PLANNED RELAPAROTOMY AND LAPAROSTOMY - “AGGRESSIVE METHODS” IN THE TREATMENT OF DIFFUSE PURULENT PERITONITIS

The goal of the present study is to present the results of treatment of severe forms of diffuse purulent peritonitis using aggressive methods - laparostomy and planned relaparotomy.

The study includes 228 patients with diffuse purulent peritonitis treated over a period of 22 years. 61 patients (26.75%) were subjected to prospective analysis and 167 patients (73.25%) to retrospective analysis. 143 (62.72%) of them were male and 85 (37.28%) female patients.

In 75 (32.89%) of the cases laparostomy was applied, and in 153 (67.11%) planned relaparotomy was performed. The registered mortality in the first group was 33 patients (44%), and in the second group - 37 patients (24.18%). The overall mortality rate for the two aggressive methods was 30.70%.

The “aggressive” methods of treatment of diffuse purulent peritonitis allow us to apply the main principles of treatment of peritonitis in the extreme degree, and are methods of choice in the surgical management of severe forms of diffuse purulent peritonitis.

Keywords: Diffuse purulent peritonitis, laparostomy, planned relaparotomy

UDC: 616.381

Introduction

This perpetual problem in surgery has no solution even today, more than a century after Lawson Tait from Birmingham (1897) for the first time successfully performed a surgical intervention in a patient, diagnosed preoperatively with acute peritonitis. Nevertheless, medicine has achieved quite a few successes related to this problem (Eryuhin, 1986). The fear of localised peritonitis is already in the past. We also cope with some of the forms of diffuse peritonitis (serous, serofibrinous, hemorrhagic) almost without problems. We achieve very good results in the less severe forms of diffuse purulent peritonitis. Fear however, remains in cases of severe forms of peritonitis, accompanied by initial or existing organ failure (Kriger, 1988; Shurkalin et al., 1988). As an expression of our ceaseless search for a breakthrough in the discouraging statistics, we share our experience in its surgical treatment.

Materials and methods

This study covers a period of 22 years (1989-2010). The “aggressive” methods of treatment of diffuse purulent peritonitis were applied in 228 patients admitted at the Clinic of Surgery of the “Tsaritsa Yoanna - ISUL” University Hospital. 61 patients (26.75%) were subject to prospective analysis, and 167 patients (73.25%) to retrospective analysis. 143 (62.72%) of them were male and 85 (37.28%) were female patients. The age distribution is presented in Table 1. The causes, as a result of which peritonitis occurred, are shown in Table 2.

In all 228 patients intraoperative peritoneal lavage with normal saline solution, warmed up to body temperature was performed. Regarding the used amount of lavage fluid, in 153 cases (67%) it was described as “the amount needed to obtain clear fluid”, and in 75
(33%) of the cases it was indicated in litres. The average amount of lavage fluid used was about 4 liters (Figure 1).

### Table 1. Distribution of Patients According to Age

<table>
<thead>
<tr>
<th>Age groups</th>
<th>Patients</th>
<th>%</th>
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<tbody>
<tr>
<td>≤20</td>
<td>5</td>
<td>2.19</td>
</tr>
<tr>
<td>21-30</td>
<td>44</td>
<td>19.30</td>
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<td>31-40</td>
<td>15</td>
<td>6.58</td>
</tr>
<tr>
<td>41-50</td>
<td>21</td>
<td>8.74</td>
</tr>
<tr>
<td>51-60</td>
<td>43</td>
<td>18.86</td>
</tr>
<tr>
<td>61-70</td>
<td>51</td>
<td>22.37</td>
</tr>
<tr>
<td>71-80</td>
<td>37</td>
<td>16.23</td>
</tr>
<tr>
<td>&gt;80</td>
<td>12</td>
<td>5.26</td>
</tr>
<tr>
<td></td>
<td>228</td>
<td>100</td>
</tr>
</tbody>
</table>

