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The functional and physical state of the anal sphincter complex in the patients with rectal prolapse in the post-surgery period

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ABSTRACT

Purpose: The work was aimed at comparative studying of the functional and physical state of the patients with rectal prolapse after surgical treatment with various surgical techniques and at identifying the most optimal procedure technique.

Patients and methods: The authors observed 49 patients (32 women, or 65.3 %) aged 22 — 83 years (the median age of women was 46.1 ± 1.3 years old, of men — 48.7 ± 1.4 years old) with the rectal prolapse of varying severity. The Delorme's procedure was indicated for 28 patients (57.1 %). Perianal proctosigmoidectomy (the Altemeier's surgery) was performed in 12 patients (24.5 %). In the young patients, preference was given to the Ripstein's abdominal surgery (nine patients; 18.4 %). To objectively assess

the physical state of the anal sphincter apparatus, traditional sphincterometry was performed using S4402 sphincterometer with a nonperfusing sensor (Pro Medika GmbH, Germany), and the functional state of the sphincter complex was subjectively assessed using the Wexner's score scale.

Results: The best results were obtained after the Delorme's procedure ($p < 0.05$), while the worse results were obtained in the young patients after the Ripstein's surgery ($p < 0.05$).

Conclusion: The obtained results may be used for assessing the functional and physical state of the anal sphincter complex in the surgical treatment of the patients with the rectal prolapse syndrome, especially in those with ASFs of varying severity.

Keywords: rectal prolapse, anal sphincter failure, chronic constipation, fecal incontinence, sphincterometry

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INTRODUCTION

Rectal prolapse syndrome (RPS) is a severe pathosis. It is characterized by the mucous membrane prolapse and other layers of the rectum due to the relaxation of the pelvic and perineal muscles and ligaments in the deep Douglas pouch.^{1,2} The first scientific ideas and the first method of surgical treatment (suturing of the Douglas pouch) were proposed by Moschowitz A. V. in 1912. However, the results were unsatisfactory, the relapse developed in 80 % of the cases.³

The incidence of RPS in the adult population is within one to a thousand; it is found in all age groups, more frequently in the adults, especially in women who in the age of over 50 years are six times more likely to suffer partial or complete rectal prolapse than the men.^{4,5} The previous idea of RPS association with multiple difficult deliveries is refuted because this state occurs in about one-third of the nulliparous women. In 31 % of the cases, the disease develops in the persons engaged in heavy physical work.⁶ In the middle-aged and older women, the bladder and colon dysfunction develops in 25 % of the cases due to the pelvic floor

descent. Therefore, the patients complain urinary incontinence in 16 % of the cases, and in 9 % of the cases — of fecal incontinence, and in 3 % of the cases, the symptoms of the pelvic organ (rectum, bladder, vagina, uterus) prolapse are manifested.^{6,7}

In RPS complicated by anal sphincter failure (ASF), the cardinal symptom is fecal incontinence due to which perianal ulcers, ulcerations, and skin maceration develop at later stages in 0.8 – 18 % of the cases, as well as ascending urogenital infections, sometimes accompanied by psychoemotional disorders ranging from self-isolation and depression to complete disability and suicide. Disproportionate visits to the doctor are characteristic, i.e., only 10 – 30 % of the patients with ASF contact medical institutions.^{8,9}

The formation of feces and fecal continence depends on the coordinating activity of several factors: the geometric, elastic, and fixing properties of the anal sphincter muscles; the values of the anorectal angle; the motor-evacuation activity of the colon, and the interaction of the rectum receptor apparatus with the anal canal, neural pathways, spinal cord, and brain.^{1,10} Naturally, the central role in fecal and gas continence belongs to

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the sphincter-locking complex (apparatus) of the rectum¹⁰ since the regular activity of this complex is ensured by the internal smooth (70 – 80 %) and the external cross-striated (20 – 30 %) sphincter muscles. Voluntary activity is mainly provided by the external sphincter muscle and the pelvic floor muscles.¹¹

The severity of ASF is determined by many scales, systems, and indexes proposed at various times. In recent decades, the Wexner's fecal incontinence scale of the Cleveland Clinic (USA, Ohio) has been most frequently used in surgical practice.^{8,12} Its main disadvantage is the fact that it is based on the subjective feelings of the patient, since the subjective factors (physical feelings, complaints) are insufficient for choosing the treatment policy, the method of surgery and its extent, further rehabilitation treatment, and the medical rehabilitation measures.^{4,11} Therefore, studying the pre- and post-surgery objective parameters (sphincterometric, manometric, electromyographic, etc.) and their clinical and mathematical interpretation are of great importance.

