THE EVALUATION OF RISK FACTORS OF ANASTOMOTIC LEAKAGE IN PATIENTS WITH COLORECTAL CANCER COMPPLICATED BY ILEUS

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ABSTRACT Background: Obstructive ileus and peritonitis are the most frequent complication of colorectal cancer, manifested in 8-40% cases. Anastomotic leakage (AL) is a fatal complication in colorectal surgery. In our study, we aim to analyse the safety, outcomes in patients with colon obstruction after resection with new anastomosis technique implementation and to identify prognostic value of each risk factor on the development of AL. Methods: A retrospective analysis of prospectively acquired data of 155 consecutive emergency patients with cancer of the proximal rectum and sigmoid colon complicated by chronic bowel obstruction in the stage of subcompensation and decompensation were included in our study and divided into two groups. In the basic group (n=95), primary nonfunctional anastomosis (PNA) was performed after resection of the rectum. In the comparing group (n=60), resection of the colon or rectum with primary anastomosis was performed. Results: Postoperative complications have arisen in 5(5,3%) patients of group I and 11 (18,4%) patients of group II. AL was developed only in 1 patient in the basic group (1,1%) and in 7 (11,7%) patients of the compared group on the 5th-12th day after the operation. We have worked out the rating score of risk factors of AL. A score was given for each AL factor which we had selected for the elaboration of this scale. Conclusions: Based on AL risk factors scale we highlighted five levels of risk which have significant clinical meaning and help surgeons decide finally how to finish operation in a patient with bowel obstruction to avoid AL. PNA with preventive transversostoma was shown to provide adequate decompression of the colon, reliable prevention of colorectal AL and avoid complex reconstructive operations.

KEYWORDS: colorectal cancer, bowel obstruction, anastomotic leakage.
80% of patients and mortality makes up to 43.8%. One-third of all deaths in colorectal surgery is caused by AL [2-4].

AL is more likely to occur after anterior resection of the rectum than after colon resection [5,6]. The incidence of AL is a polyethyologic problem and depends on the location and conditions of its imposition. Multi-central investigations reveal that not only local changes in the bowel have an impact on AL, but also such factors as: blood transfusion, ASA score > 3, smoking, alcohol abuse, patients with diabetes mellitus, hypertensive disease, hypoproteinemia, overweight, age, sex, tumor stage, the use of steroids and neoadjuvant chemoradiotherapy, heart and lung failure and many others [7-15]. AL increases the risk of local recurrence and reduces overall 5-year survival [16,17].

Overlapping colostomy closes surgeries on obstructive ileus in 26-70%. The second stage - reconstructive surgery is one of the most complicated operation in abdominal surgery with a high percentage of postoperative complications. The frequency restoration of physiologic passage through the colon can be performed only in 30-40% of patients [18,19].

Identifying all AL risk factors and preoperative treatment adjusted to reduce the impact of these factors are so far the only standards of treatment of patients who have colorectal cancer complicated by obstructive ileus [20-25].

In this study, we aim to analyse the safety, outcomes in patients with colon obstruction after resection with primary non-functional anastomosis (PNA) comparing with primary anastomosis and influence of each risk factor on AL. On the basis of this analysis to maintain algorithm of reducing the incidence of AL in patients with colorectal cancer complicated by bowel obstruction.

