The evolution of sphincter-saving surgery in patients with low rectal cancer.

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Summary. The comparative analysis of different methods in the sphincter-preserving surgical interference efficiency in treatment of 205 patients with low rectal cancer depending on the method of bowels reconstruction was carried out. The advantages of proctectomy with formation of anastomosis under the developed in clinic methodology and low anterior resections of rectum with formation of colorectal anastomosis using a linear stapling device were proved to ameliorate the ultimate and functional results of treatment and patients' quality of life improvement in comparison with standard abdominal-anal resections.

Key word: low rectal cancer, sphincter-saving surgery, method of reconstruction.

Actuality

The problem of surgery treatment in patients with low rectal cancer (LRC) is still one of the most argumentative in oncology that is determined by the high increase of morbidity level, high frequency of local recurrences, stable low survival, difficulties of social and labor rehabilitation of patients [1,2,5,13,18]. According to the National Cancer Registry the morbidity of patients with rectal cancer has increased 18 % in Ukraine during the last 15 years and death rate has increased 12,4 %. The rough morbidity index made 20,2 to 100 000 people in population rate and death rate of 12,1 correspondingly in 2010. In the structure of oncology morbidity rectal cancer (RC) ranges the fifth in male sex and the seventh in female sex, in the whole death rate structure it takes the fourth position in both groups. Without reaching a year lethality made up 31,9 % in 2010 and it had nearly been without changes since 2001 [4]. Whereas reaching a year lethality never comes up 18 % in the USA. General five-year survival rate of patients with RC

never exceeds 31 % in Ukraine, while in the USA this index makes up 69 % with the tendency towards its augmentation 2,5 % every five years that is due to the major change in the influence of surgical procedure technique, more widespread adoption of preoperational use of radiotherapy and multimodal approach in choosing the policy of treatment [4,8,13,14].

Rectal adenocarcinoma is localized in the distal part in 60-65 % and more than 35 % is in low ampullar part [1,3,5,11].

The surgical management is the main one in the treatment of such a nosological form. Recent decades have seen revolutionary changes in the distal RC surgery up to the significant growth of specific density of sphincter-saving operations (SSO) due to the improvement of the technique of surgical procedure with the methodological adoption of total mesorectal excision (TME), widespread use in the clinical practice of mechanical linear stapling device in formation of low coloanal and colorectal anastomosis in addition to conventional use of neoadjuvant radiotherapy [5,6,12,18].

Accumulation and development of knowledge about the biology of RC namely regularity of distal intramural spreading resulted in definite denying “the rule of 5 cm” as for the distal resection margin for the patients of this category [1-3,5,12,13]. According to modern trends to obtain a negative resection margin (R0) is considered appropriate for patients with distal RC [5,12,13,18]. In such a way abdominoperineal resection lost its status as “the gold standard” in surgical treatment of patients with LRC being replaced by functionally profitable sphincter-preserving operations in surgical procedure [1,3,15,18] .

According to a modern stage of medical development oncology expediency of using SSO in patients with LRC treatment is not a controversial subject any more but a firm clinical paradigm [2,5,8,10,12]. In addition to this surgical method of treatment the demands to secure not only satisfactory oncology but also functional results of treatment and moreover acceptable life level that can be achieved by means of the highest possible morphological integrity and functional adequacy of sphincter mechanism of rectum [6,9,12,17]. While the value and

resection rectum level is regulated by oncological efficacy, functional treatment results are influenced by many factors when the method of reconstructive stage takes a significant place among them [5,6,9,13,16].

Nowadays there are three main ways of SSO in LRC surgery. They are stapled low anterior resection, proctectomia (intersphincteric resection) and abdomino-anal resection of rectum (AAR) with pulled-down colon («pull-through» operation) onto the perineum with surplus in different modifications. The revolutionary difference of such surgical procedures is the method of reconstruction stage. In the countries with well-developed economy the operations of a choice in patients' LRC treatment are stapled low anterior resection and proctectomia [8-10,18], while in Ukraine and post-Soviet countries in general AAR is still one of the most popular way of SSO treatment for this group of patients [1-3]. According to literature data these ablastous ways of surgical procedures are identical, as the crucial surgery moment is specified by the general resection stage of TME while functional results are still contradictory and ambiguous enough [5,6,9,10,16].

The representatives of different surgery schools postulate the priority of repercussion of this or that surgical procedure and demonstrate the advantages of their author approach especially relying direct and functional results of their treatment [1,3,9,17]. Nonetheless, according to our concern the value of functional results in the majority of research cases is not often informative enough and doesn't depict impartial assessment as it doesn't contain appropriate and unambiguous interpretations of final data estimated with the help of legitimate standard special tools. Thus, the conceptions of relative descriptions ("well", "satisfactory", "bad") are often used with other own authors' and any incompetent unimportant from checklists data are cited [1,3,8,9].

Thereby, there is an urgent necessity to conduct comparative analyses of all the three ways of SSO in patients with LRC appears. The usage of modern, objective and legitimate tools is intended to minimize the amount of mistakes in estimation the functional results of treatment.