Given the above, the need to study the functional and physical (objective) state of the anal sphincter complex in the perisurgical period in the case of RPS is considered necessary, and therefore the expediency of this study is of clinical importance.

The aim of the study

The work was aimed at comparative studying of the functional and physical state of the patients with rectal prolapse after surgical treatment with various surgical techniques and at identifying the most optimal procedure technique.

MATERIAL AND METHODS

This work was performed in 2017 – 2019 at the educational and surgical clinic of the Azerbaijan Medical University and involved 49 patients (32 women, or 65.3 %) at the age of 22 – 83 years (the median age of women was 46.1 ± 1.3 years old, of men – 48.7 ± 1.4 years old) with rectal prolapse of varying severities. In the past medical history, 23 women (71.9 %) indicated severe traumatic deliveries (2 to 4). The average observation period was 16.1 ± 2.2 months (4 to 21.6 months) ($p > 0.05$). All patients were informed about the research and had given written permission.

In order to prevent statistical distortions and potentially distorting factors, exclusion criteria were determined: patients with concomitant diseases of the cardiovascular system, respiratory system, severe renal (hepatic) failure, diabetes mellitus, and the ones who previously underwent surgery in the anorectal region, experienced complex surgical

interventions in the abdominal cavity, especially in its lower part.

Clinical material was collected, and data of laboratory and instrumental studies were taken from the electronic database of the Department of Surgical Diseases-I.

To objectively assess the physical state of the anal sphincter apparatus, traditional sphincterometry was performed using S4402 sphincterometer with a nonperfusing sensor manufactured by Pro Medika GmbH (Germany). With that, the quantitative (physical) indicators and their graphic images obtained by processing these data with the corresponding program were displayed on the PC screen.

Sphincterometry can obtain indicators, such as the strength of the anal muscles (the internal and external sphincters, and the pubic and rectal and levator muscles), which directly ensure fecal and gas continence, and the degree of their contraction and relaxation. The indications for this study were fecal and gas incontinence, chronic constipation, anismus, anal stenosis (pectenosis), anal fissure, rectal and rectovaginal fistulas, unidentified and idiopathic anal pains, rectocele, inflammatory diseases of the rectum and the colon, solitary rectal ulcer, etc.

The methods of sphincterometry

The study was performed in the morning hours after the first defecation without prior special preparation of the patients. However, the use of laxatives (Fortrans, Pikoprep, DulcoSoft, etc.) one day before the examination was advisable. Cleansing enemas on the eve of the examination were not recommended, since the excessive relaxation of the anal muscles might lead to the distortion of the results due to the reduction of their power. The patient was lying on his/her side with the knees as close to the belly as possible. A surgical glove was put on the nonperfusing sensor, which was carefully introduced into the anal canal to the depth of 3.0 – 3.5 cm with a lubricant applied. After waiting a short while (for the patient adaptation to the device), the necessary indicators were recorded: at rest for the first 20 seconds, followed by two times within five seconds, and finally at the moment of voluntary contraction.

The following sphincterometric indicators were measured: the average pressure at rest, the tonicity of the anal sphincter, the voluntary contractile pressure, and the arbitrary contractile gradient (for determining the functional state of the muscle tissue). The indicators of other functional tests were also determined (upon straining, upon severe coughing).

The Delorme's procedure had been indicated for 28 patients (57.1 %), after which no complications requiring additional surgical treatment were observed. Local infectious complications (wound abscess in two cases) were treated conservatively. Relapse was observed in two cases (7.1 %). Perianal proctosigmoidectomy (the Altemeier's surgery) was performed in 12 patients (24.5 %). With that, in the early post-surgery period, local purulent infectious complications developed (wound abscess in two cases, purulent abscess of retrorectal space in one case). Relapse was observed in only one case (8.3 %).

