BACKGROUND: Postoperative morbidity after reversal of Hartmann’s procedure remains high. AIM: to evaluate efficacy of laparoscopic-assisted approach. PATIENTS AND METHODS: 36 patients (19 men, aged 55.7 ± 1.5 years) underwent laparoscopic-assisted reversal procedures in May 2008 - June 2010. The comparable control group consisted of 35 patients (16 men, aged 51.5 ± 13.9 years). RESULTS: operation time was 179.5 ± 65.1 min, 266.9 ± 71.8 min in controls. Blood loss was 64.7 ± 33.7 ml, 181.8 ± 120.4 ml in controls. No conversions occurred in the main group. In three patients of the main group preventive ileostomy was performed. There were 11 diverting stomas in the control group. Postoperative hospital stays were 9.1 ± 2.7 days (12.9 ± 3.4 days in controls). There were 2 (5.9%) postoperative complications in the main group: one wound infection and one parastomal fistula. No mortality occurred. In the control group 3 (9.1%) complications (wound infection and haematoma) were detected. CONCLUSION: laparoscopic-assisted reversal of Hartmann’s procedure promotes faster rehabilitation, its results are not worse than after open approach.

Key words: Colostomy closure; Hartmann’s reversal; Laparoscopic surgery.

Abbreviations: LAHR – laparoscopic-assisted Hartmann’s reversal; OHR – open Hartmann’s reversal; BMI – body mass index.

INTRODUCTION

The Hartmann’s procedure originally was indicated for complicated cancer of the lower sigmoid and upper rectum, but today it is used for a variety of indications, such as perforated diverticulitis, traumatic perforations, volvulus, inflammatory colitis, and postoperative anastomotic leaks. After recovery from the initial surgery, colostomy reversal and restoration of bowel continuity is a procedure of a high degree of complexity. This second stage requires a major abdominal surgery and is associated, according to different authors, with a complication rate ranging from 0.2% to 60.0% 1-2, thus an anastomotic leak reaches 12.0% 2. Such high level of complications leads to a high mortality, which reaches 8.0% 2. A high frequency of complications and mortality is caused by different reasons, such as massive postoperative adhesive process in the abdomen which arises after Hartmann’s procedure. The low locating of the stump and its involving in adhesions complicates identification and allocation. Such operations lead to distortion of normal anatomic planes. A big distance between anastomosed parts demands, in some cases, additional mobilization of a proximal colon. Besides, in some situations there is a necessity of colon resection, for example, for diverticulosis or recurrence of the colon cancer.

Minimally invasive techniques for colorectal surgery have evolved since the early 1990s. Advantages of the laparoscopic approach in colectomies such as a decreased morbidity, less postoperative pain, hospital stay, and a faster return to a normal activity have led to the application to other procedures 3-4. In 1994 Sosa J.L. published the first results of 14 laparoscopic-assisted Hartmann’s reversal (LAHR). Thus, in this research conversions rate occurred in 22.2% of the cases 5. With experience accumulation of the LAHR, conversions frequency of these operations has dropped, but postoperative complications are still high and reach according to C. Haughn et al. – 32.8% 6, and mortality rate (S. Slawik et al.) – 5.2% 7. Several small series have reported successful laparoscopic-assisted Hartmann reversal, and a recent systematic review has confirmed that minimally invasive benefits apply for LAHR. Nevertheless, the data comparing laparoscopic and open Hartmann’s reversal (OHR) are limited. The aim of this study was to assess the efficacy of the LAHR in patients with the end stoma in comparison with the patients operated with a traditional mean.
TECHNIQUE OF OPERATION

We used the following method of laparoscopic-assisted Hartmann’s reversal. At the beginning of the procedure stoma is separated from the abdominal wall through a peristomal incision. Then pre stomal parts of the colon are mobilized by local dissection of adhesions (Figure 2). The anvil of the circular stapler inserts into the lumen and put it in peritoneal cavity (Figure 3).