### Table 2. Distribution of Patients According to the Peritonitis Anatomical Origin

<table>
<thead>
<tr>
<th>Anatomical origin</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach, duodenum</td>
<td>17</td>
</tr>
<tr>
<td>Small intestines</td>
<td>35</td>
</tr>
<tr>
<td>Appendix</td>
<td>15</td>
</tr>
<tr>
<td>Large intestines, rectum</td>
<td>49</td>
</tr>
<tr>
<td>Liver and extrahepatic bile ducts</td>
<td>15</td>
</tr>
<tr>
<td>Gynecological origin</td>
<td>3</td>
</tr>
<tr>
<td>Extraperitoneal organs (pancreas)</td>
<td>26</td>
</tr>
<tr>
<td>Post-operative peritonitis</td>
<td>54</td>
</tr>
<tr>
<td>Other</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>228</td>
</tr>
</tbody>
</table>

### Figure 1. Amount of Used Lavage Fluid

A nasogastric tube was inserted and the gastro-duodenal content was evacuated in all 228 patients. The applied methods for decompression of the gastro-intestinal tract are shown in Table 3.
### Table 3. Used Surgical Methods for Decompression of the Intestinal Tract

<table>
<thead>
<tr>
<th>Method for Decompression</th>
<th>Total</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Nasogastric intubation</td>
<td>8</td>
<td>3.51</td>
<td></td>
</tr>
<tr>
<td>Ileostoma</td>
<td>29</td>
<td>12.72</td>
<td></td>
</tr>
<tr>
<td>Temporary iliac anus</td>
<td>9</td>
<td>3.95</td>
<td></td>
</tr>
<tr>
<td>Intestinal intubation</td>
<td>7</td>
<td>3.07</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>53</td>
<td>23.25</td>
<td></td>
</tr>
</tbody>
</table>

Planned relaparotomy was performed in 153 (67.11%) of the cases, (mean Mannheim peritonitis index score - 28.9) and laparostomy - in 75 (32.89%) of the cases, (mean MPI score-33.19). 3 patients from the second group were treated with postoperative continuous open dorso-ventral lavage (according to F. Guthy and R. Pichlmayer (Guthy, 1984; Guthy, Pichlmaur, and Lehr et al., 1980), by placing 2 tube drains in the dorsal part of the peritoneal cavity in the subdiaphragmatic space.

During the first period of application of laparostomy (1989-1995), we ended the operation by leaving the abdominal wall completely free, with no tightening, while the underlying visceral organs were covered with the Bulgarian antibacterial polyamide mesh (BAPS), fixed to the abdominal wall with a continuous suture. Later, a zip was sutured to the BAPS in the middle, which allowed easier revision of the peritoneal cavity. Subsequently, we rejected the application of a zip, and used a longitudinal incision through the mesh, which we closed at the end of the revisions with a continuous suture. In the cases where the concomitant intestinal paresis had a tendency to be overcome, the mesh was reduced with an oval vertical incision with a following continuous suture. In this way we closed the surgical wound and restored the abdominal wall. In the following period, at the end of the successive revisions of the peritoneal cavity, after suturing the BAPS, a polyethylene sheet was added, by the so-called “sandwich” method of Schein, 1986. The exudate collected in the space between the BAPS and the polyethylene sheet was evacuated by placing a tube drain for continuous aspiration.

The revision usually was performed in the operating room under general anesthesia. The interval between the subsequent revisions was not fixed. In most cases it was between 24 and 48 hours.

**Technique:**

The main objectives after relaparotomy were:

- visual control with eventual intervention on the source of peritonitis and the inflammatory process
- evacuation of purulent exudate and necrotic material
- obtaining material for bacteriologic monitoring
- peritoneal débridement
- timely reaction to intestinal paresis.

Final closing of the abdominal wall was performed in the case of:

- ceasing of the purulent secretion
- reduction of fibrin accumulation in the peritoneal cavity
- appearance of spontaneous and effective intestinal peristalsis
- improvement of the parameters of the main vital functions.

**Results**

Adequate source control was obtained in 209 patients (91.67%). The mortality rate registered in this group was 23.67% (51 patients). In the 19 cases in which the source control could not be obtained, there were no survivors.

The number of performed planned relaparotomies is shown on Figure 2. The time interval respectively was: 24 h. - 23%, 48 h. - 51%, 72 h. - 21%, 96 h. - 5%.