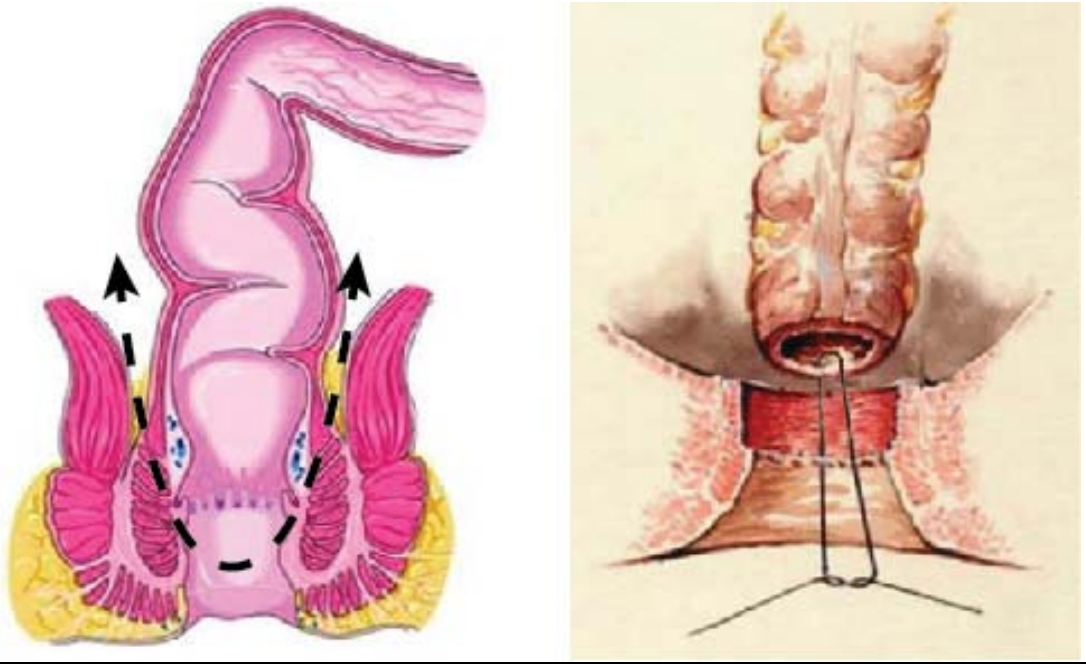
The object of the research is to increase the efficiency of patients' with LRC treatment and improve quality of life improving the SSO methodology.

