммоль/л):

Диурез (мл/сутки):

Тип поступления:

Сумма баллов:

Очистить

Instrumental diagnosis

1. Palpation, percussion, auscultation.
2. PR for men or PV for women– «Duglases cry» (effusion).
3. Ultrasound – effective method – liquid in the abdominal cavity

Instrumental diagnosis

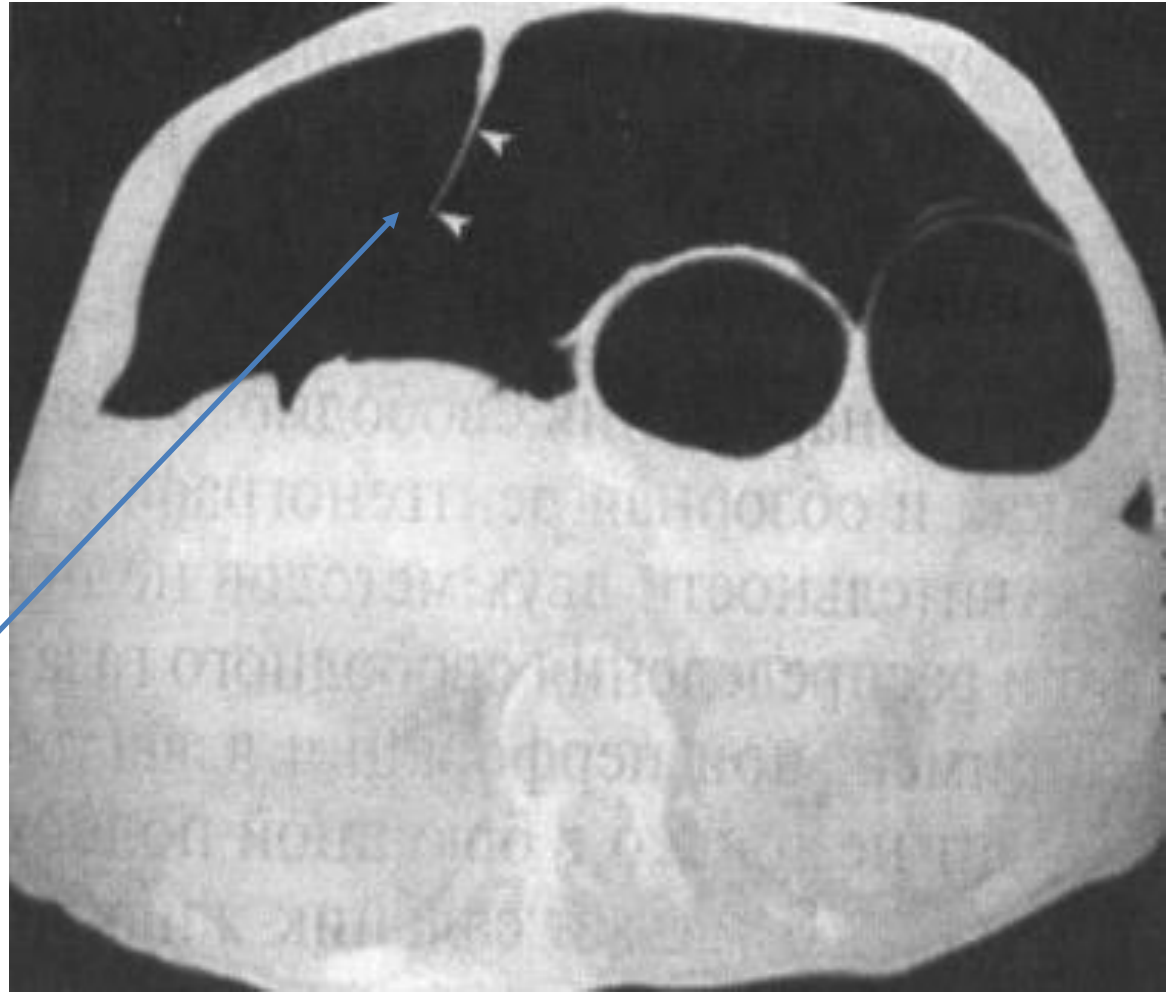


4. X-rays of the abdominal cavity:

- Signs of the intestinal blockage (раздутые петли, чаши Клойбера);
- Free gaz (perforative peritonitis, gaz-producing flora).

