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PRIMARY EXPERIENCE OF NATURAL ORIFICE SPECIMEN EXTRACTION SURGERY (NOSES) FOR RECTAL CANCER

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AIM: to demonstrate the first results of natural orifice specimen extraction surgery (NOSES) for rectal cancer.

PATIENTS AND METHODS: in the period from June 2019 to October 2019 five NOSES for rectal cancer were performed in the hospital. The following factors were evaluated: age, gender, BMI, ASA, operation time, intraoperative blood loss, intraoperative and postoperative complications, duration of postoperative rehabilitation, need for narcotic analgesics.

RESULTS: mean age of patients was 61.2 years. Mean BMI was 25.9 kg/m². Mean ASA score was 2. Mean operative time was 225 minutes. Mean intraoperative blood loss was 45 ml. One intraoperative complication occurred – defect of anastomosis in the point of crossing of 3 stapler sutures. One postoperative complication occurred – postoperative ileus. Narcotic analgesics were not used. Mean duration of postoperative stay was 9.8 days. The primary results demonstrate feasibility of NOSES for rectal cancer with adequate qualification of colorectal surgeon.

CONCLUSION: NOSES is a promising technique for rectal cancer surgery. However, the further experience and randomized trials are required.

[Key words: rectal cancer, natural orifice specimen extraction surgery]

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INTRODUCTION

Minimal invasive technologies have developed rapidly and are widespread in all areas of surgery in past twenty years. A lot of randomized trials have proven that the laparoscopic technique significantly exceeds the conventional one in terms of the postoperative rehabilitation with comparable oncological results [1,2]. However, during any laparoscopic resection for CRC, minilaparotomy is necessary to extract the specimen. It accompanied by postoperative pain, wound complications and increase in the duration of postoperative stay. The solution the problem was the implementation of the natural orifice transluminal endoscopic surgery (NOTES) in colorectal surgery. However, the technique did not receive further development due to the technical problems associated with the difficulty of exposure and the inability to use traditional rigid laparoscopic instruments [3]. The search for a solution to these problems led to the development of a new branch of transluminal surgery – natural orifice specimen extraction surgery (NOSES). During all main stages of the procedure are performed by laparoscopic access, and the specimen extracts through the anus or vagina. Currently, the greatest experience with NOSES procedures for CRC has been accumulated in Asian clin-

ics. So, in 2018 Professor Wang X. released a textbook summarizing the experience of more than 500 cases of NOSES for CRC [3]. In Russia, there are currently only a few centers where similar procedures are performed [4-6]. The purpose of this study was to demonstrate the primary experience of laparoscopic surgery using the NOSES technique for CRC.

PATIENTS AND METHODS

In June 2019 – October 2019 five procedures were performed using the NOSES technique for CRC in the Oncology Department of Regional Clinic Hospital of Ryazan. The mean age of the patients was 61,2 years. There were 4 women and 1 man. The mean body mass index (BMI) was 25,9 kg/m². The mean ASA index was 2. The mean distance from the anal verge to the lower edge of the tumor was 11,2 cm. In three cases the preoperative TNM stage was cT₂N₀M₀. In one case, a patient with cancer of the middle third of the rectum cT₃N₂M₀ received neoadjuvant chemoradiotherapy with a positive response, which was confirmed by magnetic resonance imaging. In one case the stage was T_{1s}N₀M₀. The classification proposed by Professor Wang in 2018 was used [3].

Table 1. The classification of NOSES procedures by Wang X.

