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PREVENTION OF POSTOPERATIVE COMPLICATIONS IN PURULENT PERITONITIS

Objective of the study is to improve the efficiency of surgical treatment of peritonitis by introducing new methods of prevention of postoperative complications.

In this paper, we presented the results of clinical studies of 180 patients operated on various forms of diffuse peritonitis.

We developed the “Drainage device” consisting of coaxially placed tubes, optimal for draining the irregularly shaped cavities, and applied it in clinic.

Anolyte solution, which is an aqueous solution of diluted sodium chloride solution passed through the electrochemical reactor, has been used to cleanse the abdominal cavity. The bactericidal effect of the solution has been clearly demonstrated by the results of bacteriological studies.

We have validated that viscero-parietal adhesions play pathogenetic role in the mechanism of acute adhesive intestinal obstruction, the latter being the result of fixation of two multifunctional organs, small bowel and anterior abdominal wall, which leads to continuous traction with accompanying ischemia, pain syndrome and impaired passage of intestinal contents.

In order to prevent viscero-parietal adhesions in peritonitis and acute adhesive small bowel obstruction, we proposed a novel Method for the prevention of acute adhesive bowel obstruction”.

The introduction of these preventive methods into clinical practice resulted in a threefold decrease in the number of postoperative complications.

Key words: Peritonitis, postoperative complications, visceroparietal adhesions, prevention of adhesions, acute adhesive intestinal obstruction, peritoneal lavage.

Introduction

G.M. Wegner, a renowned surgeon of the 19th century, is believed to utter a catch phrase in 1876, ‘Me and my generation have been brought up in awe of God and peritonitis.’

In 1971, K.S. Simonyan [1] in his seminal book Peritonitis, remarked, ‘One hundred years have passed since these words were said, and alas, we have no awe of God now, though are still fearful of peritonitis.’ Nowadays, surgeons [2,3,4,5] claim the awe of God is back, with awe of peritonitis in place as before.’

Indeed, in spite of achievements of modern surgery, diffuse peritonitis is still the greatest challenge faced by emergency abdominal surgery.

Lead Russian and foreign clinics failed to report any downward trend in mortality rate associated with this condition over the past decades: it ranges from 20-30% to 50-70% plus, being the highest in postoperative peritonitis, with established multiorgan failure and septic shock [6,7,8].

The incidence of postoperative complications in peritonitis varies from 10 to 23%, with no noticeable dramatic change in recent years [9].

Most common encountered complications are: wound infection, 12.5%; progressive peritonitis, 22%; abdominal cavity abscesses, 9.7%; eventration, 7.5%; early adhesive small bowel obstruction, 12.2%. [10,11].

Diffuse peritonitis creates particularly favorable conditions for the development of adhesions in the abdominal cavity: fibrin deposits on the intestinal loops, intestinal paresis.

According to T.T. Daurova and S.D. Andreev [12], abdominal adhesive disease (AAD) occurs in 83-92% of patients, with acute adhesive small bowel obstruction (ASBO) developing in 30% to 67% of patients with this disorder.

The aim of the study is to develop and introduce efficient ways of prevention of both early and late postoperative complications of peritonitis.

Material and Methods

We analyzed the results of operations performed on 180 patients with various forms of diffuse peritonitis in the clinic during the period of 2000 to 2019. The age of patients ranged from 15 to 92 years.

The main group included 42 patients who were given surgical treatment using the methods of prevention of postoperative complications developped by us, vs. the control group of 138 people treated by conventional methods.

By etiology of peritonitis, both groups were similar in terms of underlying diseases, with equal incidence and severity of the disease. The etiological factors were: acute appendicitis (21%), acute cholecystitis (26%), perforated peptic ulcer, both duodenal and gastric (5%), adhesive bowel obstruction (10%), pancreonecrosis (12%), abdominal injuries (12%), and a number of gynecological diseases (5%).

We evaluated the peritonitis prognosis using the APACHE scoring system and the Mannheim Peritonitis Index. The extent of surgical treatment in patients depended on the cause of peritonitis and aimed at eliminating the source of the disease (Table 1).

