

МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ

**УЧРЕЖДЕНИЕ ОБРАЗОВАНИЯ
«ГОМЕЛЬСКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ»**

**Кафедра хирургических болезней № 1
с курсом сердечно-сосудистой хирургии**

АБДОМИНАЛЬНАЯ ТРАВМА

**Учебно-методическое пособие для студентов 5 и 6 курсов
факультета по подготовке специалистов
для зарубежных стран медицинских вузов**

ABDOMINAL TRAUMA

**Teaching workbook for 5th and 6th year students
of the Faculty of preparation of experts for foreign countries
of medical higher educational institutions**

**Гомель
ГомГМУ
2015**

УДК 617.5–001=111

ББК 54.5 (2англ)

А 13

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Абдоминальная травма: учеб.-метод. пособие для студентов 5 и 6 курсов
А 13 факультета по подготовке специалистов для зарубежных стран меди-
цинских вузов / А. А. Призенцов [и др.] = Abdominal trauma: teaching
workbook for 5th and 6th year students of the Faculty of preparation of ex-
perts for foreign countries of medical higher educational institutions. —
Гомель: ГомГМУ, 2015. — 20 с.

ISBN 978-985-506-705-5

Учебно-методическое пособие содержит учебный материал по теме «Абдо-
минальная травма». Соответствует учебному плану и программе по хирургиче-
ским болезням для студентов высших медицинских учебных заведений Мини-
стерства здравоохранения Республики Беларусь.

Предназначено для студентов 5 и 6 курсов факультета по подготовке специа-
листов для зарубежных стран медицинских вузов.

Утверждено и рекомендовано к изданию научно-методическим советом уч-
реждения образования «Гомельский государственный медицинский университет»
29 декабря 2014 г., протокол № 8.

УДК 617.5–001=111

ББК 54.5 (2англ)

ISBN 978-985-506-705-5

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«Гомельский государственный
медицинский университет», 2015

CONTENTS

General description of abdominal trauma	4
Clinical features	5
Methods of diagnosis	6
Surgical tactics and principles of operative treatment	8
Abdominal wall trauma	9
Liver trauma	10
Spleen trauma	11
Pancreas trauma	11
Gastric trauma	12
Duodenal trauma	13
Trauma of the small intestine	14
Trauma of the colon	14
Trauma of the abdominal and retroperitoneal vessels	15
Kidney trauma	16
Bladder trauma	16
Postoperative complications	17
References	19

GENERAL DESCRIPTION OF ABDOMINAL TRAUMA

Abdominal trauma has a wide variety of injuries and that's why, the following terminology is adopted.

Isolated trauma — if the patient has no other injuries except abdominal trauma. Mortality is 5–20 %. Distinguish single and multiple traumas (multiple stab wounds).

Concomitant trauma — the presence of other injuries with abdominal trauma. The most frequent combination is cranio-cerebral trauma and abdominal trauma, rarely abdominal trauma and musculoskeletal injury, abdominal trauma and chest injury. Mortality reaches 50–90 %. The most severe injury is the chest and abdomen.

Thoracoabdominal trauma. There is always damage to the diaphragm. Thoracoabdominal injuries should be distinguished, simultaneous, from injuries of the chest and abdomen, without involvement of the diaphragm.

Combined trauma. In addition to abdominal trauma, injury from another factor (thermal, chemical, radiation, etc.).

Open injuries are applied by cold weapons and firearms. The percentage of open injuries is between 20 and 45 % of all abdominal injuries.

Wounds are divided into contused, stabbed, incised, chopped and lacerated.

Contused wounds arise from a strong blow blunt object.

Stab wounds are characterized by small size of skin lesions with considerable depth of the wound canal.

Incised wounds have a greater length and a linear direction. Edges of wounds are often smooth.

Chopped wounds are characterized by a large array of destroyed tissue.

Lacerated wounds are the most traumatic and often the most infected.

Gunshot or bullet wounds may coincide with through, blind and tangents. Characterized by severity, multiplicity and extensiveness of injury to tissues and organs.

In gunshot wounds lesion volume increases towards the outlet and in fragmented wounds greatest extent of the damage observed the inlet side.

Depending on the presence of peritoneal injury, traumas are divided into penetrating (into the abdominal cavity) and non-penetrating injuries.

Penetrating is divided into, without internal injuries and injuries to internal organs.

Also divided injury of hollow organs, parenchymal organs and blood vessels.

Blunt abdominal trauma — no wound on the abdominal wall. In this case the skin may have abrasions and bruising. Blunt injury arises from a blow on the abdomen with a blunt object, compression of the abdomen, falling from a height. Blunt injury is divided into abdominal wall (muscle injury, hematoma), abdominal organs (hollow, parenchymal) and retroperitoneal space.

Injuries of hollow organs divide into bruises, tears, ruptures and crushing.