Instrumental diagnosis

4.1. **CA-scan** — very good method, not largely used because of it's cost



Instrumental diagnosis

5. **Laparoscopy** –
invasive method for good
visualisation and
therapeutic procedures in
a lot of cases
(laparoscopic surgery of
the inflammation source
with sanation and
drainage of the abdominal
cavity)



Treatment

Peritonitis - absolute indication for an urgent surgical treatment

It includes:

1. Pre-operative treatment,
2. surgical procedure itself,
3. postoperative treatment.

- **Important!** surgical treatment occupies the central role in the complex treatment of the peritonitis

Preparation for the surgical procedure

3 goals

1. Blood volume recuperation;
2. Correction of all the metabolic dysfunctions caused by the intoxication or other diseases;
3. Pre-surgical antibacterial therapy.

During 2 to 3 hours in the Reanimation Department or in the surgical block

Pre-op preparation

1. tube catheters principle:

- nasogastric sond (aspiration of the stomach content for the decompression of the intestins);
- Good venous access for infusion, central venous pressure control;
- Urinary sondage (diuresis control).

2. IV liquids infusion:

- 2-3 L. of cristalloid solutions ;
- during septic shock - colloids (ГЭК, реополиглюкин) and crystalloids under central venous pressure control.

Pre-op preparation

3. Correction of the homeostasis alternations:

- Inotropic support
- respiratory support (moistened O₂).
- central venous pressure control (N 80-120 mm. H₂O.)
- Stop vasopressants and diuretics if insufficient central pressure

4. Diuresis control.

Normal volume– 1 ml/min (60 ml/h, 1,5 L/day).

diuresis increase – sign of central venous pressure recuperation.

Pre-op preparation

5. Adequate antibacterial therapy C2G or C3G IV.

Criteria of the good patient's pre-op preparation:

1. Hemodynamic's recuperation;
2. Normal central venous pressure;
3. diuresis recuperation.

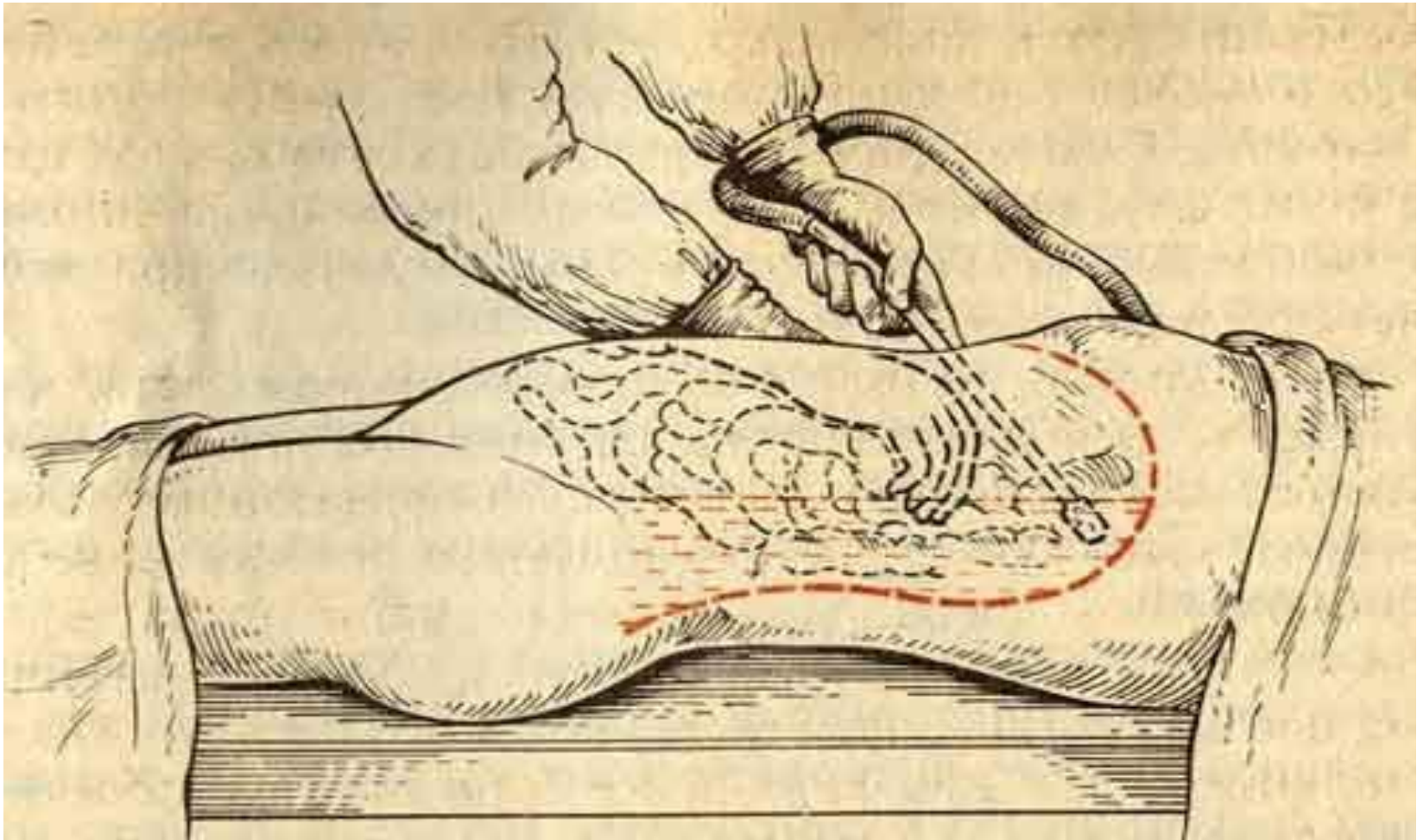
Time factor (surgery's prolongation)