Abbreviation	Meaning
NOSES I	Laparoscopic rectal resection for lower ampullary cancer with transanal extraction of specimen
NOSES II	Laparoscopic rectal resection for middle ampullary cancer with transanal extraction of specimen
NOSES III	Laparoscopic rectal resection for middle ampullary cancer with transvaginal extraction of specimen
NOSES IV	Laparoscopic rectal resection for upper ampullary cancer (distal sigmoid colon cancer) with transanal extraction of specimen
NOSES V	Laparoscopic rectal resection for upper ampullary cancer (distal sigmoid colon cancer) with transvaginal extraction of specimen
NOSES VI	Laparoscopic left hemicolectomy with transanal extraction of specimen
NOSES VII	Laparoscopic left hemicolectomy with transvaginal extraction of specimen
NOSES VIII	Laparoscopic right hemicolectomy with transvaginal extraction of specimen
NOSES IX	Laparoscopic colectomy with transanal extraction of specimen
NOSES X	Laparoscopic colectomy with transvaginal extraction of specimen

Table 2. Patient characteristics

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Mean value
Sex	M	F	F	F	F	-
Age, year	66	65	59	54	62	61,2
BMI, kg/m ²	31,2	22,4	27,9	23,7	24,3	25,9
ASA	2	2	2	2	2	2
The distance from tumor to anus, cm	8	8	18	10	12	11,2
Stage TNM	cT ₂ N ₀ M ₀	cT ₃ N ₂ M ₀	cT ₂ N ₀ M ₀	cT ₂ N ₀ M ₀	cT ₁ N ₀ M ₀	-
Type of NOSES	II	II	IV	III	V (+LCCE)	-

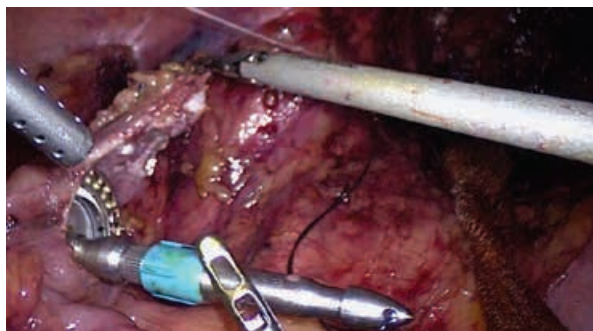
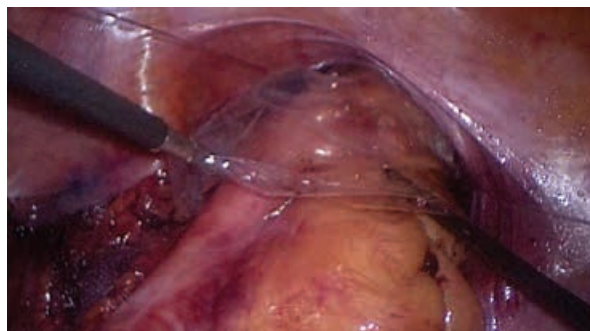
According to this classification we performed two NOSES II procedures, one NOSES III, one NOSES IV and one NOSES V. In last case a simultaneous operation was performed – anterior resection was combined with laparoscopic cholecystectomy (LCCE). The description of the operated patients as a whole and separately is presented in Table 2.

Technique of the operations.

NOSES procedures for rectal cancer have common features to all laparoscopic resections. Their differences are associated with the extraction of the specimen. Veress needle was used to create carboxyperitoneum, 4 trocars were used: 10 mm trocar close to navel for optics, 12 mm trocar in the right iliac region, 5 mm trocar in the right mesogastrium, 5 mm trocar in the left mesogastrium. Mediolateral mobilization of colon was performed using an ultrasonic scalpel. In all cases D2-lymph node dissection was performed.

Mobilization of the inferior mesenteric artery (IMA) and its bifurcation was performed. In all cases the superior rectal artery (SRA) was intersected with preserving of the left colon artery (LCA). Then the sigmoid colon, descending colon, rectum were mobilized in the interfascial layer according to the principles of complete mesocolon excision and mesorectal excision. The further course of the operation was different in each of the four cases.