Injuries of parenchymal organs could be without damaging the integrity of the capsule (subcapsular and central haematoma) and with the damage of its integrity (tear, rupture, detachments of the organ and crush). Subcapsular haematoma can cause the “double-moment” rupture of the organ. Sometimes serious injury leads to detachment of organ from its pedicle and ligaments. Due to injury to the pelvic bones and spine occurs retroperitoneal haematoma.

Single and multiple injuries of abdominal organs are also described.

If the organ has a single wound, injury is called monofocal, if more than one, polyfocal. Terminology “polyfocal” trauma is equivalent to multiple injuries.

CLINICAL FEATURES

Each patient should be carefully asked about the complaints, history and clarification of the circumstances and mechanism of injury. Blood test for alcohol detection is necessary. Police must be informed about the trauma.

The main symptom is abdominal pain. The pain may be of different localization, intensity and irradiation. Most likely pain corresponds to the location of injury, but in some cases, there is less pain at the site of injury, but in the area of irradiation can be severe.

At liver injury pain radiates to the right shoulder, spleen — in the left shoulder, pancreas injury — in the lumbar region, both supraclavicular region and left shoulder.

In injuries and ruptures of the stomach and duodenum pain is "sharp knife-like" typical for perforated ulcer. In injuries and ruptures of the small intestine pain can be of different localization and intensity. Colon injuries (intra peritoneal parts) — usually sharp pain. Injury of the retroperitoneal parts of the colon is characterized by a dull persistent pain.

Vomiting soon after the injury is reflexive in character further becomes stagnant in the development of peritonitis. In stomach injuries vomit with blood may be present. Constipation often occurs in peritonitis, but may be due to paralytic ileus with retroperitoneal hematoma. Discharge of blood from the rectum may indicate its injury.

Highly characteristic of complaints related to blood loss: severe weakness, collapse, dizziness, cold sweat, blurred vision.

Dysuric disorders, hematuria speaks about the injury of the urinary tract. It should be remembered that the anuria may be associated with a fall in blood pressure below 90 mm Hg.

Position of the patient is usually forced. Most often the victim lies on his back or side with bended legs to the stomach. In intraperitoneal bleeding Roza-nov's sign can be observed, when the patient tends to take a sitting position. For bleeding into the abdominal cavity characteristic features are pallor of the skin and mucous membranes, cold clammy sweat, weak filling rapid pulse, lower blood pressure, rapid shallow breathing.

On examination of the abdomen pay attention to the anterior abdominal wall, its participation in the act of breathing, the presence of symmetric and local distention. All scratches, bruises, wounds must be carefully noted. Description of wounds should be in the following order (describe each wound separately): localization of wound towards anatomical landmarks, its size, shape, length, direction, nature of the edges and skin around the wound, the presence of bleeding, etc.

Tension of abdominal muscles suggests damage to internal organs. It must be remembered that sometimes muscle tension can be present in the abdominal wall injury, fractures of the lower ribs, cranio-cerebral injury. At the same time, muscle tension may be absent in accumulation of exudate in the pelvis, as pelvic peritoneum has no somatic innervation.

With the development of peritonitis, peritoneal signs are revealed: Blumberg, Voskresensky, Razdolsky. Pseudoperitonitis is observed in intraperitoneal bleeding (symptom Kulen-kampf: peritoneal symptoms in the absence of tension).

Percussion in injury of hollow organ may reveals disappearing of hepatic dullness (Spizharn's symptom), in the presence of liquid — blunting of percussion sound in different parts of the abdomen.

Auscultation in peritonitis or paralytic ileus reveals absence of bowel sounds.

Digital rectal examination is compulsory. It reveals overhang and sharp pain of pelvic peritoneal, defects of the rectal wall, presence of bone fragments in fractures of the pelvis and presence of pathological admixtures.

METHODS OF DIAGNOSIS

Analysis of blood is the most important indicator with a decrease level of erythrocytes, hemoglobin and hematocrit in blood loss, and leukocytosis in the inflammatory process. It must be remembered that all shifts are only a few hours after injury. Even in severe blood loss in the early hours can be normal level of red blood cells. In analysis of urine, hematuria is observed in kidney injury; in pancreas injury amylasuria is present. Biochemical analysis of blood in the abdominal injury is non-specific.

The simplest instrumental methods of diagnosis are gastric tube and bladder catheterization.

At ultrasound can reveal the presence of free fluid in the abdominal cavity, the damage of parenchymal organs (spleen, liver, kidney and pancreas), retroperitoneal hematoma. In some cases, free gas can be revealed.

Fibrogastroduodenoscopy shows the injury of stomach and duodenum. Inabilities to inflate the stomach or severe abdominal pain during endoscopy are signs of perforation. For clarification of diagnosis after endoscopy, a plain abdominal radiography for detecting free gas in the abdominal cavity should be done.

Plain abdomen radiography reveals free gas under the diaphragm, presence of pleural effusion, movements of the diaphragm, the presence of fluid in the abdomen (if an amount is greater than 500–700 ml). In case of injury of retroperitoneal parts of

the intestine, small bubbles of gas are visualized in the retroperitoneal fat.