Table 1 – Surgical treatment of peritonitis

Type of operation	Main group (n=42)			Control group (n=138)		
	Total	RL*	ELC*	Total	RL*	ELC*
Appendectomy	9	-	-	46	5	2
Cholecystectomy	11	1	1	43	4	2
Simple oversewing of the gastric and duodenal peptic ulcer	1	-	-	7	1	1
Resection of the ulcer plus pyloroplasty	-	-	-	2	-	-
Gastric resection	1	-	-	2	-	-
Adhesiolysis	3	-	-	10	2	-
Division of adhesions + small bowel resection	1	1	-	-	-	-
Herniotomy	2	-	-	5	-	-
Herniotomy + small bowel resection	1	-	-	3	-	1
Suture closure of traumatic rupture of the intestine	3	-	-	6	1	-
Resection of the site of traumatic rupture of the intestine	1	-	-	3	-	1
Double barrel colostomy in colonic disruption	1	-	-	2	-	-
Drainage of the omental bursa	5	-	-	1	-	-
Salpingo-oophorectomy	2	-	-	7	-	-
Uterine amputation	1	-	-	2	-	-
Total:	42	2	2	138	12	7

Abbreviations: RL, relaparotomy; ELC, elective laparo-cleansing;

A total of 203 operations, including RL and ELC, were performed on 180 patients.

Results and Discussion

We retrospectively reviewed the results of surgical treatment of patients in control group and found the following postoperative complications:

Wound-related complications: wound infection (48), anterior abdominal wall phlegmon (8), eventrations (3). The incidence of these complications varied from 0.7 to 19.6% and was proportionate to the length of stay.

Extra-abdominal complications: pneumonia (21), others (7) 1.5% to 6.5%.

Intraperitoneal complications: abdominal abscesses (up to 5.1%), progressive peritonitis (up to 7.3%), early acute adhesive ileus (up to 4.3%).

Radical removal of the source of peritonitis and thorough cleansing of the abdominal cavity intraoperatively are the two key elements of therapeutic efforts largely determining the further course and outcome of the disease.

In peritoneal lavage, the primary task is to mechanically cleanse the peritoneal cavity, and secondly, exercise antibacterial effect on intra-abdominal infection.

The first task, in advanced forms of peritonitis with non-removable fibrinous-purulent deposits firmly accreted to visceral peritoneum, is quite a challenge and not always feasible. The second task is also problematic, because sanitizing solutions, including antibiotics, often fail to achieve complete positive effect. Therefore, there is a constant search for more effective means of sanitizing the abdominal cavity.

For this purpose, we use anolyte solution in our clinical practice. Anolyte is an aqueous solution of dilute sodium chloride solution passed through the electrochemical reactor that produces chlorine oxygen and hydroperoxide oxidants (hypochloric acid, hypochlorite ion, active oxygen compounds). The solution is non-toxic, displays high reactive and catalytic activity at low concentration of active substances, possesses disinfectant and anti-inflammatory properties.

The bactericidal effect of the solution is clearly demonstrated by the results of a bacteriological study (Table 2). A quantitative study of microflora in 1 ml of peritoneal exudate was carried out as a gauge for sanitizing effect. Samples were taken (from the drainage tube) before sanitizing the abdominal cavity, upon completion of the procedure, and while in progress, on different days after the operation.

Table 2 – Bacteriological study

Group	Duration of treatment (days)			
	1	3	5	7
Controls	$7.96\pm0.14 \times 10^7$	$7.1\pm0.21 \times 10^7$	$6.5\pm0.19 \times 10^6$	$5.7\pm0.23 \times 10^5$
Main	$7.1\pm0.20 \times 10^7$	$4.74\pm0.16 \times 10^3$ $p < 0.05$	Not isolated	Not isolated

Efficiency of the surgical intervention largely depends on how adequate are the applied abdominal cavity drainage methods.

Conventional methods for draining the abdominal cavity in generalized purulent peritonitis entail insertion of drain tubes through individual punctures on the anterior abdominal wall and into the lesser pelvic cavity (right and left), subphrenic space (bilaterally) and subhepatic space.

However, specifics of anatomical structure of the abdominal cavity, such as attachment sites for the mesentery, spatial orientation of pouches and recess-es of the peritoneum and its bursae, especially amid peritonitis, preclude an adequate drainage of pathological exudate from each and every cavity formed by the peritoneum by means of conventional drains.