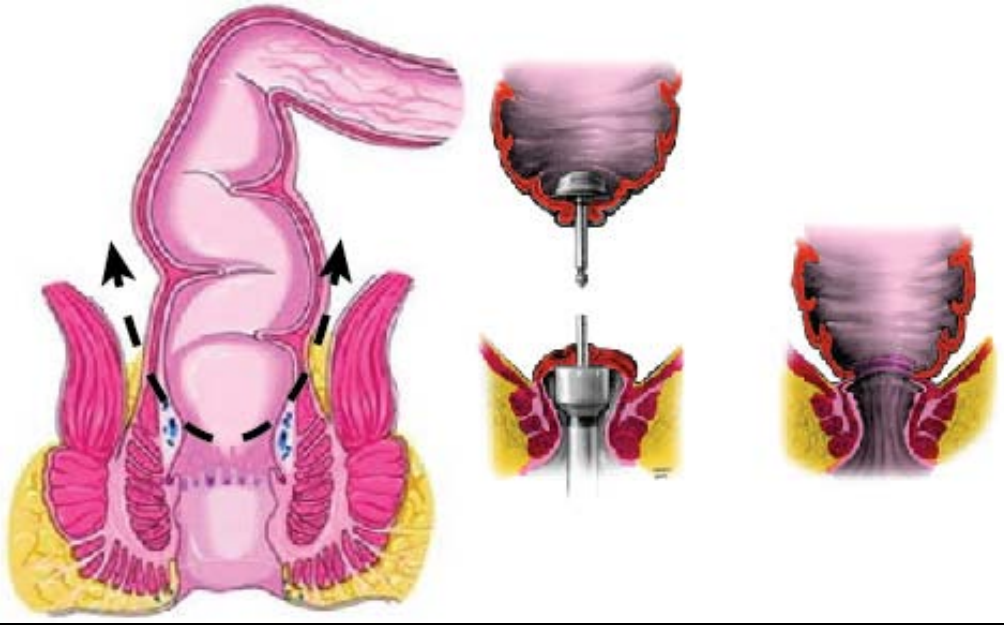
Research material and methods

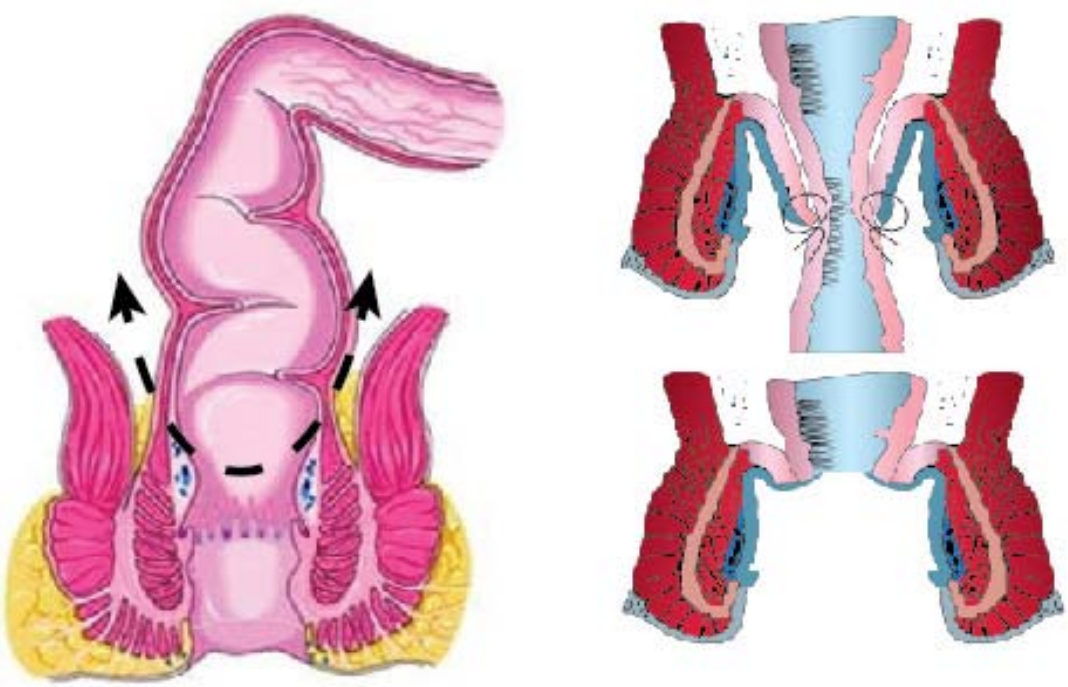
Complex clinical statistics analysis of the SSO results among the 205 patients with low ampoule part of rectum T2- 4N0 - 2M0 is conducted. There were male sex of 119 (58,1 %) and female sex of 86 (41,9 %) among them. The average age of body under consideration included 60,9 ± 10,2 and fluctuated in the range of 24-81 years old. More than 87 % of patients were in the age of 50 years old and older. For appropriate phasing a standard complex of researches was used including pelvic MRI, endorectal US and CT scan. All the patients got neoadjuvant radiotherapy according to the standards, all of them got TME.

According to the way of bowels reconstruction there were examined three groups of patients: group 1 included 65 patients who were performed the proctectomia operation (PE) with the formation coloperianal hand-sewn anastomosis after the elaborated methodology in clinic, a temporary diverting stoma to protect anastomosis wasn't used; group 2 included 65 patients who were performed low anterior resection (LAR) with the formation of stapled colorectal anastomosis and temporary loop ileostomy (81,5 %). In 2 months covering up of ileostomy was performed in consequence with the lack of clinical and radiological data as for anastomotic leakage; group III included 75 patients who underwent abdomino-anal resection of rectum (AAR) with pulled-down colon ("pull-through" operation) onto the perineum with surplus and hand formation of colorectal or coloanal anastomosis with the help of evagination method in two-stage. According to the fact that the evidence of functional disorder after low rectal resections is inversely proportional to the height of anastomosis formation over the dental line, to conduct further intergroup comparison of functional results and the quality of life adequate heterogeneous group III was subdivided into a group III A (colorectal anastomosis, a kind of Turnbull-Cutait procedure; equivalent to LAR) and a group III B (coloanal anastomosis; a kind of Nisnevitch-Petrov-Holdin operation; equivalent to PE) according to the height of anastomosis formation. Diagrammatic

display of the level of rectal resection and the methodology of bowels reconstruction is depicted on the Fig. 1.

Group I – proctectomia
• partial / subtotal resection of the IAS • coloperianal hand-sewn anastomosis • temporary diverting stoma wasn't used
Inset1 

Group II – low anterior resection
• stapled colorectal anastomosis • temporary loop ileostomy + (81 %) / - (17 %)
Inset 2 

Group III A – abdomino-anal resection of rectum (Turnbull-Cutait procedure)
• pulled-down colon (“pull-through” operation) onto the perineum with surplus and hand formation of colorectal anastomosis with the help of evagination method in two-stage • temporary diverting stoma wasn’t used
Inset 3 

Group III B – abdomino-anal resection of rectum (Nisnevitch-Petrov-Holdin operation)
• partial / subtotal resection of the IAS • pulled-down colon (“pull-through” operation) onto the perineum with surplus and hand formation of coloanal anastomosis with the help of evagination method in two-stage • temporary diverting stoma wasn’t used
Inset 4