To verify the perforation of the stomach and duodenum contrast study methods are performed (using only water-soluble contrast) and show leaking of contrast into the free peritoneal cavity or retroperitoneal space.

In suspected rupture of the bladder and urethra, cystography and urethrography should be performed. Water-soluble contrast is used. Radiographs should be done in 3 projections: straight, oblique, and after emptying the bladder, again in straight projection. Diagnosis is based on the contrast agent flowing into the abdominal cavity or paravesical tissue.

In suspected injury to the kidney or ureter excretory urography should be performed, 60–80 ml intravenous Urografin and after 7 minutes X-ray of the abdomen. When blood pressure is below 90/60 mm Hg, an excretory urography is not informative.

In suspected penetrating wound investigation of wound canal should be done. Under local anesthesia around the wound purse string suture is applied, which is tied around the catheter, a water-soluble contrast is inserted through the catheter, than plain abdomen radiography in the two positions. A penetrating wound shows flow of the contrast into the abdominal cavity.

In major hospitals to diagnose the trauma of parenchymal organs emergency angiography may be performed. Angiography is the most informative investigation in kidney injuries and may also be performed intraoperative, with the help of which, source of bleeding can be diagnosed in retroperitoneal hematoma.

Invasive methods of instrumental diagnosis include laparocentesis, laparoscopy and diagnostic laparotomy.

Laparocentesis is performed when it is impossible to exclude injury to internal organs due to unclear clinical picture, especially when combined craniocerebral injury and patient under high influence of alcohol.

Laparocentesis and Method «groping catheter» is performed as follows: Under local anesthesia, below the umbilicus in the midline a transverse incision (0,5–1 cm) is made, upper edge of wound's skin is stitched with thick synthetic suture or hold with instrument that allows to lift aponeurosis. Further by trocar with rotational movements abdominal wall is punctured in the upward and to the left direction. Stylet is removed and out flow of blood, bile or intestinal contents indicates the injury of internal organs. If no discharge from abdominal cavity, entre a catheter through the trocar. The catheter is inserted towards the liver, spleen, left and right side of the abdominal cavity, in the pelvis. If nothing is obtained by this manipulation then peritoneal lavage should be done by inserting 1 liter of isotonic solution into the abdominal cavity and then evacuating and visual evaluation. For dynamic monitoring catheter can be left in the abdominal cavity and 4–6 hourly repeated lavage.

Diagnostic value of laparoscopy is 95–99 %, but its implementation is not always possible, especially in respiratory failure and hemodynamic instability. The technique is as follows. Above the umbilicus, or the same as in laparocentesis, using a Veress needle, pneumoperitoneum is imposed (pressure 10–12 mm Hg.) and

troacar D10 is introduced. After removing the stylet laparoscope is inserted. Detailed inspection of organs is achieved by changing the position of the patient on the operating table and, if necessary, additional manipulator can be introduced through a troacar D5 in one of the iliac region.

Diagnostic (explorative) laparotomy is the most informative, but also the most traumatic method of diagnosis, so should be used only when no other method of diagnosis is possible.

SURGICAL TACTICS AND PRINCIPLES OF OPERATIVE TREATMENT

At prehospital stage in abdominal trauma wounds should be covered with aseptic dressing. Fluid intake by mouth is prohibited. At open trauma, analgesics can be given, where as in blunt trauma painkillers are contraindicated. Patients with trauma required emergency hospitalization. In critical general condition at the trauma site venous access must be provided and anti-shock therapy should be started.

Principles of medical triage in abdominal trauma:

1. Victims with the clinical picture of severe internal or external bleeding are delivered immediately to the operating room, bypassing the emergency department. Antishock therapy is carried out simultaneously with surgery.

2. Victims with open trauma, after administration of tetanus toxoid, directed to operation theatre.

3. Patients with blunt abdominal trauma and clinical picture of internal organs injury are directed to operation theatre.

4. Victims in a state of traumatic shock are admitted in the emergency department for antishock therapy and diagnosis. At revealing of internal organs injuries patient is transferred to the operating room.

5. Victims in a serious condition with clinical peritonitis are delivered to the emergency department for preoperative preparation for 2 hours, then transferred to the operating room.

6. Patients with abdominal trauma, mild to moderate severity, whom emergency surgery is not shown, are directed to the surgical ward for medical treatment and dynamic observation.

7. Victims, who do not need hospital treatment and observation, are directed to ambulatory treatment.

Victim with any injury to the abdominal wall, except pointed wounds with no signs of penetration, should be operated. Primary surgical treatment is carried out under local anesthesia with 0,25 % solution of Novocain. Novocaine is administered along the periphery of wound. Through the wound administration of anesthetic is not recommended due to possible infection. Wound edges and non-viable tissue are excised, the wound is cleaned of foreign bodies and blood clots, blood vessels ligated, trace the track of the wound in the tissues of the abdomin-

al wall to exclude or confirm penetration.