![Figure 2. Performed planned relaparotomy](image)

In 4 patients treated with laparostomy, spontaneous perforations of the small intestines occurred. None survived.

The average total hospital stay was 23.38 days for patients with planned relaparotomy and 27.33 days for patients with laparostomy.

The mortality rate in both aggressive methods was 30.70% (70 patients): 24.18% (37 patients) in cases with planned relaparotomy and 44% (33 patients) - with laparostomy.

The cause of death was multiple organ failure in 37 patients (52.86%); two organ system failure in 22 patients (31.43%) and single organ system failure in 11 patients (15.71%).

Regarding the residual infection, our efforts were directed towards the application of one of the “aggressive methods” and adequate antibiotic treatment covering both aerobic and anaerobic flora.

**Indications for the application of “aggressive” methods:**
- impossibility for source control of the peritonitis in one stage
- impossibility for evacuating the purulent material from the peritoneal cavity in one stage
- initial or existing organ failure
- poor prognosis according to some of the score systems (MPI, APACHE II).
Discussion

In the surgical treatment of all patients, we follow strictly the main principles of management of peritonitis, formulated in the XIXth century by L. Rhen and M. Kirschner (Hau, 1998).

Regarding the most significant of them, adequate source control, we strive to achieve it during the initial surgical procedure. In many cases, however, this was impossible to achieve in one stage (in the cases of acute pancreatitis or insufficiency of the duodenal stump, leading to peritonitis). Regardless which of the two methods was used, the failure to achieve source control led to 100% mortality in 51 cases in which, this proved to be practically impossible.

Reduction of bacterial contamination and evacuation of toxins, cytokines and necrotic matter from the peritoneal cavity during the surgical procedure was achieved by thorough peritoneal debridement of the entire peritoneal cavity in all 228 patients.

After peritoneal debridement, intraoperative lavage with physiologic serum was performed. In 66% of the cases the quantity used was described as “until nearly clear”, which did not allow us to determine the real amount of liters and in 34% of the cases the average amount was 4 litres, almost half of the amount most frequently reported in the literature by different authors.

When answering the question when to perform the revision, most of the surgeons recommend a period of 24 - 48 hours (Guivarch, Roulet-LAudy, and Chapmann, 1979; Andrus, Doering, Hermann, and Kamiński, 1986). The time interval for revision of the peritoneal cavity reported in our series was: 24 h. - 23%, 48 h. - 51%, 72 h. - 21%, 96 h. - 5%.

Doutre et al., 1982, performed the first revision after 48 hours, and the next - not more frequently than twice weekly.

Woutres et al., 1983, performed revision with subsequent lavage after 24 hours in 80% of 65 patients, after 12 hours in 2%, and after 48 hours in the rest of the cases. Two planned relaparotomies were sufficient for the successful treatment of 13 patients, three planned relaparotomies - for 20 patients, four planned relaparotomies - for 12 patients, and five - for 6 patients. The remaining 14 patients were intervened from 6 to 12 times. The total mortality rate was 20%.

In regard to the residual infection, our efforts are directed towards the application of one of the “aggressive methods” - planned relaparotomy or laparostomy and antibiotic treatment, covering both the aerobic and anaerobic flora.

Assuming that diffuse purulent peritonitis is “a great abscess with many pouches” and following the principles of septic surgery, in 1884 Johann von Mikulicz-Radecki (Makoha, 1984) proposed a method for “open treatment” of peritonitis. After eliminating the source of peritonitis and cleaning the peritoneal cavity Mikulicz packed the abdomen with gauze in order to remove the exudate and left it open.

The French surgeon Faure (1928) further developed the method of Mikulicz, using it for treatment of peritonitis of gynecological origin and abscesses in the pelvic region. Faure prepared a sack from multi-layer gauze and placed it deep into the pelvis. The author left the abdomen open for 9-10 days, starting from the third day to take out 2-4 gauzes daily, ending the procedure on the 9th - 10th day. Similar methods were reported by J. Murphy, A. Pawlowsky, H. Schreiber, F. Bode, J. Grekow (Hau, 1998).