Then in upper and lower corners of the wound two 10 mm thoracars are placed. Wound is closed and pneumoperitoneum is made (10-12 mmHg) (Figure 4). During the laparoscopic revision prevalence and expressiveness of the adhesive process in the abdominal cavity is estimated (Figure 5). Adhesiolysis was carried out using scissors, monopolar diathermy, or ultrasonic activated devices according to surgeon’s preference (Figure 6).

Only the left lateral canal and small pelvis were released from adhesive process for free anastomosis formation. Also adhesions, which could lead to the ileus, are divided. Additional ports were used in the paraumbilical zone and in the right or left lower quadrant of the abdominal wall (Table 4). Then we identified and mobilized rectal stump (Figure 7).

To identify the rectal stump, a dilator or stapling device was inserted into the rectum. Mobilization of the left colon, splenic flexure, and resection of proximal sigmoid or left colon were done as needed (Figure 8).

A transanal, end-to-end anastomosis was performed using a circular stapling device (Figure 9). Anastomotic integrity is confirmed by using insufflations of air and saline. Hemostasis is checked and wound is closed. Conventional reversal of Hartmann’s procedure was performed in control group.

RESULTS AND DISCUSSION

We have estimated intraoperative data (Table 5). Operative time in the laparoscopic group on the average was shorter for 90 min., than in the open group. That is caused, first of all, by the economy of time at the middle laparotomy, total adhesiolysis and closure of a postoperative wound. The same factors cause smaller blood loss in the main group (64.7±3.7 ml) in comparison with the control (181.8±120.4 ml). A little less adhesive process is noted in the laparoscopic group – 18.4±5.6 and 19.9±4.3 points accordingly. Length of a postoperative wound was 9.5±2.5 cm in the main and 36.5±3.3 cm in the control groups.

In the laparoscopic group, there was a necessity of a preventive stoma in 3 cases: in one patient because of the arisen difficulties at anastomosis formation and at two because of total diverticulosis. No conversion occurred in the group of patients, who underwent LAHR.

Also, we have estimated postoperative data (Table 6). Time of appearance of a peristalsis and the defecation at the patients of the laparoscopic group, in average, arose for 1 day earlier, than at patients in the open group. As in the main group ability to self-service arose on 2.3±0.5 and

### Table 1

<table>
<thead>
<tr>
<th><strong>DEMOGRAPHICS AND CLINICAL DATA</strong></th>
<th>Laparoscopic group (n=36)</th>
<th>Open group (n=35)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex** (male/female)</td>
<td>19:17</td>
<td>16:19</td>
<td>0.55</td>
</tr>
<tr>
<td>Age, years* (mean, dev., range)</td>
<td>55.7±11.5 (39-75)</td>
<td>51.5±13.9 (18-74)</td>
<td>0.18</td>
</tr>
<tr>
<td>BMI, kg/m²* (mean, dev., range)</td>
<td>28.6±5.7 (17.1-40.7)</td>
<td>27.7±4.9 (20.5-39.0)</td>
<td>0.51</td>
</tr>
<tr>
<td>No of previous surgeries** (mean, dev., range)</td>
<td>0.6±0.9 (0-4)</td>
<td>0.5±0.7 (0-2)</td>
<td>0.72</td>
</tr>
<tr>
<td>Time to reversal, month* (mean, dev., range)</td>
<td>12.7±7.4 (4-36)</td>
<td>14.3±8.4 (5-48)</td>
<td>0.42</td>
</tr>
<tr>
<td>Stump length, cm* (mean, dev., range)</td>
<td>23.7±8.6 (10-41)</td>
<td>21.6±9.9 (10-55)</td>
<td>0.36</td>
</tr>
<tr>
<td>Distance between anastomosed colon parts, cm* (mean, dev., range)</td>
<td>11.5±4.2 (7-24)</td>
<td>12.8±4.9 (7-20)</td>
<td>0.45</td>
</tr>
</tbody>
</table>