If nonpenetrating wound is detected, wound is sutured in layers with drainage.

At revealing of defect of any size in the parietal peritoneum, laparotomy is performed under general anesthesia.

Standard steps of surgical intervention:

1. Access. Perform a large mid line median laparotomy. If it is difficult for inspection or injury is found in the upper or lower abdomen, access expands up to the xiphoid process or down to the pubic symphysis.

2. Stop the bleeding. The source of bleeding is determined after eventration of the intestinal loops by finding blood clots. First stop the bleeding by pressing a finger or clamping the vascular pedicle, and then ligate the vessel. On the large vessels impose vascular suture.

3. Reinfusion of blood, carried out at recent trauma in the absence of hollow organs injury and hemolysis. Blood is collected in a jar with a 4 % solution of sodium citrate (30 ml per 1 liter of blood) through 4–8 layers of sterile gauze and infuses into a vein of the patient. Before transfusion, hemolysis test should be performed: 5 ml blood is centrifuged for 10 minutes (in hemolysis appears bright pink coloration).

4. Inspection of the abdominal cavity is carried out after removing the blood and pathological exudate from abdominal cavity. Inspection starts with the stomach. A detailed inspection of small intestine from Treitz ligament to the ileocecal junction should be performed. At suspected injury to the duodenum, it can be mobilized by Kocher's method. Next, inspect the colon, rectum and bladder. If injury of retroperitoneal part of colon is suspected, dissect the peritoneum on the lateral edge of the colon to mobilize it. Next, inspect and palpate parenchymal organs and retroperitoneal space.

5. Features of the surgical intervention in organs injury are discussed below.

6. Remediation of the abdominal cavity is carried out with warm isotonic sodium chloride solution. At once up to 1 liter of solution is poured and organs are washed, the liquid is removed with suction. Manipulation is repeated up to 3–4 times.

7. Abdominal drainage. All drains are inserted through separate incisions in the abdominal wall. In organ injury, a drain is put to the site of injury and second — in the pelvis. In diffuse peritonitis, additional drains are inserted in the subdiaphragmatic, subhepatic and in the right flank.

8. Laparotomic wound suturing is done layers by layer. Peritoneum is sutured with catgut in case of diffuse bleeding from the edges. Aponeurosis, subcutaneous tissue and skin are sutured with non-absorbable material. In excessive subcutaneous tissue, vacuum drainage by Redon is indicated.

ABDOMINAL WALL TRAUMA

It can be divided into open and blunt abdominal wall trauma. Types of wounds were discussed above. Blunt traumas are up to 25 % and occur more

frequently by the direct impact and sudden strong contraction of the abdominal muscles, as well as when lifting heavy weights. There are contusions, hematomas, tears and ruptures of the muscle. Hematoma may be subcutaneous, intramuscular, and preperitoneal. At the tear of rectus muscles, a hematoma of upper and middle third of the processus vaginalis is observed, bounded by two tendinous intersections. In the lower third hematoma often gets the form of a sufficiently large infiltration. Clinically injury of abdominal wall is accompanied by severe pain and strain of muscles (usually local). The patient lies on their back or side with legs bent at the knee and hip joints. Abdominal wall may stop participating in the act of breathing. Sometimes there are doubtful peritoneal signs, especially in the case of preperitoneal hematoma. A few hours after injury pain get reduced, but with a change in body position again becomes severe. In the case of extensive muscle ruptures may occur “traumatic hernia”. In this case under the skin intestinal loops are palpated. Thus, in abdominal wall injuries frequently observed symptoms of internal organs injuries, which is extremely difficult to diagnose and often leads to futile laparotomy. Small hematomas are treated conservatively. Extensive hematomas are incised and drained. In the case of post-traumatic hernia operation is carried out in a planned manner after subsiding of acute symptoms.

LIVER TRAUMA

Liver injuries are observed in 20–25 % of patients with abdominal trauma. Blunt liver trauma arises from a direct impact, counter impact (ribs and spine) and compression.

Divided into:

1. Blunt injuries.

A. By type of damage: subcapsular hematoma, central hematoma, rupture of liver with capsule damage; injury to the extrahepatic bile ducts and vessels.

B. By time: Single moment and double moment injury.

C. According to the degree of damage: surface rupture up to 2 cm, depth of discontinuity from 2 cm to half of the organ, discontinuity deeper than half of the thickness of organ, through ruptures, crush injury or fragmentation of the liver.