Principles of surgery treatment

1. General anaesthesia
2. Vaste median laparotomy;
3. Full effusion evacuation;
4. Attentive revision of the abdominal cavity;
5. Treatment of the primary cause of peritonitis – appendectomy, cholecystectomy, etc;
6. Attentive sanation of the abdominal cavity (промывание растворами кристаллоидов, антисептиков до чистых вод);
7. Intestinal intubation;
8. Rational drainage of the abdominal cavity.

Principals of surgical treatment

Effusion evacuation and sanation of the abdominal cavity



Video - revision of the abdominal cavity

Principles of surgical treatment

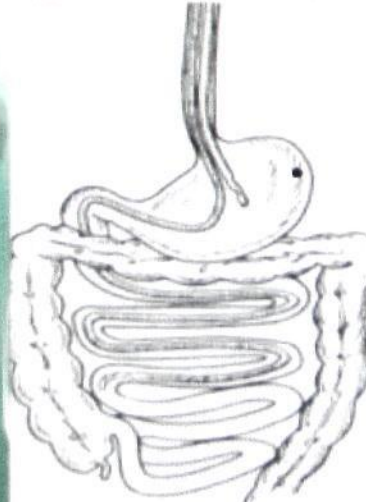
Intestinal intubation if signs of it's paralysis

Goal – to drain the intestin lumen for toxic materia evacuation.

Methods

- 1.Nasogastroenteral tubage;
- 2.Retrograde tubage
 - transanal,
 - through caecostoma.