* - Student’s test; ** - Pearson’s test; 1 - except Hartmann’s procedure

### Table 2

<table>
<thead>
<tr>
<th><strong>INDICATIONS FOR HARTMANN’S PROCEDURE</strong></th>
<th>Laparoscopic group (n=36)</th>
<th>Open group (n=35)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colon cancer</td>
<td>22</td>
<td>17</td>
<td>0.29</td>
</tr>
<tr>
<td>Diverticulitis</td>
<td>11</td>
<td>10</td>
<td>0.85</td>
</tr>
<tr>
<td>Abdomen trauma</td>
<td>2</td>
<td>6</td>
<td>0.12</td>
</tr>
<tr>
<td>Villous tumor</td>
<td>1</td>
<td>0</td>
<td>0.32</td>
</tr>
<tr>
<td>Endometriosis</td>
<td>0</td>
<td>1</td>
<td>0.31</td>
</tr>
<tr>
<td>Tuboevarial abscess</td>
<td>0</td>
<td>1</td>
<td>0.31</td>
</tr>
</tbody>
</table>

*Pearson’s test
4.1 ± 0.5 days after operation accordingly. Nevertheless, postoperative days to flatus authentically did not differ. There were 2 (5.9%) postoperative complications in the main group: one wound infection and one parastomal fistula. In control group 3 (9.1%) complications, all - wound infection, were detected. In both groups no mortality occurred.

Postoperative hospital stay in main group was 9.1 ± 2.7 days and – 12.9 ± 3.4 in control.

We have studied a postoperative pain syndrome at patients of both groups. The level of patients’ pain is estimated on a ten point’s visually-analogue scale (Figure 10).

In the main group in the first day of operation patients specified that pain level was 4.0 ± 0.6 points, while in control – 6.7 ± 1.0 points (p<0.0001). On the fifth day many patients of laparoscopic group did not mark a pain. In the open group patients marked a pain even after a week.

All patients were under supervision, in ranges from 1 to 24 (9.0 ± 5.4) months in laparoscopic and from 2 to 44 (25.8 ± 9.4) months in open groups. It is noted that in both groups, there were no ileus after procedure. This fact allows suggesting preliminary conclusion, that division of all adhesions in the abdomen at LAHR is not necessary.

Study of quality of life of patients in the basic and control groups was made by MOS-SF – 36. The analysis of the received data has shown that statistically significant
distinctions in indexes of physical health in compared
groups are not noted (Figure 11).
However the index of mental health was different in the
main group and in the control group on the 8th postopera-
tive day and was 49.5 +3.3% and 41.0 +9.5% (p<0.05) ac-
cordingly. In 1 month after operation significant distinc-
tions were not noted (Figure 12).

**MATERIALS AND METHODS**

Between May 2008 and June 2010 in state science cen-
ter of coloproctology LAHR were performed in 36 pa-
tients. These patients entered into a main laparoscopic re-
search group. The control, open group included 35 pa-
tients, who underwent OHR in last 3.5 years.

Criteria of inclusion were:
- Hartmann procedure in anamnesis;
- Length of the rectal stump =10 cm.

Criteria of exception were:
- Contraindications for pneumoperitoneum;
- Recurrence of the colon cancer;
- Postoperative ventral hernia demanding surgical
  correction.

To identify differences between the laparoscopic and
open reversal groups, univariate analysis with chi-square
(Pearson’s), t-test (Student’s) was used to compare groups
by demographic, complication, and postoperative course
criteria. Statistical calculations were completed using sta-
tistical software Statistica 6.0 (StatSoft. Inc., USA) and a
p value < 0.05 was considered to represent statistical sig-
nificance for all comparisons.