D. By localization of damage (lobe, segment).

E. By the nature of the damage of intrahepatic bile ducts and vessels.

2. Open trauma (superficial, deep; through, non-through, lobe, segment).

3. Combination of open and blunt trauma.

Bleeding from minor wounds is stopped with electro-coagulation. In significant bleeding, for temporary hemostasis, hepatoduodenal ligament must be squeezed with fingers. Maximum compression time is 15–20 min. Removing debris and non-viable tissue, visible blood vessels and bile ducts are ligated. Nonviable tissues are subject to mandatory resection as absorbable decomposition products lead to massive intoxication. It is believed that 15 % necrosis of the liver parenchyma and more leads to death. Linear wounds are sutured with

thick catgut on circular needle, grasping in suture at least 1 cm of healthy tissue. In case of suture eruption, sutures are tied on protector (omentum, round ligament, polypropylene mesh). In major defects, tamponade with omentum is used. In the case of multiple small lesions on the diaphragmatic surface of the right lobe of the liver, hepatophrenopexia can be performed (liver fixed in depth of hypochondrium with several catgut sutures to the parietal peritoneum and the diaphragm). In extensive liver damage resection (typical and atypical) is indicated. If hemostasis is not possible, apply tamponing. Small wounds of gallbladder are sutured. Large wounds, as well as the presence of calculi, are an indication for cholecystectomy. In bile ducts injury, wounds are sutured with atraumatic needle and external drainage of the common bile duct. In liver injuries subhepatic and right subphrenic space must be drained.

The lowest mortality (10 %) is observed in stab wounds of the liver. Whereas blunt trauma reaches 30–45 %, which is usually related to severity of injury, massive blood loss and difficulties in diagnosis.

SPLEEN TRAUMA

Spleen injury occurs in 20–25 % of patients with abdominal trauma. Arises from a direct blow, compression, sudden organ displacement. Spleen injury is also possible from rib fragments.

Divided into:

A. Blunt trauma.

1. By time: Single moment and double moment injury.

2. By the nature of injury:

a) discontinuities — Single, multiple; superficial, deep; with or without damage to the capsule;

b) crush injury;

c) detachment of the part of organ, entire organ.

3. By localization: in the centre or periphery.

4. On clinic features of blood loss: mild, moderate and severe.

B. Open trauma.

More often happens a momentary rupture of the spleen (85 %). Double-moment rupture (rupture of subcapsular hematoma) usually occurs on day 3–7.

Minor wounds of spleen are coagulated. Suturing of the spleen in most cases leads to increased bleeding. At ruptures and crush splenectomy is the choice of treatment and the left subphrenic space must be drained.

Mortality in spleen injuries is 15–25 %.

PANCREAS TRAUMA

Injuries to the pancreas occur in 1–4 %. The most common cause is a motor vehicle accident (hitting the steering wheel). Almost always pancreatic trauma

combined with damage to the liver, spleen, and duodenum.

Divides:

A. Blunt trauma.

1. Contusion (hematoma of the gland tissue without damaging the capsule).

2. Partial tear, capsule tear.

3. Complete rupture with pancreatic duct injury, detachment of the gland or its part.

B. Open trauma.

Considering the localization: Head, body and tail. Head injury is considered as a severe trauma.

Superficial wounds of the gland are sutured with atraumatic needle. At crush injury of the body and tail, left-sided resection of the pancreas is indicated. At severe head trauma, decompression of the biliary tract (cholecystostomy) is choice of treatment. Pancreatoduodenal resection is not performed; because of worsen prognosis and mortality increase. In all cases of pancreas injury, omental bursa and abdominal cavity are drained; at major trauma marsupialization of omental bursa is performed. Postoperative management is no different from that in acute destructive pancreatitis.

Mortality in open injuries of the pancreas is about 25 %, in blunt trauma 50–65 %. Combined injury of pancreas and duodenum results in 60–80 % of death.

GASTRIC TRAUMA

Blunt trauma occurs by a hit in the epigastric region and falling from height. Open gastric traumas are more common at thoracoabdominal injuries. The frequency of gastric trauma is 2–3 %. Divides:

A. Blunt trauma.

1. Bruising (hematoma of the stomach wall).

2. Discontinuities (often suffers front wall).

3. Crushing of the stomach wall (often suffers rear wall).

4. Complete detachment of the stomach (gastric detachment from the esophagus, stomach from the duodenum).

B. Open injuries (front, rear wall, through).

Cut wounds of stomach are sutured in double row. If the front wall of the stomach is injured, gastro — colic ligament is cut and rear wall of the stomach, pancreas and duodenum is inspected. Nonviable tissues are excised, vessels of the sub-mucosal layer are ligated and then double-row suture is imposed. At gastric ruptures, wound edges are economically excised and sutured on the same principles. In rare cases, in extensive crush injury gastrectomy is shown.

Mortality in open injuries of stomach and closed trauma without tearing of the wall does not exceed 0,5–3 %. In closed tears reaches 10–40 %, depending

on the stage of peritonitis.

DUODENAL TRAUMA

The frequency of duodenal trauma is 1 to 5 %. Often duodenal injury is combined with injury of adjacent organs: head of the pancreas, superior mesenteric artery, inferior vena cava, right kidney. Divides:

A. Blunt trauma.

By localization:

1. Intraperitoneal injury (upper horizontal part).
2. Retroperitoneal (Extraperitoneal) injury (descending and the lower horizontal part).