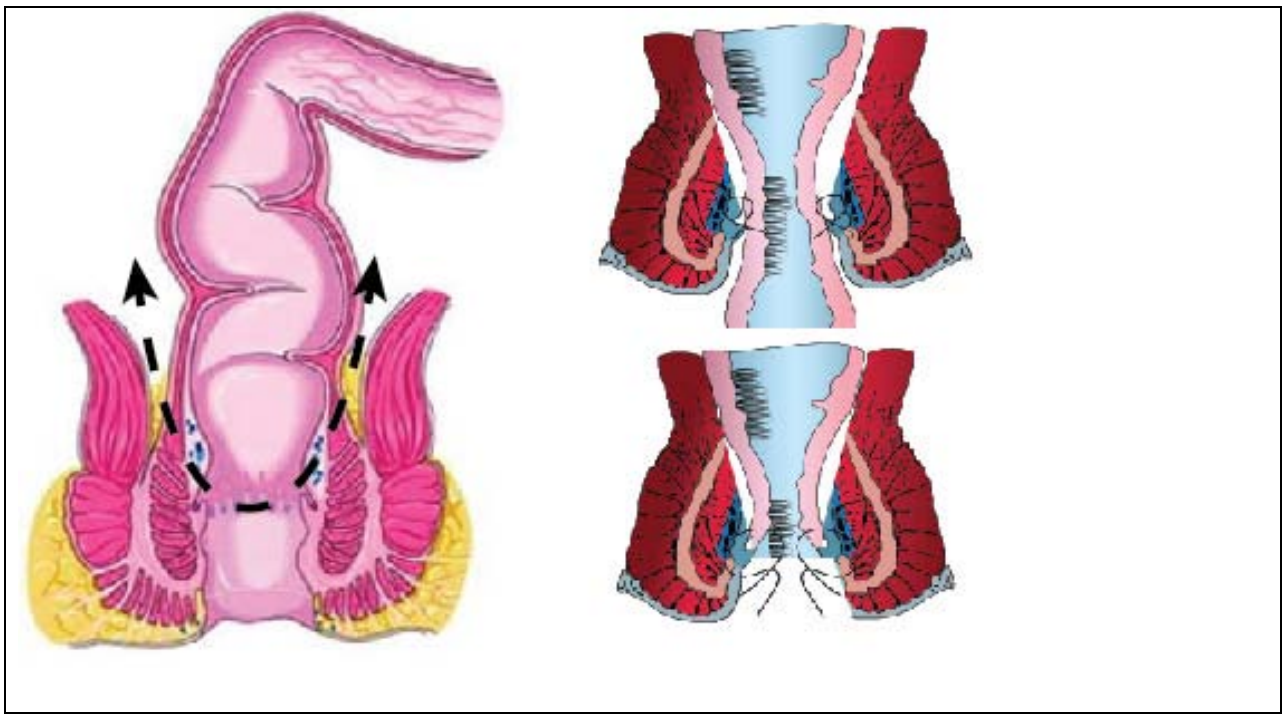


Fig. 1 Diagrammatical depicting of the rectal resection level and the methodic of bowels reconstruction in the investigated groups

The value of functional results conducted with the help of the survey FISI score. For additional objective value persistent infusion anal profilometry was used aiming to identify the pressure in anal canal and sphincterampoulemanometry to value the condition of neuroreflex neorectum arch and sphincter apparatus of rectum (SAR). The quality of life was investigated with the help of specialized survey FIQL. To provide justification of the research planning, statistical method ground and formation of investigation groups according to target aims were conducted. Statistical analysis was conducted with the help of statistical program package Stata 12. An average period of patients' supervision made 39,2 (16 - 64,2 months). The groups are represented by age, sex, oncological process spreading and general prediction factors. Patients' characteristics are submitted in the table 1.

Table 1.

Patients' characteristics

Groups	**I**	**II**	**III**	**P value**

Sex				> 0,05
m	35 (53,8 %)	31 (47,7 %)	53 (70,7 %)	
f	30 (46,2 %)	34 (52,3 %)	22 (29,3 %)	
Average age **(X+σ)**	60,1±11,2	58,8±10,1	61,3±9,3	> 0,05
Tumor height from anocutaneus line of Hilton (anal verge), sm, **(X+σ)**	3,05 ±1,0	5,2 ±0,8	4,1 ±1,1	< 0,05
Tumors < 3 sm from line of Hilton	72,5 %	4,6 %	32 %	< 0,05

Results and discussions

The analysis of direct results of the treatment in the investigated groups was carried out. Thus, in I group 3 patients (4,6 %) had post-operation complications which were represented by widespread necrosis in pulled-down colon that resulted in formation of ileostomy (case 1), transverse colostomy (case 1) and extirpation of pulled-down colon (case 1) correspondingly.

In group II 7 patients (10,76 %) were revealed in anastomotic leakage with outer fecal fistula developments. Among them the complications were eliminated due to the conservative way in 3 cases (4,6 %) and all the cases had their ileostomy closed within the period of 7 months. All the rest 4 cases (6,15 %) underwent the formation of transverse colostomy which took them different periods of post-operation time to heal the defect in anastomosis. It should be mentioned that in the last cases preventive ileostomy in the bowels reconstruction was not used. According to chronological analysis of surgical procedures data it was ascertained that 3 patients had their operations completed in 2008 at the stage of adoption of new practices. This fact is vivid to justify the necessity of conventional formation of diversion intestinal stoma after low anterior resection of rectum.

In group III 9 patients (12 %) had complications. Among them 6 cases (8 %) were observed necrosis of pulled-down colon, notably 1 case (1,3 %) was researched with terminal necrosis and conservative treatment was held; 2 patients (2,7 %) had their transverse colostomy formed; 2 more cases (2,7 %) had re-

laparotomy with proximal colon re-pulling-down; and 1 patient (1,3 %) had the extirpation of pulled-down colon . The leak of delayed anastomosis was revealed in 1 case (1,3 %) that required the formation of transverse colostomy. There was no lethal outcome in the cases of investigated groups. Although there are better results of treatment in groups I and II than in group III, statistically significant difference in the frequency of post-operation complications between investigated groups was not distinguished ($p>0,05$).

Thereby necrosis of pulled-down colon in groups I and III and anastomotic leakage in group II happened to be the most frequent post-operation complications. Taking into consideration the fact that anastomotic leak is conditioned on poor blood supply or ischemia of approximated segments in a gastrointestinal tract it is etiopathogenetically reasonable to join these two types of complications in a unit – the complications connected with the ischemia of transplant. Taking everything into consideration, this type of post-operation complication is the dominating one in the investigated groups and it is traced in III cases (4,6 %) in group I, in 7 cases (10,8 %) in group II and in 7 cases (9,3 %) in group III.