**Materials and methods:**

One-hundred and fifty-five patients (87 males and 68 females), with cancer of the proximal rectum and sigmoid colon complicated by an ileus, who were treated in the surgical department of Ternopil University Clinic (Ukraine) from 1996 till 2016, were selected for our retrospective database analysis. The youngest patient was an age of 32 years old and the oldest of 88 years old. The mean age was 65,5±10,8. The classification of bowel obstruction which we use in our practice divide chronic bowel obstruction into 3 stage: compensation, subcompensation and decompensation [26]. All patients were presented in the emergency surgical department with chronic bowel obstruction in the stage of subcompensation (122 patients) and decompensation (33 patients) and complained of on acute periodic pain in the abdomen, mostly in hypogastric and left the mesogastric area, nausea, vomiting, non-discharge of gases and faeces, general fatigue, weight loss. Patients with a non-complication form of colorectal cancer in the stage of compensated bowel obstruction were excluded from our investigation. All patients had the same preoperative diagnostic program (objective examination, complete blood count, coagulation profile, blood chemistry, chest and abdomen X-ray, colonoscopy or rectoromanoscopy, CT-scan in some cases, ultrasonography) and postoperative follow-up program. 135 patients were divided into two groups. In the basic (I) group(n=95), primary nonfunctional anastomosis(PNA) with preventive transversostoma (patent No 72889) was performed after resection of the rectum. In comparing(II) group(n=60), resection of the colon or rectum with primary anastomosis was performed. Local peritonitis was revealed in 7(7,4%) patients of group I and 5(6,7%) patients of group II. All patients had the same weight loss. Patients with a non-complication form of colorectal cancer of the proximal rectum and sigmoid colon complicated by cancer of the proximal rectum and sigmoid colon (I) group(n=95), primary nonfunctional anastomosis(PNA) with preventive transversostoma (patent No 72889) was performed. In 1 (1,7%) case, AL was successfully treated without operation. In 4 (6,7%) patients with AL, subcutaneous eventration developed in early postoperative period. The average length of hospital stay of patients with AL was 36,85 days. In 3 (5%) cases of AL, local recurrence of cancer was diagnosed within 6-9 month after operation.

**Method description:**

**Figure 1:** All operation performed in the strictness of oncological requirements and standard (D3 lymph dissection and total or subtotal mesorectal excision).

**Figure 2:** After the resection of the proximal end of the colon was sutured by the stapler, two welt ligatures were imposed through the colon in the cross direction, which was lowered into the distal lumen.

**Results and Discussion:**

Postoperative complications were developed in 5 (5,3%) patients of group I and 11 (18,4%) patients of group II. AL was diagnosed only in 1 patient of the basic group (1,1%) and in 7 (11,7%) patients of the compared group on the 5th-12th day after the operation. In 6 (10%) cases of AL, relaparotomy, lavage and Hartman’s procedure were performed. In 1 (1,7%) case, AL was successfully treated without operation. In 4 (6,7%) patients with AL, subcutaneous eventration developed in early postoperative period. The average length of hospital stay of patients with AL was 36,85 days. In 3 (5%) cases of AL, local recurrence of cancer was diagnosed within 6-9 month after operation.
Traditional end-to-end anastomosis (one layer) was supplemented. Proximally imposed preventive transversostoma, which is disclosed on the 2nd day after the operation.

On the 7th-8th day, we ligatures were dragged out, afterwards necrosis of staple stitched area of the colon was advanced, and as a result, anastomosis became passable. Stoma was closed in the 2-2.5 month after operation.

We have worked out the rating score of AL risk factors (Table 1).

To reduce leakage rate, many studies have focused on identifying patients at risk for postoperative development of AL [1,4,6,10,12,13]. AL is responsible for the increased rate of local recurrence and thus shorter long-term survival rate and quality of life [16,17]. In our study in 3 cases with AL, during 6-9 month recurrence of cancer was diagnosed. Our results support the findings of the previous studies that have shown that localization of the tumor and stage of bowel obstruction are an important risk factor of AL, and it is declared that in more distal part of large bowel AL is more frequently than in proximal part and in patients with decompensated bowel obstruction the incidence of AL is more higher [1,5,6]. The presence of peritonitis is a significant risk factor of AL. Our study showed that risk of AL in a group of patients with peritonitis is in 2.5 times higher than in patients without peritonitis. Similar results have been reported by other investigation [14,15]. Comorbidities are significant AL risk factor. In our study incidence of AL was higher in 11.9 times in patients with diabetes [6,11], in 5.28 times greater in patients with pneumonia and in 1.58 times higher in patients with ischemic heart disease [12]. These findings are consistent with some other studies [7,9,11-13]. Also we have found that incidence of AL was in 2.5 times higher in male than in female [13], in 5 times higher in patients with less than 45g/l level of total serum [16,20], in 1.66 times higher in smokers [12], in 1.55 times higher in patients with adhesions [9].