Operation № 1. Mobilization in the caudal direction was performed up to the low third of the rectum. Partial mesorectal excision was performed. The proximal intersection was made at the level of the middle third of the sigmoid colon, the distal one at the level of the low part of the rectum using scissors. The lumen of the opened colon was irrigated with an antiseptic solution. The anvil of the circular stapler was inserted to the colon. A loop of Prolene 3-0 was fixed on the rod

**Figure 1.** Insertion of the anvil of the circular stapler to the colon**Figure 2.** Transanal extraction of the specimen (view from the abdominal cavity)

of the anvil (Fig. 1).

The colon was cut with a linear stapler above the inserted anvil of the circular stapler, while the loop fixed on the rod of anvil remained outside the colon. The angle of the stapler suture was cut with scissors. Pulling for the previously applied loop, the rod of the



Figure 3. The rectum extracted transanally by eversion

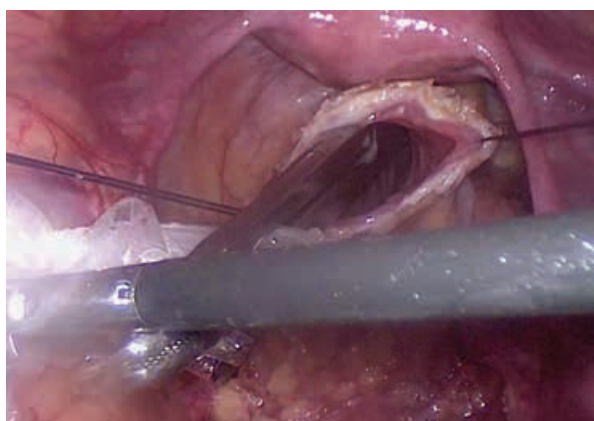


Figure 4. A polyethylene «sleeve» inserted into the abdominal cavity and captured by a clamp through the rectum

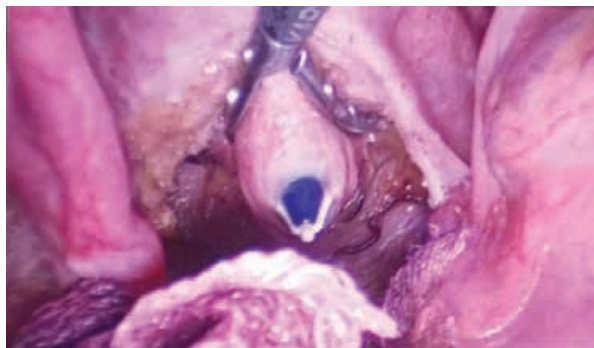


Figure 5. An incision is formed in the posterior fornix of vagina

anvil was pulled out of the colon. The proximal colon was prepared for suturing. A «sleeve» of polyethylene was inserted transabdominally through the 12 mm trocar in the right iliac region according to ablasic and antiseptic principles. Then one of the edges of the sleeve was pulled out through the anus. Then the specimen was extracted through anus (Fig. 2). In the next step the lumen of the rectum was closed using a linear stapler. The circular stapler was inserted through the anus, connected with the anvil. The stapler anastomosis was created. To protect the anastomosis, a preventive ileostomy was made.

Operation № 2. Mobilization in the caudal direction was performed to the pelvic floor, the total mesorectal excision was performed. Using the forceps, the anvil of a circular stapler with a loop was transanally inserted into the colon above the proximal line of the intersected sigmoid colon. The sigmoid colon was cut at the middle third using a linear stapler so that the loop fixed on the anvil remains outside the colon. The rod of the anvil was pulled from the colon according to the method described above. The colon was ready for stapling. The rectal stump was washed with an antiseptic solution. The next step was the eversion of the rectum from the abdominal cavity to the outside. This technique was carried out by pressing transabdominally on the stump of the rectum and pulling the stump of the rectum using a forceps transanally. The image of the extracted everted rectum is shown in Fig. 3. After this, the rectum was cut 1 cm proximal to the dentate line from the perineum using a linear stapler. An anastomosis was created using a circular stapler in the same way as in the previous procedure.