In our investigation an average length of post-operation bed-day made up 12,9 (min 10 – max 27) in group I; 11,7 (min 9 – max 34) in group II and 17,3 (min 14 – max 36) in group III correspondingly. Statistically significant ($p<0,05$) reduction of the length of bed-day in groups I and II is caused by a reconstruction stage of operations with immediate anastomosis formation. Nevertheless the methodology of delayed anastomosis formation in two stages is used in group III which appropriately leads to length increase of patients' staying in hospital.

Analyzing immediate and long-term results of treatment in compared groups statistically significant difference of rate as overall and recurrence-free cumulative survival ($p>0,05$) is not mentioned in the investigation. This fact is explained by the usage of united for all the three groups standard technique of operative intervention (TME). Thus, the index of three-year general and recurrence-free survival in group 1 made up 79,5 % and 66,1 %, in group 2 81,5 % and 66,6 %, and in group 3 77,9 % and 68 % respectively (Fig. 2, 3). The frequency of

locoregional relapses made up 6 cases (10,9 %) in group 1; 6 cases (10,9 %) in group 2; and 10 cases (13,3 %) in group 3 (p>0,05).

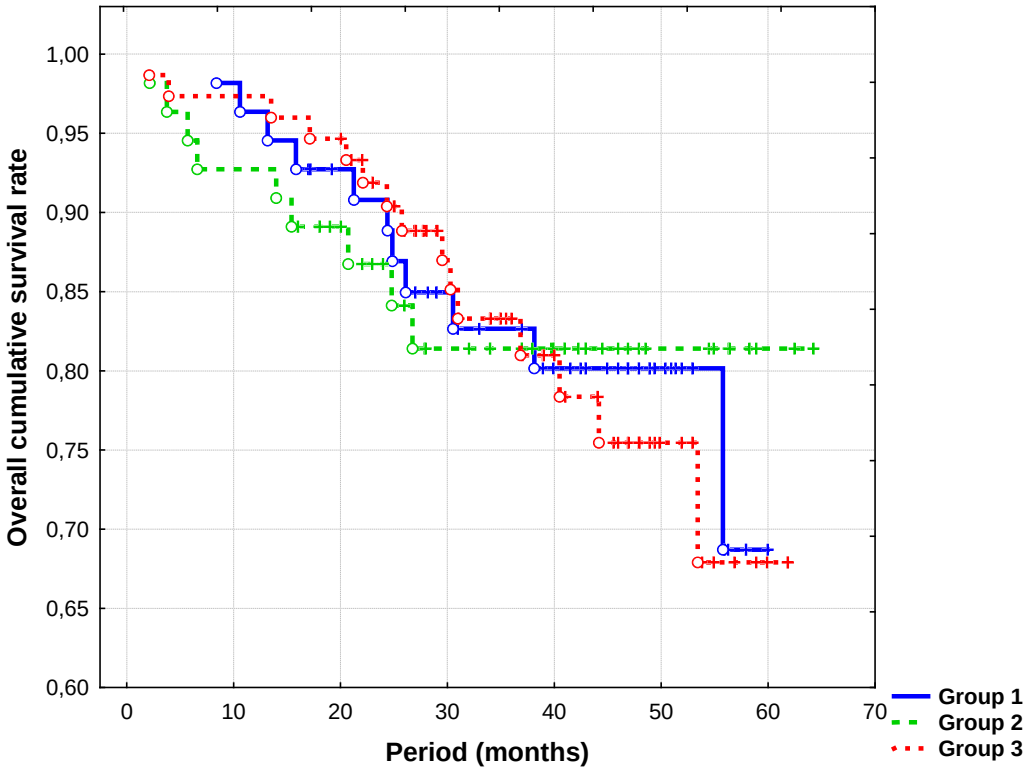


Fig. 2. The dynamics of overall cumulative survival rate according to Kaplan-Meyer in the investigation groups (p> 0,05). (**p –** the assessment of variety significancy as for the criterion χ^2)