We have proposed and used in our clinical practice a *Drainage Device* (Inventor's Certificate #1813457) consisting of coaxially mounted tubes, installed movably relative to each other. The device is optimal for draining the irregularly shaped cavities (Figura1).

This is how the device works: through a puncture in the abdominal wall, a small diameter tube (1) is threaded from within the abdominal cavity outward, with tubes 2 and 3 in its lumen; then from within the lumen of tube 1, tube 2 is threaded through the inlet holes, further on, tube 3 is threaded from within the lumen of tube 2 through the inlet holes. From the abdominal side of the drainage system, tubes 2 and 3 are placed in advance. Then, by sliding the inner tubes relative to the outer ones, the target sections of the abdominal cavity are drained. The inlet openings are sealed. Postoperatively, different compartments of the abdominal cavity are independently suctioned through tubes 1 – 3. Moreover, each of the tubes can be used for peritoneal lavage, with no risk of contagion through the drains from one source of infection to another.

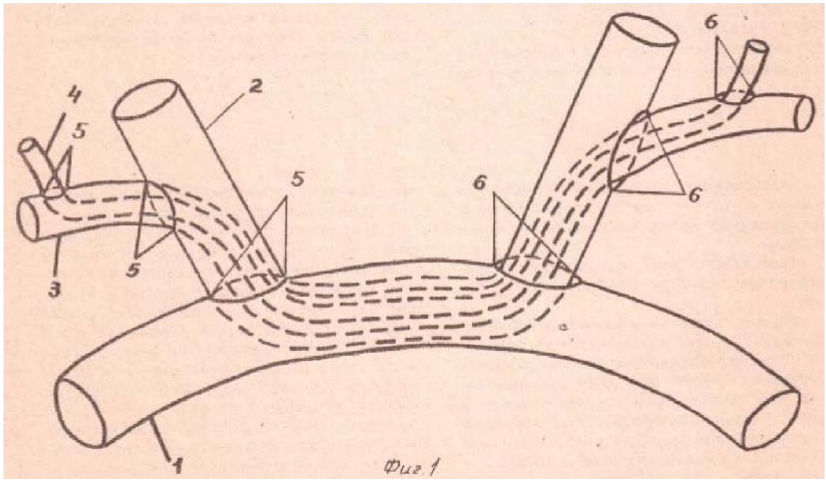

Figure 1 – Drainage device. 1. Principal drain. 2,3,4. Internal drains. 5. Openings in the proximal end of drains. 6. Distal end openings.

Diffuse peritonitis with fibrin deposits on intestinal loops, non-sliding relative to each other (largely due to intestinal paresis) presents an excellent environment favoring the development of adhesions in the abdominal cavity and its ominous complication: acute adhesive ileus, both in early and late postoperative period.

We retrospectively reviewed the patients in the control group (138) and found early adhesive intestinal obstruction in 12 cases (8.7%), and late one in 28 cases (20.3%).

In developing our methods of prophylaxis of acute adhesive intestinal obstruction in the wake of peritonitis, we abided by the following tenets:

Intraperitoneal adhesions per se are recognized as the primary cause of acute adhesive small bowel obstruction (ASBO). Of practical importance, both in terms of incidence and probability of ASBO onset, are adhesions between the parietal peritoneum of the anterior abdominal wall and intestine, categorized in D.I.Balatsenko's classification (1957) as viscero-parietal adhesions (VPA), or traction adhesions according to A.O.Vereshchinsky's classification (1925).

The high probability of ASBO formation in the presence of VPA is due to the fact that:

1. The anterior abdominal wall – an integral part of respiration process and contributor to abdominal muscles – will cause impaired intestinal motility when restricted in its excursion by tenacious accreted adhesions.

2. Let's regard the parietal peritoneum and intestinal loops as two parallel planes. Then, the adhesions formed between these two planes run perpendicularly or at an angle, which naturally may lead to an inflection of the bowel loop.