Pujol in 1975 renewed the method of “open treatment” of the most severe forms of purulent peritonitis. The method found many followers in France. The French surgeons subdivided the method into “close” and “open” evisceration (Champault, Magnier, and Psalmon, 1979; Lally, Trettin, and Torma, 1983).
In “close evisceration” the intestinal loops are isolated with omentum or napkins, infiltrated with vaseline, antiseptics or polyurethane foam.

In “open evisceration” the intestinal loops are not covered, and prolaboration is avoided using different adaptive mechanisms of rubber circles, drainages, etc.

The method was popularized in the Anglo-Saxon countries by Steinberg (1979), and in the countries of the former Soviet Union by N. Makoha (1949; published in 1967; 1984). The term laparostoma according to L. F. Hollender (Mughal, Bancewicz, and Irving, 1986) is used for the first time by Prof. J. N. Maillard (Wild, Stremitzer, Budzanowski, Rinder et al., 2004) in 1976. In some reports from Russia it is mentioned as peritoneostoma (Kuznecov, Chuprinin, and Anisimov 1992).

The method was popularized in the Anglo-Saxon countries by Steinberg (1979)

The indications for laparostomy are still not clearly formulated. The different authors use the terms: “advanced”, “severe”, “protracted”, “terminal”, “massive” peritonitis, “septic abdomen” (Krasilnikov et al., 1993; Forloni, Olivieri, and Zani, 1994; Muratov et al., 1994; Adkins, Robbins, Villalba et al., 2004).

In a clinical investigation over a five years period (1992 -1997), which included 307 patients with diffuse purulent peritonitis treated with different surgical methods - surgical drainage, closed postoperative peritoneal lavage, planned relaparotomy and laparostomy, we reported an overall mortality rate of 30.94% (95 patients). The analysis of this most important index showed the following distribution: 26.16% mortality rate in patients treated with the standard drainage method (62 out of 237); 41.18% - using the closed postoperative peritoneal lavage (7 out of 17); 40.54% - in patients with planned relaparotomy (15 out of 37) and 68.75% - in patients with laparostomy (11 out of 16).

Using the method of alternative analysis to compare the results of the four alternative methods we came to the conclusion that despite the fact that the standard drainage method shows the lowest overall mortality rate, in more severe cases the mortality rate using this method was much higher. For instance, in patients with Manheimer peritonitis index >29, the mortality rate in patients treated with the standard drainage method was 71.43% (35 out of 49); 62.5% (5 out of 8) - using the closed postoperative peritoneal lavage; 57.89% (11 out of 19) - using planned relaparotomy and 66.67% (10 out of 15) - using laparostomy. This conclusion suggests that even statistically, the treatment with more aggressive methods has a lower mortality rate, compared to the standard drainage method.

Based on the unsatisfactory results from the treatment of diffuse purulent peritonitis with the methods of drainage techniques and closed postoperative peritoneal lavage, we implemented the method of laparostomy in 1989.

The inefficiency of the drainage function of BAPS, which very quickly was filled with fibrin and purulent material, as well as the occurrence of spontaneous intestinal perforations in 4 patients, made us discontinue the use of BAPS. The impaired microcirculation in the wall of the small intestine and the purely mechanical component are likely to have relation to this most severe complication of the laparostoma. In some cases, intestinal fistulas develop, which are hard to be treated (Losanoff, Richman, and Jones, 2003). Mastboom et al., 1989, observed this complication in 14 of 135 patients treated with laparostomy. J. H. Duff and J. Moffat, 1981 - in 5 of 18, Fagniez et al., 1980 - in 19 of 32.

Very frequently omentum majus adheres to the parietal peritoneum, which prevents the evacuation of the exudate.

The losses of electrolytes, protein and liquids are great (Steinberg, 1979; Duff and Moffat, 1981) described a patient who needed 8500 ml of infusions in order to compensate the losses) (Cheatham, Safcsak, Brzezinski, and Lube, 2007).