We have analysed each factor and the whole rate score of AL in general. We have calculated general points of AL for all patients from both groups. The lowest point which we received during this analysis was 7, and the highest was 32.

All the patients with AL gained over 19 points by our scale (zone of high risk), and 25% gained even over 24 points. 90.5% of patients without AL gained less than 24 points, and 59.9% of patients without AL gained less than 19 points. The odds ratio is 3.17; it means that the probability of AL among patients with the risk of more than 24 points (zone of very high risk) in 3.17 times higher than in patients who obtained less than 24 points.

For a better analysis of the proposed scale, we have constructed comparing ROC curve (Figure 5) between sensitivity and specificity of AL risk index. The area under this curve is 81.8%, which is a good index and it indicates that the proposed risk scale is a useful method to identify patients who are at high risk of AL development (95% confidence interval of this area ranges from 73.1% to 90.5%).

By analysis above of AL risk factors score, we have highlighted five levels of risk: very low risk of AL is ≤ 7 points, low risk is 8-13 points, moderate risk is 14-18 points, high risk is 19-23 points and very high risk is ≥ 24 points. We have conducted the calculation of patients belonging to one or another AL risk separately for both groups (Figure 6). As we see from the figure No 6, the majority of our patients were at moderate, high and very high risk of AL. Furthermore, we have analysed affiliation of patients with AL to some degree of risk: 2 (28.6%) patients were at high risk, and 5 (71.4%) were at very high risk of AL. These findings are consistent with some other studies that assessed prognostic parameters in emergency colorectal surgery [1,21-23].

Despite on significant success of modern technological achievements percentage of Hartman’s procedure is still high in colorectal surgery. The role of the protective stoma is controversial, but it is accepted that stoma can reduce the incidence of AL [4,18,19,23]. However, the new method of PNA which

![Figure 3](image1.png)

**Figure 3:** Traditional end-to-end anastomosis (one layer) was supplemented. Proximally imposed preventive transversostoma, which is disclosed on the 2nd day after the operation.

![Figure 4](image2.png)

**Figure 4:** On the 7th-8th day, we ligatures were dragged out, afterwards necrosis of staple stitched area of the colon was advanced, and as a result, anastomosis became passable. Stoma was closed in the 2-2.5 month after operation.

![Figure 5](image3.png)

**Figure 5:** Comparing ROC curve of analysis of the AL scoring scale risk.
Table 1 Incidence of each AL risk factors in both groups and given score