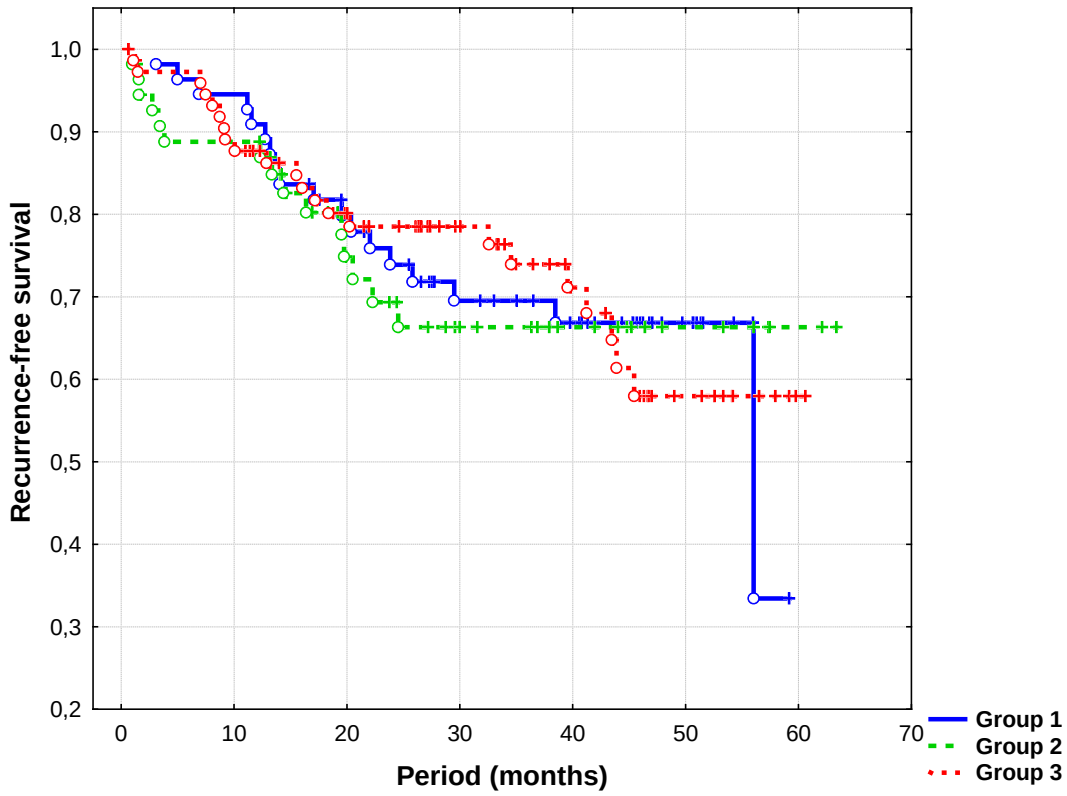


Fig. 3. The dynamics of recurrence-free survival in the investigated groups (p > 0,05).

The frequency of post-operation complications suggested in the research is not higher than in some other literature sources. According to the data of foreign literature the frequency of anastomotic leakage after LAR makes 5 till 23 % [6-10,12,15] . Thus, Stratilatovas E. et al. [17] were studying the results of treatment of 82 patients after LAR . The frequency of post-operation complications made up 34,4 % (11 patients) among whom anastomotic leak occurred in 5 cases (15,6 %). During the next 3 years cases of relapses occurred in 4 patients (4,9 %). General 3-year long survival made up 79%. According to the investigations made by Fazio V. et al. [7] the results of LAR were analyzed with the formation of coloanal anastomosis in 364 patients. The height of tumour above the dental line is 3,5 sm (2-5,5). Temporary loop ileostomy was used in all cases and it closed in a period of 3 months. General number of complications made up 32 %. Anastomotic leakage was traced in 10,2 %.

According to the system overview data laid out by Martin S. et al. [13] as for the results of intersphincter rectum resection the frequency of R0 resection made

97 %, the frequency of diverting ileostomy formation made 93,1 %, average post-operative mortality made 0,8 % (0-6), postoperative complications made 25,8 %, anastomotic leakage made 9,1 %, fecal fistula made 2,2 %, septic complications in pelvic cavity made 2,4 %. With the median of observation within 56 months the frequency of local relapse made 6,7 % (0-23), overall 5-year survival made 86,3 % (62-97), and recurrence-free survival made 78,6 % (69-87).

Taking into consideration the original point of the research to provide ultimate objective value of functional results and life quality in the investigated groups as a complex modern index of social adaptation was paid a great attention. While analyzing functional results with the help of FISI score a stable tendency to improve rates within a year after the operation in all investigated groups is determined with the most dynamical group II. With paired intergroup comparison of equivalent groups weighty statistical advantages of PE and LAR groups as for equivalent AAR group ($p<0.01$). The dynamics of indices is suggested in tables 2 and 3.

Table 2.

The level of anal incontinence according to FISI score in the groups with PE and AAR (group III B), (X±σ)

Groups of investigation	**Fecal Incontinence Severity Index**			
	3 months	6 months	9 months	12 months
Group I	55,5±3,6	48,5±6,4	46,5±8,4	43,0±9,9
Group III B	60,2±1,0	59,2±2,2	57,7±5,0	56,5±6,2
p I-IIIB	0,0001	0,0001	0,0001	0,0001

Table 3.

The level of anal incontinence according to FISI score in the groups with LAR and AAR (group III A), (X±σ)

Groups of	**Fecal Incontinence Severity Index**

investigation				
	3 months	6 months	9 months	12 months
Group II	53,6±4,5	41,9±7,3	31,8±7,1	30,8±7,5
Group III A	58,6±2,0	54,7±7,4	51,2±7,7	47,0±6,5
p II-IIIA	0,0001	0,0001	0,0001	0,0001

The analyses of the results got while performing profilometry also supported the persistent trend increasing of basal and squeeze pressure in anal canal during a year. The statistical analyses of basal tone rate and squeeze pressure SAR with the comparison of equivalent groups demonstrated evidently low rate in group III A and group III B with comparison of groups II and I correspondingly ($p<0,05$) except basal tone rate of the first 6 months between groups II and III A ($p>0,05$). The most distinguished difference according to received results is traced between groups I and III B. The dynamics of indicators is depicted on the Fig. 4. Analyzing of the indicator of the length of functional anal canal between groups in comparison no significant statistical difference was revealed ($p>0,05$), that supports the adequacy of intergroup comparison as for the value of rectal resection. On the grounds of sphincterampoulemanometry as for basal tone and pressure under voluntary constriction in the anal canal the same conformity to the analyses of profilometry data is marked, notably tonus increasing during the year after the operation; statistically evident advantage of groups I and II over groups III A and III B correspondingly ($p<0,01$) with the exception basal tone rate on the third month of observation between groups II and III A ($p=0,158$).