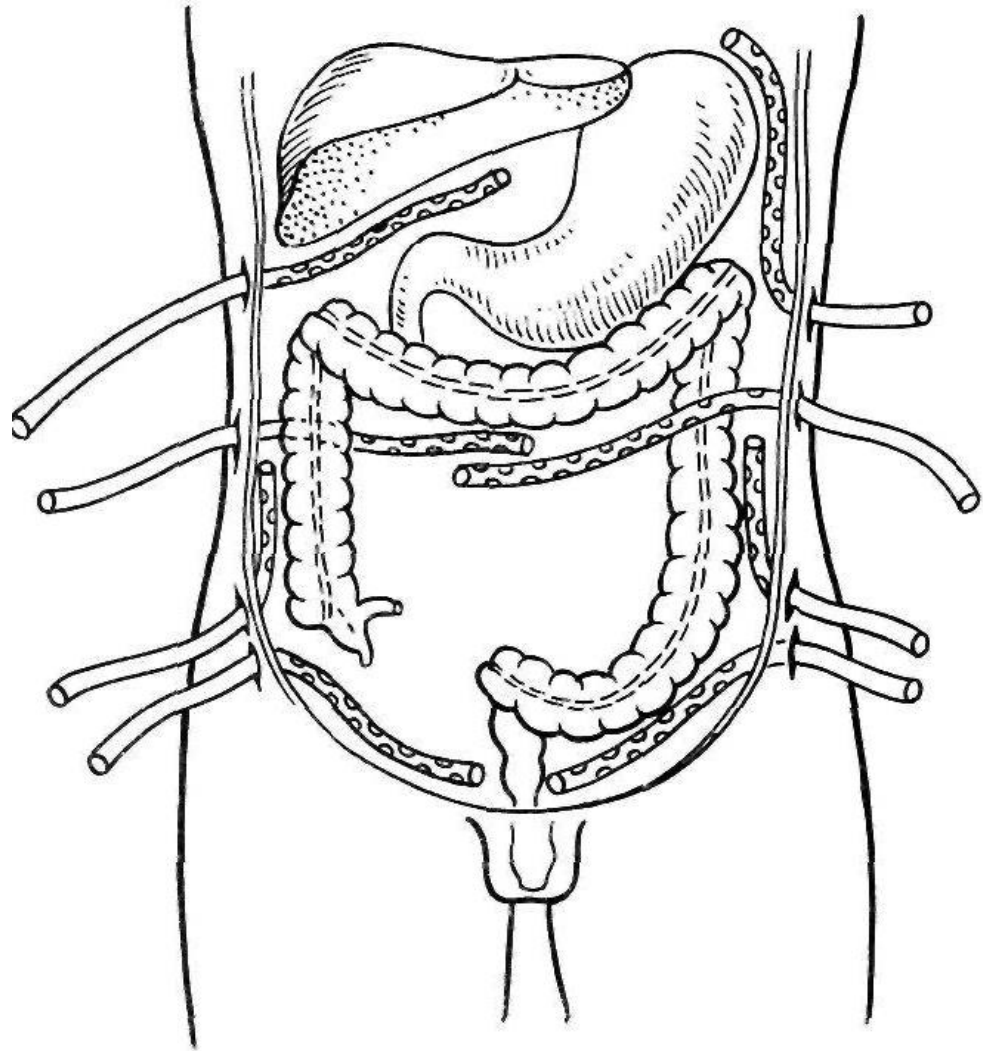
Кишечный зонд Миллера-Эбботта (2-3 м.) Срок 3-4 сут. До восстановления перистальтики



Principles of surgical treatment

Drainage of the
abdominal cavity

No tampons use



Principles of surgical treatment

Methods of median wound closure

1. Tight suturing B if the primary source is totally liquidated , the abdominal cavity is well sanitated and drained.

Video – laparoscopy, sanation

Principles of surgical treatment

2. Step by step closure – temporary closure of the wound for another intervention later.

Source control

Second look

Damage control

Sanation relaparotomy

Laparostomy

Principles of surgical treatment

Indications:

- Septic shock - limitations for the primary intervention;
- The primary source is not totally liquidated (pancreonecrosis);
- Peritonitis (**complicated, fecal**) without possibility for total liquidation or localisation of the primary source (abscesses with fixed fibrino-purulent layers);
- Signs of anaeroby infection of the abdominal cavity;
- Impossibility to close the abdominal defect;
- **Syndrom of intraabdominal hypertension;**
- Recidivating perforations of the полых organs after surgical intervention ;
- Presence of organs in parabiosis (mesenterial thrombosis, wounds).

Methods of the surgical treatment

Method:

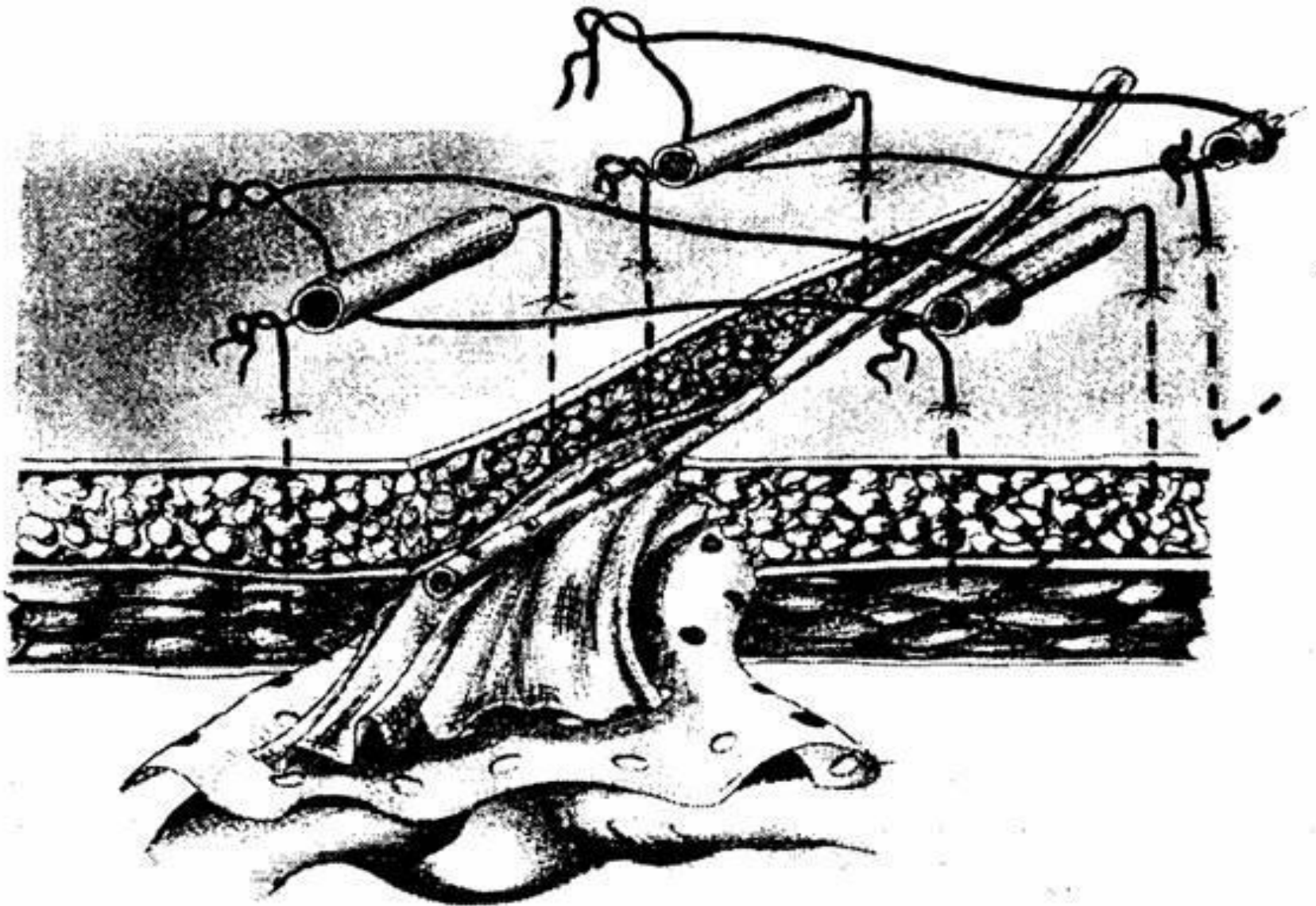
1. only skin layer closure;
2. closure with rare stitches and sticking влажные салфетки;
3. Allomaterial use.
4. Possibility of the total closure with step by step endovideosurgical sanitation

Important: organs should not be in the direct contact with the environment and should be in a wet ???

Laparostomy



Method of the temporary wound closure



Video - laparostomy

ABDOMINAL COMPARTMENT SYNDROME

Причины:

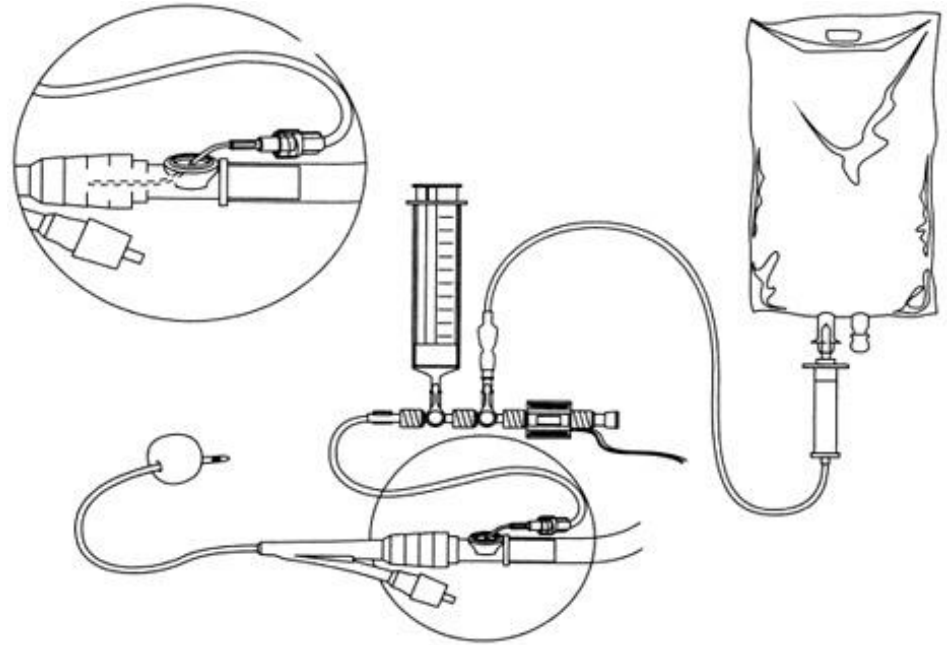
- 1.intestinal paralysis
- 2.infiltrative changes of abdominal organs;
- 3.infiltrative changes in the retroperitoneal space.