In the laparoscopic group, there were 19 male and 17 fe-
male, in the open group – 16 and 19, accordingly. Age
ranges from 39 to 75 years (55.7 +11.5) in the main group
and from 18 to 74 years (51.5 +13.9) – in the control. The
average body mass index (BMI) was 28.6 +5.7 kg/m² and
27.7 +4.9 kg/m², accordingly (Table 1).

Time to reversal after Hartmann’s procedure ranges
from 4 to 36 month (12.7 +7.4) in the laparoscopic group
and from 5 to 48 month (14.3 +8.4) – in the open one. A
number of previous abdominal surgeries on the average
was 0.6 +0.9 in the main and 0.5 +0.7 in the control group.
Significant differences in length of a stump and a distance
of anastomosed parts of the colon were not noted. In the
main group these parameters on the average were
23.7 +8.6 cm and 11.5 +4.2 cm accordingly, in the control

**TABLE 5**

<table>
<thead>
<tr>
<th>Intraoperative data</th>
<th>Laparoscopic group (n=36)</th>
<th>Open group (n=35)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time, min* (mean, dev., range)</td>
<td>179+65.1 (90-360)</td>
<td>266.9+71.8 (170-460)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Blood loss, ml* (mean, dev., range)</td>
<td>64.7+33.7 (50-200)</td>
<td>181.8+120.4 (50-500)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Adhesive process, points** (mean, dev., range)</td>
<td>18.4+5.6 (9-27)</td>
<td>19.9+4.3 (14-27)</td>
<td>0.20</td>
</tr>
<tr>
<td>Length of a postoperative wound, cm* (mean, dev., range)</td>
<td>9.5+2.5 (6-16)</td>
<td>36.5+3.3 (30-42)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Necessity of preventive stoma**</td>
<td>3</td>
<td>11</td>
<td>0.01</td>
</tr>
<tr>
<td>Conversion rate</td>
<td>0</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

*Student’s test; **Pearson’s test

**TABLE 6**

<table>
<thead>
<tr>
<th>Postoperative data</th>
<th>Laparoscopic group (n=36)</th>
<th>Open group (n=35)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of peristalsis, days* (mean, dev., range)</td>
<td>1.0+0.2 (1-2)</td>
<td>1.5+0.6(1-3)</td>
<td>0.0001</td>
</tr>
<tr>
<td>Postoperative days to flatus* (mean, dev., range)</td>
<td>2.3+0.5 (2-4)</td>
<td>2.7+0.9 (1-5)</td>
<td>0.02</td>
</tr>
<tr>
<td>Defecation/stoma function, days* (mean, dev., range)</td>
<td>3.0+0.8 (2-4)</td>
<td>4.1+1.5 (2-10)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Self-service, days* (mean, dev., range)</td>
<td>2.3+0.5 (2-3)</td>
<td>4.1+0.5 (3-5)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Length of stay, days* (mean, dev., range)</td>
<td>9.1+2.7 (7-15)</td>
<td>12.9+3.4 (8-28)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Complication rate**</td>
<td>2 (5.9%)</td>
<td>3(9.1%)</td>
<td>0.61</td>
</tr>
</tbody>
</table>

*Student’s test; **Pearson’s test
group – 21.6 ±9.9 cm and 12.8 ±4.9 cm. The most common indication for Hartmann’s procedure in both groups was complicated left colon cancer. This disease was in 22 patients in the laparoscopic group and 17 - in the open one. Diverticulitis was a cause of the operation in 11 and 10 cases, accordingly. Various traumas of the abdomen were at 2 and 6 persons, accordingly. In one case in laparoscopic group the indication to procedure was large villous rectal tumor. One woman underwent Hartmann’s procedure concerning extra genital endometriosis and one more – tubeovarial abscess with bowel wall involving (Table 2).

Causes for the procedure with formation end stoma were peritonitis (38 cases), obstruction (28 cases), anastomotic leak (2 cases), low level of the rectal resection (2 cases) and in one case – bleeding from anastomosis zone (Table 3).