The active intervention for evacuation of necrotic residues and fibrin during peritoneal débridement in elective relaparotomy is frequently associated with the risk of lesion of the
intraabdominal organs (especially the small intestinal loops). It is also combined with the risk of bleeding from the inflamed intraperitoneal organs and tissues, thus creating an excellent feeding medium for the bacterial flora. Furthermore, the presence of hemoglobin prevents the migration of phagocytes in the peritoneal cavity and makes even more difficult the process of phagocytosis.

The subsequent intraoperative peritoneal lavage is always accompanied by the transfer of bacteria, endotoxins and cytokines to the lymph circulation and to the systemic blood circulation. That is why the use of extracorporeal detoxification is appropriate immediately after relaparotomy.

In 3 cases we additionally performed postoperative, open continuous dorso-ventral lavage by F. Guthy and R. Pichlmayer (1980), with two tube drains introduced along the anterolateral zones in the dorsal part of the peritoneal cavity in the subdiaphragmatic spaces. This allowed the evacuation of exudate to continue between the revisions. The method, however, although with a very good theoretical base, turned out to be very cumbersome and was discontinued later on.

After accumulating experience with laparostomy, many surgeons adopted even more aggressive tactics in the treatment of these advanced forms of purulent peritonitis. According to them the surgical treatment in these cases is a multiple act, which requires elective, interval (most frequently every 24 hours) interventions and planned relaparotomy. Therefore, the multiple reinterventions make the closing of the abdominal wall unnecessary and it should be performed temporarily, using different methods (Guy, 2004; Lamme, Boermeester, Belt, van Till, Gouma, and Obertop, 2004; Agalar, Eroglu, Bulbul, Agalar, Tarhan, and Sari, 2005; Rakic, Popovic et al., 2005).

There is no clear determination between the two approaches. The difficulties originate from their essence, as well as the indications for their application.

During the introduction of these methods, with which we mark the second period in the “aggressive” treatment of diffuse purulent peritonitis, a similar uncleanness was also observed in our Clinic of Surgery. This, to some extent, makes the determination of the indications for application of each of the "aggressive" methods difficult. Such tendency is observed in other surgical clinics both in Bulgaria and abroad, despite the fact that planned relaparotomy (very close to the “close evisceration” of the French authors) began to be applied in 1979, and the results were published in the USA in 1982, 1984 and 1985 (Teichmann et al., 1984; Teichmann, Eggert, Wittmann, and Böcker, 1985; Witmann Aprahamian, and Bergstein, 1990).

The application of planned relaparotomy pursues two goals: elimination of the infectious focus (i), and evacuation of the toxic necrotic materials (ii).

Planned relaparotomy combines the advantages of both laparostomy and multiple elective relaparotomy. The elevated intraabdominal pressure is also taken under consideration. The peritoneal cavity is not closed by suturing the fascia. Instead, different methods for its temporary closure are applied. Primarily, retention sutures were used. In 1936 A. Strauss for the first time used a zip for the fascia. P. Lequit popularized the zip technique in the treatment of two cases of intestinal necrosis after mesenterial ischemia. Because of the increased intraabdominal pressure, it became necessary to implant the zip on a mesh. Other means for temporary closure include: retention wires, polyamide polypropylene mesh, polyglactine mesh, Steri-Drape, Bogota bag and different types of locking and adherent mechanisms (Barker, Kaufman, Smith, Ciraulo, Richart, and Burns, 2000; Foy, Nathens, Mashe, Mathur, and Jurkovich, 2003; Wild et al., 2004; Hinck, Struve, Gatzka, and Schurmann, 2006).

The planned relaparotomy differs from laparostomy by the more active intervention in the peritoneal cavity in order to prevent the formation of new abscesses. As a method it is more aggressive than laparostomy, where the main goal is unrestricted evacuation of exudate from the wound. In contrast to laparostomy, where the abdominal incision is left
without any tension, in planned relaparotomy the abdominal wall is tightened. These are two principally different methods.

According to D. H. Wittmann the main concepts of planned relaparotomy are the following: sanation of the infectious focus; adaptational restitution; absence of drainage; reintervention after 24 hours.