By the nature of injury:

1. Hematoma (without impaired patency, with impaired patency of the intestine).
2. Incomplete rupture of the wall (tear).
3. Complete rupture of the wall.
4. Complete enterorrhexis.
5. Detachment from the stomach.
6. Injury to the duodenum combined with other organs injury.

B. Open injuries (intraperitoneal, retroperitoneal, anterior wall, posterior wall, through).

Retroperitoneal parts of duodenum are least mobile, so often injured.

In case of intraperitoneal intestine injury double-row sutured are applied. Zone of injury is drained; naso-duodenal intubation is performed. In case of impossibility of suturing, stump suturing resection of duodenum is performed, gastro-jejunostomy on a short or Roux loop.

Injury of retroperitoneal parts of the duodenum rapidly leads to retroperitoneal phlegmon and after 8–16 hours, there are signs of peritonitis. At laparotomy, signs of retroperitoneal duodenal injury are yellowish exudates, retroperitoneal hematoma, retroperitoneal emphysema, gelatinous edema and yellow - green staining of tissues in the intestine region. Kocher's maneuver is performed to mobilize the duodenum. Double-row sutured is applied on wounds of intestine. Naso-duodenal intubation is performed. Retroperitoneum is drained through lumbotomy. Suture zone can be shrouded strand of omentum. If required, nutritional jejunostomy by Maidl can be performed. In severe injury, duodenum must be disabled. Intestine is cut from the stomach, both stumps and wound of intestine is sutured and stomach with the jejunum is anastomosed by Roux. If the defect of intestine is not possible to stitch, duodenostomy is performed with fixing the tube into the duodenum and cholecystostomy. At this, damage zone is wrapped with the greater omentum and carefully isolated from the abdominal cavity by gauzes. Tampons and duodenostomic tube is placed out via counter puncture in the right upper quadrant. Be sure to drain the retroperitoneal fat through lumbotomy.

Mortality in duodenal injury reaches 50–80 %.

TRAUMA OF THE SMALL INTESTINE

In abdominal trauma, small intestine is often injured (30–38 %). As in gastric trauma, injury also occurs because of hydrodynamic shock. Open injuries are usually multiple, closed — single. Ileum injures more often than jejunum. Multiple small intestine injury occurs in 10 % of cases. Adhesions also contribute in trauma.

Divides into:

A. Blunt trauma.

1. Contusion (bruise) of the intestinal wall. Hematoma often localized in the submucosal layer.

2. Detachment of intestinal part from its mesentery (with or without necrosis).

3. Incomplete rupture of the intestinal wall (tear).

4. Complete rupture of the intestinal wall.

5. Full enterorrhesis.

6. Crush injury.

B. Open injuries (single, multiple, injury of one side of the wall, through, with and without damage to the mesentery).

Small injuries of serous layer are immersed with sero-muscular sutures in the transverse direction. Small localize subserous hematomas do not need specific treatment. In the presence of extensive subserous or submucosal hematoma, revision should be done, as it can hide almost complete rupture of the bowel wall. Incised wounds of gut are double row sutured in the transverse direction. Edges of lacerated wounds are economically excised before suturing. In the case of detachment from mesentery, more than 5 cm and in doubt of its viability, resection of part of the intestine with end-to-end anastomosis is indicated. Resection is also shown in the presence of several wounds on one loop or extensive wounds that cannot be sutured without gross stenosis of the lumen. Under the conditions of diffuse purulent peritonitis, damaged part of intestine must be isolated from abdominal cavity. i. e. enterostomy.

Mortality rate in injuries of the small intestine is 10–30 %.

TRAUMA OF THE COLON

Colon injury occurs in 3–13 %. In colon trauma open and closed, intraperitoneal and retroperitoneal injuries are distinguished.

Deseroused portions and wounds of colon are sutured as in small bowel injury. Imposing of three-row suture is inappropriate. In extensive or multiple injuries, colon is mobilized and resects. Extraperitonisation of anastomosis can also be placed. Suturing of the colon and imposition of primary anastomosis is extremely dangerous because of the high risk of its incompetency, so it can be used only on

the right half of the colon, with trauma history not more than 6 hours and slightly contaminated abdomen. In other cases, the damaged parts of the colon are resected to form a stoma. Hartmann operation is one of the choice methods. When it is impossible to bring out injured part, the wound is sutured; damage zone is isolated with tampons and proximally from injury end stoma is imposed.

If the case of rectum injury, wound is sutured, injury zone is limited with tampons, intersect the sigmoid colon, distal end is sutured and the proximal withdrawn as stoma. Make sure to drain pararectal region from the perineum.

Mortality rate in colon trauma is 15–40 % and in rectum injury 50–70 %.