At 2 cases in the laparoscopic group and at 5 - in the open one, attempts to reversal were undertaken. But due to a massive adhesive process in the abdomen and difficulties of stump allocation, operations were refused.

For an expression assessment of the adhesive process in the abdominal cavity we have developed the original method. The abdominal cavity is divided on 9 classic topographo-anatomic areas and in each of them degree of adhesions is estimated on a three-point scale, where:

- 0 – no adhesions;
- 1 – mild adhesions;
- 2 – moderate adhesive process;
- 3 – severe adhesive process.

Then the points are summarized, and the result defines degree of adhesive process (Figure 1).

**CONCLUSION**

Laparoscopic-assisted Hartmann’s reversal is a technical feasible operation and it is accompanied with the reduction of blood loss from 181.8 ±120.4 to 64.7 ±33.7 ml. and reduction of the operative time from 266.9 ±71.8 to 179.5 ±65.1 min. LAHR promotes more fast rehabilitation, lower postoperative pain and results of this surgery are not worse than after conventional technique. Division of adhesive process only in the left lateral canal and small pelvis does not lead to postoperative adhesive ileus.

**SUMMARY**

**LAPAROSKOPSKI ASISTIRANA REKONSTRUKCIJA NAKON HARTMANN-OVE PROCEDURE**

Pozadina: Postoperativni morbiditet nakon rekonstrukcije posle Hartmann-ove procedure ostaje visok.

Cilj: evaluacija efikasnosti laparoskopski asistiranog pristupa.

Pacijenti i metode: 36 pacijenata (19 muškaraca, starosti 55.7±/-11.5 god.) bilo je podvrgnuto laparoskopski asistiranoj rekonstrukturinjoj proceduri od maja 2008 do juna 2010. Komparativna kontrolna grupa sastojala se od 35 pacijenata (16 muškaraca, starosti 51.5±/-13.9 godina).

Rezultati: vreme operacije iznosilo je 179.5±/-65.1 min i 266.9±/-71.8 min u kontrolnoj grupi. Gubitak krvi bio je 64.7±/-33.7 ml, 181.8±/-120.4 ml kod kontrole. Nije bilo
konverzija u ispitanoj grupi. Kod 3 pacijenta kreirana je protektivna ileostoma. Bilo je 11 diverzionih stoma u kontrolnoj grupi. Postoperativna hospitalizacija je trajala

FIGURE 6
ADHESIOLYSIS BY MONOPOLAR DIATHERMY

FIGURE 7
MOBILISATION OF RECTAL STUMP

FIGURE 8
MOBILISATION OF THE LEFT COLON

FIGURE 9
FORMATION OF END TO END ANASTOMOSIS BY USING TRANSCANAL CIRCULAR STAPLER DEVICE

FIGURE 10
THE LEVEL OF PATIENTS PAIN (10 POINT VISUAL-ANALOGUE SCALE)

FIGURE 11
NO STATISTICALLY SIGNIFICANT DIFFERENCES IN PHYSICAL HEALTH IN BOTH GROUPS
9.1+/−2.7 dana (12.9+/−3.4 dana kod kontrole). Bilo je 2 (5.9%) postoperativnih komplikacija kod ispitivane grupe: jedna infekcija rane i jedna parastomalna fistula. Nije bilo mortaliteta. U kontrolnoj grupi 3 (9.1%) komplikacija (infekcija rane i hematoma) su zabeleženi.

Zaključak: laparoskopski asistirana rekonstrukcija nakon Hartmann-ove procedure promoviše brzu rehabilitaciju i rezultati nisu gori nego kod otvorenog pristupa.

Ključne reči: zatvaranje kolostome, Hartmann-ova procedura, laparoskinska hirurgija

REFERENCES


This study was performed to compare conventional Hartmann’s reversal to laparoscopic Hartmann’s reversal with regard to complication, readmission, and reoperation rates.