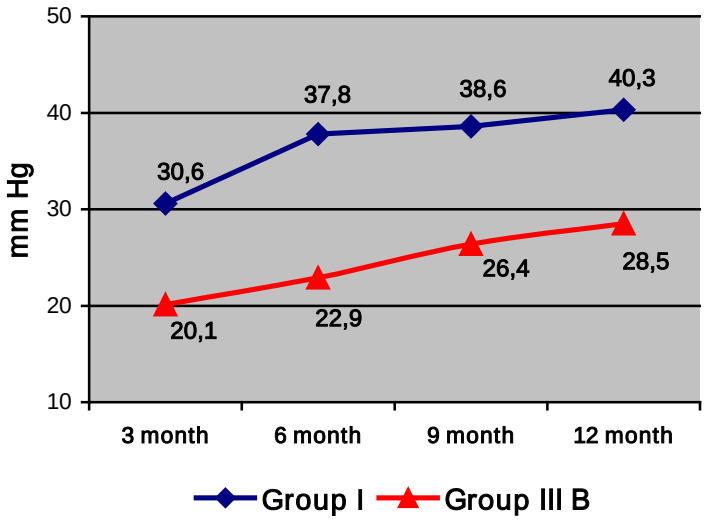


Fig. 4a. The dynamics of indicators bazal tone SAR with anal profilometry (p < 0,05).

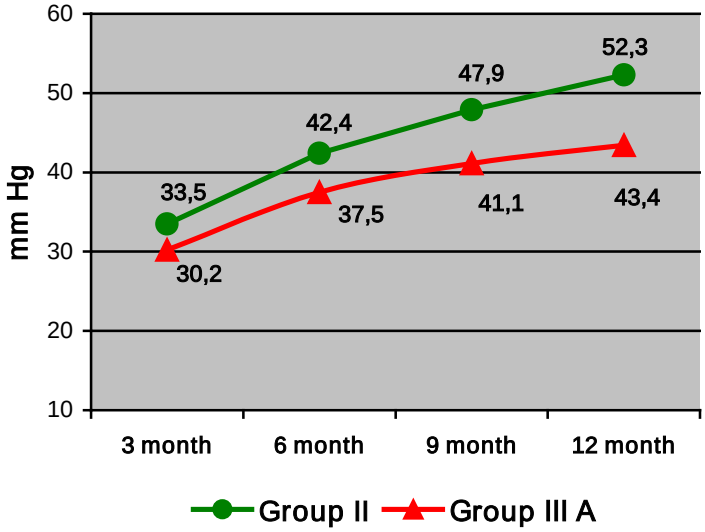


Fig. 4b. The dynamics of indicators bazal tone SAR with anal profilometry (p < 0,05 from 6 m.).

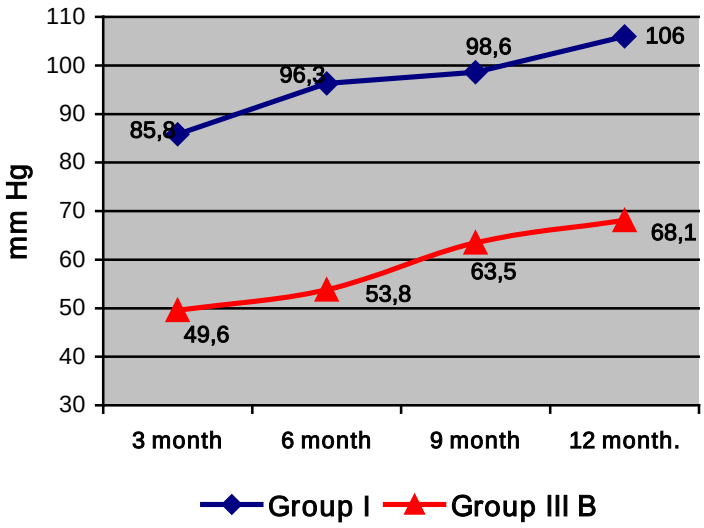
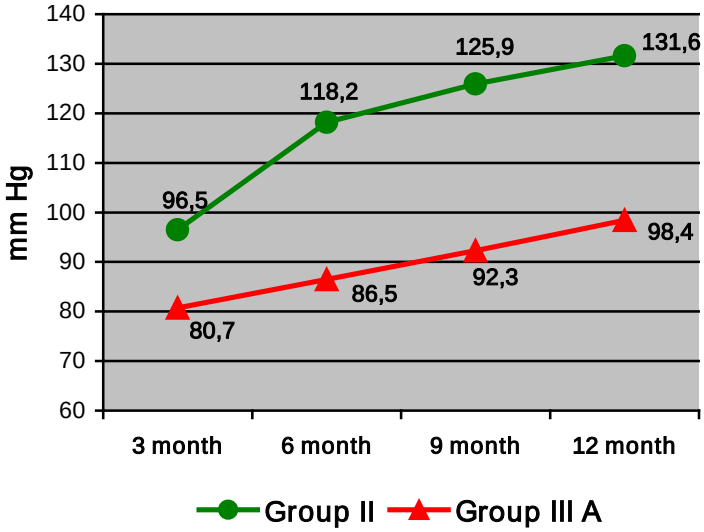


Fig. 4c. The dynamics of squeeze pressure under voluntary constriction in the anal canal ($p < 0,05$).