TRAUMA OF THE ABDOMINAL AND RETROPERITONEAL VESSELS

Source of intra-abdominal bleeding can be abdominal vessel and abdominal wall vessel (intersection of rectus artery with stab wounds, etc.). Bleeding from vessels of greater omentum is most common and usually blood loss in this case is not fatal. Mesenteric vascular injury leads to abundant intraperitoneal bleeding, and in some cases, necrosis of part of the intestine (often with transverse rupture of the mesentery). Divides into mesentery injuries (with injury of small blood vessels), ruptures and complete detachment. Upon detection of a strained hematoma, its inspection is required, as well as possible delayed bowel necrosis from compression of vessels and secondary thrombosis. Hematoma is incised, vessels are ligated and mesentery defect are sutured. When in doubt about the viability of bowel, resection of bowel should be done. Injury of retroperitoneal organs and retroperitoneal vessels, vertebral and pelvic bones trauma are accompanied by a retroperitoneal hematoma. This is accompanied by severe anemia and paralytic ileus. The latter may develop in 1,5–2 hours after injury. Blood loss in the retroperitoneal area can reach more than 3 liters. Accepted conditional division of hematoma volume according to the border of its location:

- 500 ml. Hematoma within the pelvis.
- 1000 ml. Hematoma up to iliac crest.
- 1500 ml. Hematoma up to the lower poles of the kidneys.
- 2000 ml. Hematoma up to the upper pole of the kidneys.
- 3000 ml or more. Hematoma occupies the whole retroperitoneal space up to the diaphragm.

Small unstrained retroperitoneal hematoma needs no incision. It must be remembered that the extensive retroperitoneal hematoma may obscure trauma of duodenum, ascending and descending colon, kidneys, so it is necessary to incise, ligation of bleeding vessel, to conduct an inspection and drain the retroperitoneal space through lumbotomy.

Trauma of the great vessels is rare and often is fatal.

KIDNEY TRAUMA

Kidney trauma occurs in 7–10 % of the injured, and more often in blunt trauma. Distinguish:

1. Kidney damage without disrupting the capsule (contusion).
2. Damage with perirenal hematoma (nonpenetrating in pyelocaliceal system).
3. Damage with perirenal uro — hematoma (penetrating into the pyelocaliceal system).
4. Damage to the main vessels of the kidney.
5. Crush injury of the kidney.
6. Detachment of kidneys from the pedicle.

According to the localization of trauma: body of kidney, upper pole, lower pole and the vascular pedicle.

Kidney Contusions are treated conservatively. At rupture, nonviable tissues are excised and defect is sutured with catgut through the entire thickness of the tissue. To exclude the eruption of sutures, part of omentum or muscle tissue can be used as protector. Crushing of kidney and detachment of the pedicle is an indication for nephrectomy. After nephrectomy parietal peritoneum is sutured, and perirenal tissue is drained through lumbotomy. Before nephrectomy, make sure you have a second functioning kidney. For this purpose pedicle of damaged kidney is clamped and 5 ml of indigo carmine is intravenously injected. The appearance of colored urine in urinary catheter indicates a stored function of second kidney. In case of injury to a solitary kidney, if possible, impose a nephrostoma and drain the perirenal region.

Mortality in isolated renal injury is 2–5 %; where as in combined injury can reach up to 40 %.

BLADDER TRAUMA

Divides into opened and closed trauma, extraperitoneal and intraperitoneal bladder ruptures. Open wounds are rare and occur mainly in stab wounds. Closed injuries occur in 5–10 %. Extraperitoneal rupture occurs in fractures of the pelvis due to the displacement of bone fragments and/or injuring the bladder. In fractures of the pubic bones, detachment of the bladder neck can occur. Intraperitoneal ruptures occur, when bladder is full. Entering of urine into the peritoneal cavity leads to peritonitis, in pelvic tissue — to urophlegmone. Streaks may spread to the thighs, buttocks and perineum. In trauma, injury of other walls of bladder should be excluded by their palpation from inside the bladder lumen. If retroperitoneal part of the bladder is injured, it should be incised at its apex and inspected from inside. Next, perivesical fat is revealed. The defect of bladder is double row sutured from outside without suturing mucosa. If this is impossible, the wound may be sutured from inside. Epicystostomy is imposed and drained through counter puncture on the anterior abdominal wall and through the obturator foramen by McWhorter — Buyalsky.

Mortality in isolated rupture of bladder is 5 % in patients with concomitant

trauma reaches 25 %.

POSTOPERATIVE COMPLICATIONS

Divides into local (within the area of intervention) and general (not directly related to the intervention area).

External bleeding (from the surgical wound) is a consequence of slipping ligature or insufficient hemostasis. In some cases, bleeding may occur due to elevated blood pressure ("washout" of thrombus from the vessel lumen). In case of insignificant bleeding, locally cold is applied. If no effect, under local anesthesia skin sutures are removed, revision of wound, ligation or stitching of bleeding source. In the development of extensive hematoma, same manipulations are applied. Small hematoma of wound can be emptied by administering grooved probe between skin sutures.

Secondary bleeding from the wound is erosive due to purulent fusion of the vessel walls. In this case, ligation of the vessel is best method to avoid recurrence of bleeding.