3. With every movement of the anterior abdominal wall, the traction of the bowel loops firmly attached to the mesentery posteriorly and to VPS anteriorly, will strain the mesentery and distort its vessels and nerves, with resultant compromised blood flow through the mesenteric vessels, pain syndrome and hindered passage of intestinal contents.

Thus, the pathogenetic role played by viscero-parietal adhesions in the mechanism of acute adhesive intestinal obstruction can be reduced to the following: the two differently functioning organs – the intestine and the anterior abdominal wall – attach to each other. Moreover, the inflected and stretched intestinal tube will make the mesentery strain with resultant ischemia, pain syndrome and hindered passage of intestinal contents.

In order to prevent adhesion and its complications in peritonitis we proposed the following Method of Prevention of Acute Adhesive Intestinal Obstruction (Patent #13124): Before the operation, we prepare an airtight 30 by 40 cm sized polyethylene bag (Figura 2). Multiple microperforations are made in the back of the bag. The upper corners of the bag are snipped away to make two holes. Through these holes the tube is threaded, with its perforations collocated within the bag and tube openings outside it.

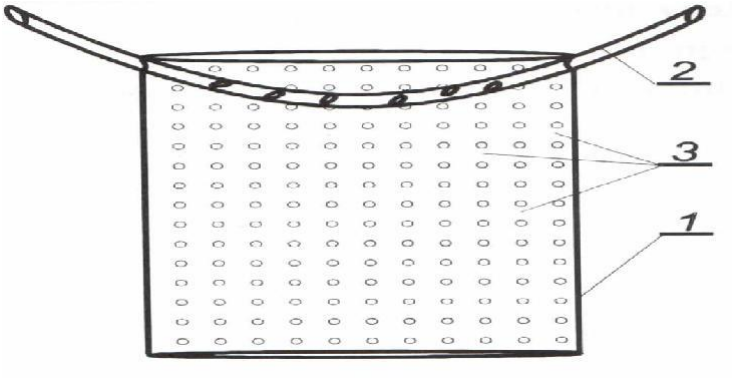

Figure 2. 1– polyethylene bag 2– drainage tube within the bag cavity. 3– microperforations in the back of the bag.

During the operation, upon control of the source of infection and abdominal cleansing, the plastic bag is placed into the abdominal cavity with its multiperforated rear aspect facing the bowel loops. Through the counterpunctures in both subcostals, both ends of the drain tube are exteriorized from the bag's cavity and fixed to the skin. In the iliac region, a small incision is made through all layers of the abdominal wall, about 2.5 cm long, through which the lower corner of the bag is exteriorized. Through the same counterpuncture, a separate drainage tube is placed into the small pelvic cavity to drain the abdominal cavity. The laparotomy wound is suture closed in a layered fashion.

After the operation, the peritoneal lavage is delivered by jet injection of antiseptic solutions through both ends of the drainage tube of the polyethylene bag. Effectively, the liquid is sprayed to all areas of the abdominal cavity through the microperforations in the bag's lower wall, mostly between the loops, in a 'shower' fashion, thus ensuring complete sanitation of the abdominal cavity. At the same time, the presence of the bag itself made of inert material (polyethylene) separates the intestines off the parietal peritoneum of the anterior abdominal wall. The peritoneal lavage is to be stopped when clean return from the small pelvis cavity is obtained and intestinal peristalsis is restored postoperatively. On day 5 or 7 post-op, as indicated, the tube is removed first from within the bag, then the bag itself is easily pulled out if firmly grasped by its exteriorized end in the iliac region. The drain tube from the small pelvis cavity is removed the next day.

Conclusion

The above described innovative methods and technical approaches we employed in surgical treatment of peritonitis, such as anolyte solution as an abdominal cavity detergent, peritoneal lavage for both optimal cleansing of the abdominal cavity postoperatively, separating the intestinal loops off the anterior parietal peritoneum, drainage device, helped us achieve an almost three-fold decrease in the number of postoperative complications: wound complications 9.5% vs. 30.4%, intraperitoneal complications 7.1% vs. 19.6%, and extraperitoneal complications 11.9% vs. 16.7%. Postoperative mortality in the main group was 6% (3) vs. 29% (21) in the control one.

We hope our limited experience with the above novel technology will help practical surgeons to better treat this complex and dangerous pathology.

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