Fiog. 4d. The dynamics of squeeze pressure under voluntary constriction in the anal canal ($p < 0,05$).

Analyzing FIQL indices statistically significant difference was revealed in quality of life factors between groups II and III A and between groups I and III B as for all survey scales ($p<0,01$), and improving dynamics factors that is shown in Fig. 5.

All the mentioned above advantages of groups I and II over groups III A and III B correspondingly can be explained by decreasing of the functional reserves of

SAR after AAR in consequence of the use of evagination stage in reconstruction and a long stage of edematous inflammatory brought down colon in the anal canal. The advantages of groups I and II over groups III A and III B as for functional results of treatment and quality of life prove the fact that the stage of anal continence is influenced not just the residual rectal value or neorectum but the decrease of functional reserve SRA in consequence of its mechanical damage during the operation or after it. These data coincide with the research results conducted by E. S. Jehle и T. Haehnel that prove the absence of correlation not only between the level of anastomosis and manometric function factors of SRA, but also between the level of anastomosis and the frequency of stools. The authors postulate that anorectic function after the low anterior rectum resection is not conditional on residual rectum length but surgical trauma of SAR and malfunction of its innervation [10].

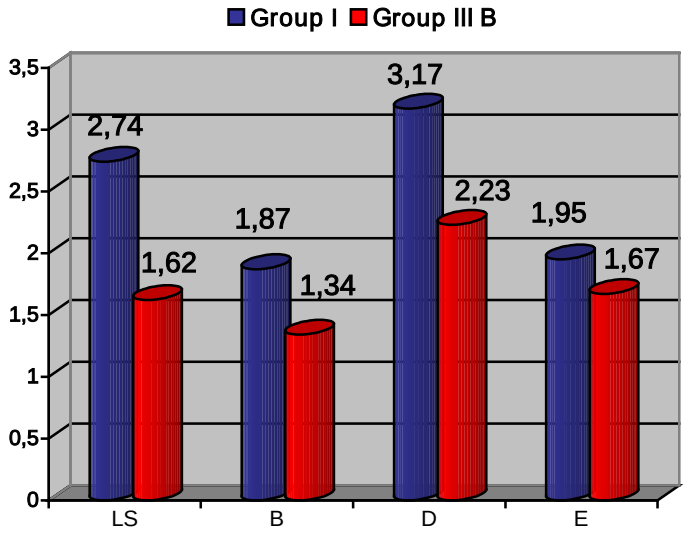


Fig. 5a. The quality of life according to FIQL scale ($p < 0,05$).

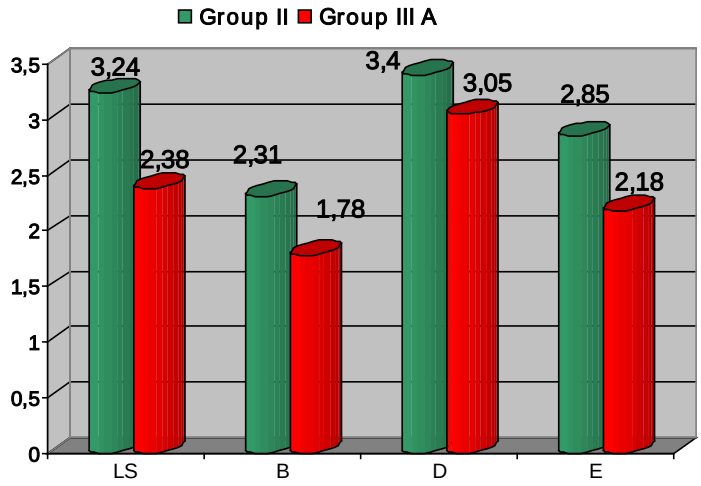


Fig.5b. The quality of life according to FIQL scale ($p < 0,05$).

The evolution of treatment in patients with rectum cancer suggests constant selection of more effective methodology. A revolutionary breakthrough in the rectum cancer treatment was the introduction of TME methodology and neoadjuvant radiotherapy. Just the usage of TME with preservation of vegetative autonomic nerve system of pelvis results in the possibility to get the best direct, functional and long-term results of treatment [5-9,14,17,18]. The question of intensity of functional malfunction after low anterior and intersphincter rectal resections with different types of bowels reconstructions [3,5,9,12]. Only the facts received in a result of thorough comprehensive scientific analyses allow overestimating the approaches of using different types of SSO in the surgery of low rectal cancer.

Conclusions

1. The method of bowels reconstruction after SSO with low rectal cancer is an independent predicting factor of distinguished functional disorder and decreasing of the quality of patients' life.
2. Groups with proctectomia and low anterior resection demonstrate significant statistical considerable advantages over equivalent groups with abdomino-anal resection according to functional results of treatment ($p<0,01$) that regulates the priority of their use in surgical treatment of patients with low rectal cancer.

3. The quality of patients' life after proctectomia and low anterior resection is statistically much better in comparison with equivalent groups with abdomino-anal resection of rectum ($p<0,01$).
4. With stapled low anterior resection in patients with low rectal cancer the bowels reconstruction should be conventionally supported with divert intestinal stoma that allows diminishing the number of after-surgery complications, to expedite rehabilitation and cut financial and economical expenditures for the treatment of patients down.

Taking everything in consideration, the results of the research demonstrate that in the modern phase of oncology development low anterior resection and proctectomia are the operations of choice in the surgery of low rectal cancer due to the ensuring of better functional treatment results and better quality of patients' life.

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