| No | Anastomotic risk factors       | I group (95 patients - 100%) | II group (60 patients - 100%) | Score |
|----|--------------------------------|------------------------------|------------------------------|-------|
| 1. | Age                            |                              |                              |       |
|    | 20-59 years                    | 28 (29,5 %)                  | 18 (30 %)                    | 0     |
|    | 60-74 years                    | 46 (48,4 %)                  | 29 (48,3 %)                  | 1     |
|    | 75-89 years                    | 21 (22,1 %)                  | 13 (21,7 %)                  | 2     |
|    | >90 years                      | -                            | -                            | 4     |
| 2. | Gender                         |                              |                              |       |
|    | Male                           | 52 (54,7 %)                  | 34 (66,7 %)                  | 1     |
|    | Female                         | 43 (45,3 %)                  | 26 (33,3 %)                  | 0     |
| 3. | BMI                            |                              |                              |       |
|    | 25-35                          | 22 (23,2 %)                  | 6 (10 %)                     | 1     |
|    | >36                            | 2 (2,1 %)                    | 3 (5 %)                      | 2     |
| 4. | Stage of obstruction           |                              |                              |       |
|    | Subcompensated bowel obstruction| 80 (84,2 %)                  | 42 (70 %)                    | 1     |
|    | Decompensated bowel obstruction| 15 (15,8 %)                  | 18 (30 %)                    | 7     |
| 5. | Peritonitis                    |                              |                              |       |
|    | Serous peritonitis             | 1 (1,1 %)                    | 2 (3,3 %)                    | 3     |
|    | Local purulent peritonitis     | 7 (7,4 %)                    | 4 (6,7 %)                    | 4     |
|    | Diffuse purulent peritonitis   | 2 (2,1 %)                    | -                            | 7     |
| 6. | Tumor location                 |                              |                              |       |
|    | Sigmoid colon                  | 17 (17,9 %)                  | 25 (41,7 %)                  | 1     |
|    | Rectosigmoid corner            | 4 (4,2 %)                    | 16 (26,7 %)                  | 2     |
|    | Upper rectum                   | 42 (44,2 %)                  | 14 (23,3 %)                  | 4     |
|    | Middle rectum                  | 32 (33,7 %)                  | 4 (6,7 %)                    | 5     |
| 7. | Tumor spread                   |                              |                              |       |
|    | Distant and regional metastasis| 33 (34,7 %)                  | 16 (26,7 %)                  | 1     |
|    | Locally distributed process    | 13 (13,7 %)                  | 15 (25 %)                    | 3     |
| 8. | Comorbidities                  |                              |                              |       |
|    | Pneumonia, COPD                | 7 (7,4 %)                    | 11 (18,3 %)                  | 1     |
|    | Coronary heart disease, heart failure | 81 (85,3 %) | 46 (76,7 %) | 2     |
|    | Diabetes                       | 3 (3,2 %)                    | 3 (5 %)                      | 2     |
|    | Other comorbidities, depending on the severity | 36 (37,9 %) | 34 (56,7 %) | 1-2   |
| 9. | Hypoproteinemia                |                              |                              |       |
|    | 45-65 g/l                      | 45 (47,4 %)                  | 23 (38,3 %)                  | 2     |
|    | <45 g/l                        | 11 (11,6 %)                  | 15 (25 %)                    | 4     |
| 10. | Other AL risk factors          |                              |                              |       |
|     | Technical difficulty of the operation | 86 (90,5 %) | 39 (65 %)   | 2     |
|     | Intraoperative decompression   | 51 (53,7 %)                  | 21 (35 %)                    | 2     |
|     | Adhesions in the abdomen       | 18 (18,9 %)                  | 10 (16,7 %)                  | 1     |
|     | Smoking                        | 31 (32,6 %)                  | 11 (18,3 %)                  | 3     |
Figure 6: The level of AL risk in both groups

we describe in our study showed that it is a good alternative for multi-stage complex restorative operation. AL occur only in 1 (1.1%) patient, indicating the high reliability of developed and applied in our clinic method, while in literature data the incidence of AL is about 6-28% [2-4]. Application of primary nonfunctional anastomosis is not limited to colon obstruction but is also appropriate in case of local peritonitis.

Conclusions

PNA with preventive transversostoma provides adequate decompression of the colon, reliable prevention of colorectal anastomotic leakage and avoids complex reconstructive operations. Identification of risk factors can help decrease their frequency of AL.

Based on our scale we propose the next medical diagnostic algorithm:

1. For patients with very low and low risk of AL, we recommend applying primary anastomosis.
2. For patients with moderate risk, when "local" factors prevail (decompensated obstruction, peritonitis, etc.), we recommend using primary nonfunctional anastomosis.
3. For patients with moderate risk, when "non-local" factors prevail (comorbidities, offset obstruction, age, BMI, etc.), we recommend applying primary anastomosis.
4. For patients with very high and high level of AL, we recommend using primary nonfunctional anastomosis.
5. In the case of the presence of such factors as diffuse purulatve fibrinous peritonitis, we recommend using Hartman’s procedure.

Competing Interests

The authors declare no conflict of interest.

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