This leads to: better source control; more effective reduction of the bacterial contamination of the peritoneal cavity; better elimination of the toxic necrotic materials; early recognition of post-operative complications;

Therefore, indications for planned relaparotomy are considered:

- diffuse purulent peritonitis in cases where sanation of the peritoneal cavity and/or definite elimination of the source of infection during the primary operation is impossible;
- diffuse purulent peritonitis and presence of primary process for more than 48 hours;
- impending or present multiple organ failure or poor prognosis by the prognostic scoring systems for peritonitis.

Technique described by Teichmann and Wittmann (1986): during the first operation the primary focus is eliminated - either by suturing, excision and anastomosis or exteriorization of the lesion. The necrotic materials are evacuated and the peritoneal cavity is lavaged with 8 litres Ringer lactate solution. At the end of the procedure the abdominal wall is closed temporarily with no tension. During the second intervention (24 hours later), bacterial monitoring, evacuation of necrotic material and lavage with 8-10 liters is performed. The relaparotomies are performed until the peritoneal cavity is clean, after which it is closed without drains.

For the period from 1980 to 1984 Teichmann and Wittmann (1986) applied the method in 61 patients. A total of 235 planned relaparotomies were performed, averagely 3.9 per patient with a mortality rate of 22.9%. Wittmann et al. published a series of 117 patients with severe peritonitis treated with planned relaparotomy (applied in 15% of the patients with peritonitis), and reported a decrease of the mortality rate to 24%. In their series, 6.1 lavages were performed averagely. During each lavage bacterial monitoring was performed and the minimum inhibitory concentration was determined. Based on their study, the authors conclude that planned relaparotomy is indicated in 10% of the patients with peritonitis.

At the same time Penninckx et al., 1983 reported decreased mortality rate from 73 to 29% in a series of 42 patients with generalized peritonitis treated by planned relaparotomy.

Andrus et al., 1986 in a comparative study on 77 patients, conclude that planned relaparotomy does not have better results. Nineteen of 43 (42%) survived with the standard method, and in the group of 34 with similar risk - 12 (38%) with planned relaparotomy.

The assessment of the application of planned relaparotomy requires patients selection and clarifying the indications for the implementation of the method. At the same time, pursuing a more radical impact on the pathological process there is real danger of unreasonable widening of the indications for this aggressive (and much more expensive) method. Many authors indicate that the probable percentage for its application is 8-10% of all surgical methods for treatment of the diffuse purulent peritonitis.

Schein et al., 1988, in 246 patients with diffuse peritonitis used the method only in 9%, and in a prospective study of 22 patients with multiple elective relaparotomy the abdomen was left open in 9 patients.

Shurkalin, 1989, in 232 patients with diffuse peritonitis applied planned relaparotomy in 34 (8.79%), and laparostomy - in 18 (7.76%).
Billing et al., 1992, in 377 patients with diffuse peritonitis performed planned relaparotomy in 152 (40.32%).

Our study of 19 scientific reports in which 1324 patients with planned relaparotomy were included, showed a mortality rate of 26.49%. Another study of ours covering 45 scientific reports including 1430 patients, treated with laparostomy showed a mortality rate of 35.4%.

**Conclusion**

The application of the “aggressive” methods in the treatment of diffuse purulent peritonitis allow us to apply the main principles of treatment of peritonitis in the extreme degree, and have no other alternative in the surgical management of severe forms of diffuse purulent peritonitis.

At the same time this experience allows us to differentiate the indications for application of these two very close in their nature surgical methods.

For the planned relaparotomy:

Presence of:

- diffuse purulent peritonitis in cases where sanation of the peritoneal cavity and/or definite elimination of the source of infection during the primary operation is impossible;
- diffuse purulent peritonitis and presence of primary process for more than 48 hours;
- impending or present multiple organ failure;
- high surgical risk.

For laparostomy:

Presence of:

- total purulent peritonitis and extensive fibrinous precipitations, multiple adhesions between the intraabdominal organs;
- organ failure and unstable hemodynamics;
- very high surgical risk.

An overall analysis of our 25 years experience in the implementation of the aggressive methods of treatment of diffuse purulent peritonitis is imperative, in order to clarify the indications for the application of these methods. It is obvious that an interdisciplinary support is essential for our further attempts in this direction.

**References**


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