Postoperative wound infiltration is characterized by the appearance of the local wound rigidity. It is a frequent cause of hematoma. Treatment is conservative (probing of infiltration, alcoholic dressings and broad-spectrum antibiotics). At a suppuration of infiltration pain is exacerbated, appears swelling and hyperemia, severe pain on palpation, increased body temperature. Necessary to remove some or all of stitches to make a toilet and drainage of the wound. Subsequently, the wound is treated with open method according to the general principles of treatment of purulent wounds.

Sutures eruption of aponeurosis and postoperative wound dehiscence observed in malnourished patients as a result of hypoproteinemia in contribution with intestinal paresis and disorders of water-electrolyte metabolism, excessive tension on the wound edges, location of wound on a highly mobile or high tension area such as the shoulders, back or legs. Individuals with Ehlers–Danlos syndrome also commonly experience wound dehiscence. Risk factors can include any of the above as well as obesity, previous scarring, surgical error, smoking, cancer, chronic use of corticosteroids and increased abdominal pressure. If the dehiscence of wound occurs before removing of skin sutures, it is called subcutaneous eventration. The main symptom is excessive soaking of bandages with hemorrhagic discharge. If skin sutures were removed, or as dispersed, there is a complete eventration of internal organs on to the skin. If possible, subcutaneous eventration can be treated conservatively with strict bed rest. Complete eventration is an indication for emergency surgery. Suturing of eventration by using tread sutures is performed.

In internal bleeding (in the abdominal cavity) develops clinical signs of blood loss, shortening of percussion sounds in different areas of the abdomen, dullness of peristalsis, positive symptom of Kulenkampf. An ultrasound reveals

free fluid. Intraperitoneal bleeding is an indication for emergency relaparotomy.

Gastrointestinal bleeding can occur due to the formation of acute (stress) ulcers, acute exacerbation of chronic ulcers. The reason can be an insufficient hemostasis of submucosal vessels of intestine or stomach during implementation of anastomosis and mucosal damage not identified during surgery. Clinical features are signs of blood loss, may be vomiting "coffee grounds" and melena. Conservative hemostatic treatment is carried out. In case of upper gastrointestinal tract bleeding, endoscopic hemostasis is performed. Continued bleeding and rebleeding is an indication for emergency relaparotomy.

Anastomosis suture failure usually develops 6–8 days after surgery. This is promoted by sluggish postoperative peritonitis. Suture failure is an indication for emergency laparotomy. Defect is sutured, sanitation and drainage of abdominal cavity is recommended. If suturing is not possible, you must either withdraw the zone of insolvency on the anterior abdominal wall, or reliably separate this area with tampons from free abdominal cavity.

Postoperative pneumonia occurs on 3–4 day; more often is hypostatic character and develops in critically ill patients. In elderly patients pneumonia is severe and often converts into an abscess, which leads to death. In the prevention of inflammatory lung diseases, main line treatment is an adequate analgesia and early activation of patients.

Thrombophlebitis of the lower extremities poses a serious threat to life. Thrombophlebitis is facilitated by the presence of varicose veins, longtime passive position. In ascending thrombophlebitis, operation of choice is ligation of the great saphenous vein at the junction (Trendelenburg operation). In other cases, limbs are given an elevated position; prescribe anticoagulants, antiplatelet agents, antibiotics, anti-inflammatory drugs. Locally apply compresses with heparin ointment. For the prevention of thrombosis elastic bandaging of the lower extremities is used, before the surgery and in post-operative period heparin, fraxiparin, Clexane is prescribed.

Bedsore occur in malnourished patients with a long stay in bed in one position. Localization is different, but more often is sacrum, heels, shoulders, and hips. For the prevention of pressure ulcers, frequent change of position in bed is required and use of backer circle. Skin is treated with camphor spirit. Pressure ulcers are treated with a strong solution of potassium permanganate, achieving the transition to dry necrosis. After stabilization and revitalization of the patient necrectomy is performed. For large skin defects, various plastic interventions are performed.

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Учебное издание

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Анджум Вакар
Скуратов Александр Геннадьевич и др.

АБДОМИНАЛЬНАЯ ТРАВМА
(на английском языке)

Учебно-методическое пособие для студентов 5 и 6 курсов
факультета по подготовке специалистов
для зарубежных стран медицинских вузов

Редактор *Т. М. Кожемякина*
Компьютерная верстка *Ж. И. Цырыкова*

Подписано в печать 02.04.2015.
Формат 60×84¹/₁₆. Бумага офсетная 65 г/м². Гарнитура «Гаймс».
Усл. печ. л. 1,16. Уч.-изд. л. 1,27. Тираж 50 экз. Заказ № 38.

Издатель и полиграфическое исполнение:
учреждение образования «Гомельский государственный медицинский университет».
Свидетельство о государственной регистрации издателя,

изготовителя, распространителя печатных изданий № 1/46 от 03.10.2013.
Ул. Ланге, 5, 246000, Гомель