In this case an active gas flow from the abdominal cavity into the lumen of the rectum was noted after stapling. A defect of the anastomosis with a diameter of 2 mm was identified. The defect was visualized, and sutured with a Z-shaped string (the causes of the defect will be discussed below). In this case a protective ileostomy was done as well.

Operation № 3. The rectum was mobilized to the level of the promontorium, so the volume of the procedure was the anterior resection of the rectum. At this level, the rectum was cut with scissors immediately the suture below. The rectal lumen was washed out with an antiseptic solution. A polyethylene «sleeve» was inserted into the abdominal cavity through the 12 mm trocar, and was captured by a clamp inserted throw the anus (Fig. 4).

The «sleeve» was pulled outside, the specimen was extracted through it. The sigmoid colon was cut with a scalpel at the level of the middle third. During traction, serosa of the sigmoid colon was damaged at the level

Table 3. Results of operations

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Mean value
Duration of the procedure, min	265	330	155	150	225	225
Bloodloss, ml	50	45	20	50	60	45
Preserving of left colic artery (+/-)	+	+	+	+	+	100%
Mobilization of the splenic flexure (+/-)	–	–	–	–	–	0%
Protective ileostomy (+/-)	+	+	–	–	–	40%
Intraoperative complications (+/-)	–	+	+	–	–	40%
		(defect of the anastomosis)	(damage of the sigmoid colon)			
Conversion (+/-)	–	–	+	–	–	20%
Postoperative complications (+/-)	+	–	–	–	–	20%
	(paresis of the small intestine)					
Postoperative stay, days	14	9	10	8	8	9,8

of the proximal resection margin. Additional bowel traction was not possible due to the massive sigmoid mesocolon and a high risk of complete rupture of the colonic wall. In this regard, the adducting colon was inserted back to the abdominal cavity. Minilaparotomy was performed. The length of the incision was 3 cm. The sigmoid colon was taken from the abdomen, the damaged area of colon was sutured with a purse string suture. The anvil was adopted with the basic part of the stapler. A colorectal anastomosis was created.

Operation № 4. The rectum was mobilized to the level of the middle third, cut at this level using a linear stapler. Using a 10 mm trocar, an incision was formed in the posterior vaginal fornix and expanded using an ultrasonic scalpel (Fig. 5).

In the right iliac region through the 12 mm trocar a polyethylene «sleeve» was inserted into the abdominal cavity. «Sleeve» was caught by a clamp inserted through the vagina and pulled out. Through the «sleeve» the specimen was extracted outside, the sigmoid colon was cut at the level of the middle third with a scalpel. The anvil of the circular stapler was inserted into the colon, around which the purse string suture was tightened. The sigmoid colon with the anvil was inserted to the abdominal cavity. The colpotomy incision was sutured with an intracorporeal suture. Colorectal anastomosis was created according to the method described above.

Operation № 5. In this case, the specimen was extracted according the technique described in the case № 4. However, this procedure had some differences. Firstly, the patient had the chronic calculous cholecystitis. That is why the laparoscopic cholecystectomy was performed. The gallbladder was extracted also through the vagina as well. Secondly, the patient had a history hysterectomy with the promontopexy by the mesh. So, severe adhesions were detected in the pelvis which negatively affected the duration of the

procedure.

In all cases the abdominal drainage was used.

RESULTS

Mean duration of the surgery was 225 minutes. Mean blood loss was 45 ml. A protective ileostomy was performed in both cases, when the tumor was located below 10 cm from the anal verge. In all cases, the superior rectal artery (SRA) was cut with the preservation of left colic artery (LCA). A mobilization of the splenic flexure was not required in all cases. Intraoperative complications occurred in two cases (see section Technique of operations).