consequences:

- 1.microcirculation failure – increase of the enteral failure, hepatic dysfunction;
- 2.lung ventilation and perfusion failure – ARDS;
- 3.venous return disturbed in the inferior cave veine.

ABDOMINAL COMPARTMENT SYNDROME

Diagnosis:



Grade	Pressure (mmHg)	Management
I	10-15	Maintenance of normovolemia
II	16-25	Volume administration
III	26-35	Decompression
IV	>35	Re-exploration

Mainnheim's peritonitis index

Risk factor	Score
Age >50 years	5
Female sex	5
Organ failure*	7
Malignancy	4
Preoperative duration of peritonitis >24 h	4
Origin of sepsis not colonic	4
Diffuse generalized peritonitis	6
Exudates:	
Clear	0
Cloudy, purulent	6
Fecal	12
*Kidney failure: Creatinine level > 177 mmol/L or urea level > 167 mmol/L or oliguria < 20 mL/h; pulmonary insufficiency: PO ₂ < 50 mmHg or PCO ₂ > 50 mmHg; intestinal obstruction/paralysis > 24 h or complete mechanical ileus; shock hypodynamic or hyperdynamic	

MPI	lethality, %
less than 21 points	2,3
21-29 points	22,3
more than 29 points	59,1

Prognostic relaparotomy index

criteria	points
urgent operation	3
respiratory failure	2
renal failure	2
interstinal paralysis 72 hours after the operation	4
pain after 48 hours after operation	5
infectious complications in the operation's region	8
confusion	2
pathological symptoms 96 hours after the operation	6

PRI > 20 point - absolute relaparotomy indication

Post-op treatment

1. **In Reanimation department;**
 2. **Vitals' control** (liver, kidney, blood gaz, ions, diuresis, hemodynamics, leucocytosis, ЛИИ, central venous pressure) **severity scales;**
 3. **Central venous catheter, urinary sondage.**
 4. **Положение Фовлера.**
 5. **Massive infusion-transfusion therapy** with the liquid necessity and loses count (drainages, sonds, perspiration). infusion volume 50 ml/kg. **crystalloids** (0,9% NaCl, Ringer;s solution, polyionic solutions). colloids (ГЭК, реополиглюкин).
- Plasma, Albumine – normal oncotic pressure recuperation, **no parenteral nutrition.**

Post-op treatment

6. Adequate antibacterial therapy:

- Empiric (before documentation) карбапенемы, цефалоспорины III-IV, аминогликозиды, фторхинолоны + метронидазол;
- Documentated – with Sensibility consideration.

7. hyperenergetic alimentation:

- Parenteral (5-10% sol. Glucose, aminoacids, lipid emulsions, combined solutions (нутрифлекс, оликлиномель);
- Enteral – introduction of the nutritive solutions in the sond (нутризон, нутрикомп, стрессон) – after peristaltism recuperation.

8. Immune support (полиоксидоний, ронколейкин, гипериммунная плазма)

Post-op treatment

9. **Recuperation of the intestinal motor function:**

-В/в р КСI 1% 200,0;

-Антихолинестеразные препараты по схемам (прозерин, убретид);

-Гипертоническая клизма.

10. **Detoxication**

- Forced diuresis;

-extracorporeal (плазмаферез, плазмофильтрация, гемосорбция);

-Фотомодификация крови (УФОК, ВЛОК);

11. **Antioxydant therapy;**

12. **Respiratory support** (продленная ИВЛ, кислород);

Post-op treatment

13. **Correction of the organs functions** (СГ, hepatoprotectors, vasopressants, diuretics);
14. **Prophylaxy of the antibio-associated diarrhea** – eubiotics;
15. **Prophylaxy of the antibio-associated fungal infections**– fluconasol;
16. bandaging, intestinal sond care, drainages care.

drainages can be removed on the 2-3 day if no liquid coming from it;

intestinal sond can be removed 3-4 сутки if peristaltic recuperation.