In case 3, due to damage of the wall of the sigmoid colon, there was a need for conversion to minilaparotomy for the safe application of a purse string suture on the proximal colon. In one case, postoperative ileus developed, which was cured conservatively. The mean duration of postoperative stay was 9,8 days (Table 3). Narcotic analgesics and their analogues were not prescribed in all cases. The cosmetic effect after NOSES procedures was great. It can be seen that on the anterior abdominal wall there were only trocar site scars (Fig. 6). Even in the case when a conversion to minilaparotomy was required to apply a purse string suture, the incision length was 3 cm, which is significantly less than in traditional laparoscopic surgery (Fig. 7).

DISCUSSION

Mean duration of the procedures in our study was 225 minutes, which significantly exceeds the duration of traditional laparoscopic procedure. However, this result is comparable with studies by other authors, which also present the primary experience of NOSES in CRC. So, Hara M., et al. showed the experience of the first 9 operations for left CRC, mean duration of

the procedure was 293 minutes [7]. Such significant duration of surgical interventions is understandable and associated with overcoming the learning curve, which is typical for the development of any new technique. The third and the fourth procedures performed by us had acceptable duration of 150 and 155 minutes, respectively, which is associated with the experience obtained.

According to Chernikovskiy I.L. et al., it is recommended to mobilize the splenic flexure and to cut LCA during extracorporeal stapling routinely [5]. In this study in all cases we selectively crossed the SRA, preserving LCA. Mobilization of the splenic flexure was not performed as well. In all cases tension of the colon and vascular bundle was not noted, both during transanal and transvaginal extraction. Of course, no strong considerations can be done basing on the first experience. We suppose, there is no need for routine mobilization of the splenic flexure and cutting LCA for both traditional and NOSES resections of the rectum. These procedures should be performed only if the colon does not reach the level of the pelvic floor and tension is noted when a colorectal anastomosis is done.

Attention should be paid intraoperative complications. During the operation № 2 an active blowing of gas from the abdominal cavity through an anastomotic defect was noted. This complication was identified intraoperatively and has been eliminated by a Z-shaped suture on the anastomotic defect. Postoperatively, the leakage was not detected. Proctography 2 months after surgery did not reveal any defects in the anastomosis as well. The reason for this complication was the «risk triangle» described by Wang, which is the intersection point of two stapler stitches placed by linear and circular staplers. The author in his book proposes to

routinely strengthen this «weak» spot with Z-shaped sutures [3]. In this study, both stapled sides of colon were cut with a linear stapler, the anastomosis was created using a circular stapler. Thus, there was a point of intersection of the three stapler sutures, which was the cause of the defect. In this regard, it is necessary to minimize the number of stapler sutures when creating an anastomosis – the ends of the colon (either one or both) should be stitched with purse-string sutures, or Roeder's loops, as suggested by Franklin M.E. et al. [8]. In the case № 3 the rupture of serosa of the proximal sigmoid colon was detected intraoperatively during transanal traction after removing the specimen. This patient had overweight (BMI 27.9 kg/m²), and therefore a massive mesocolon of the sigmoid colon hindering further traction for the purse string suture. In this case, the tension of the colon associated with the preserved LCA or non-mobilized splenic flexure was not observed. Fearing a complete rupture of the colonic wall, we performed a minilaparotomy 3 cm long, the adducting colon was pulled into the wound, the damaged area of the colon was captured in a purse string suture. In order to avoid such complications, careful selection of patients is necessary. Based on experience obtained, we do not recommend performing NOSES for CRC in patients with a BMI more than 25 kg/m². This statement was also confirmed by other studies. So, in a large meta-analysis of Liu R.J. [9], comparing the results of laparoscopic resections and NOSES procedures for CRC, summarizing 14 studies and 1435 cases, the average BMI in the NOSES group exceeded 25 kg/m² only in 3 studies.



Figure 6. General view of the anterior abdominal wall after NOSES II procedure (patient № 2)



Figure 7. General view of the anterior abdominal wall after NOSES IV surgery with conversion to minilaparotomy (patient № 3)

CONCLUSIONS

The implementation of NOSES is a promising direction

in colorectal cancer surgery. However, for the further experience and large randomized studies are needed.

The authors declare no conflicts of interest

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