In young patients, preference was given to the Ripstein's abdominal surgery (nine patients, or 18.4 %). No post-surgery complications and disease relapse were observed.

Before surgery, the severity of ASF had been determined based on the corresponding sphincterometric indicators. The degree I was found in 21 cases (37.3 %), degree II — in 17 cases (34.7 %), and degree III — in 11 cases (22.45 %); the functional state of the sphincter complex was subjectively assessed using the Wexner's score scale.

The mathematical results were processed in the Inc.20.0 version of the SPSS Statistics (Statistical Package for the Social Sciences) application. The indicators in the groups were taken by the variation series; for each series, the average value (M), its standard deviation (m), the maximum (max), and the minimum (min) values were calculated. The difference between the quantitative variables was studied using the Pearson's χ^2 test. The statistical significance of the differences was assessed using the Student's t-test and Wilcoxon's U-test (Mann-Whitney). The differences in the assessment with $p < 0.05$ were considered veracious.

RESULTS

Given the degree of ASF severity and the gender, the indicators of sphincterometry after surgical treatment of the rectal prolapse were grouped and classified (Table 1).

With all ASF severity degrees, the sphincterometric data allowed building the reference interval. The values at rest were greater in the women, while all other results (the maximum contractile pressure, the average contractile pressure, the arbitrary contractile gradient) were greater in the men.

The same results were comparatively studied after using various surgical techniques (Table 2). With that, the best results were obtained after the Delorme's procedure, while worse results were obtained in the young patients after the Ripstein's surgery. For instance, after the Delorme's procedure, the indicators in four patients with ASF degree III became close to those of degree II, in nine patients with ASF degree II, they became close to those of degree I, and in the rest of patients (15 patients, or 53.6 %), they became close to the norm; and after the Altemeier's surgery — in three, five, and four patients, respectively. After the Ripstein's surgery, similar indicators in four patients with degree III corresponded to those of degree II, in three patients — to those of degree I, and in two patients, they became close to the norm. In one patient after the Delorme's procedure and in two patients after the Altemeier's surgery, in the long-term period (six to fifteen months), anal stenosis developed, which required appropriate surgical treatment.

Before surgery and in the post-surgery period, as well as in the reference studies, the degree of fecal incontinence was assessed using the Wexner's score scale (Table 3).

Table 1. The sphincterometric indicators in the case of rectal prolapse with various severity degrees in the patients with the ASF

Parameters (mm Hg)	Severity degree	Women (results/norm limits)	Men (results/norm limits)	p
The average pressure at rest	I	36.3 – 40.0 (38.1 ± 1.6) / (41 – 63)	32.8 – 42.0 (37.5 ± 1.0) / (43 – 61)	< 0.05
	II	26.9 – 36.2 (30.25 ± 1.3)	25.3 – 32.7 (29.45 ± 0.7)	< 0.05
	III	≤ 26.8 (24.7 ± 2.2)	≤ 25.2 (24.9 ± 0.8)	< 0.001
The maximum contractile pressure	I	97.4 – 109.0 (102.5 ± 3.7) / (110.0 – 178.0)	115.0 – 120.0 (118.15 ± 2.8) / (121 – 227)	< 0.05
	II	61.9 – 97.3 (78.8 ± 4.4)	74.9 – 114.9 (97.0 ± 4.8)	< 0.05
	III	≤ 61.8 (55.75 ± 3.6)	≤ 74.8 (68.85 ± 3.2)	< 0.001
The average contractile pressure	I	68.8 – 87.0 (79.35 ± 4.1) / (88.0 – 146.0)	89.5 – 105.0 (95.9 ± 4.1) / (106 – 190)	< 0.05
	II	46.0 – 68.7 (52.3 ± 2.9)	53.0 – 89.4 (76.2 ± 3.7)	< 0.05
	III	≤ 45.9 (40.8 ± 3.5)	≤ 52.9 (47.9 ± 2.85)	< 0.05
The voluntary contractile gradient	I	≥ 73.6* (68.9 ± 4.05) / (59 – 115)	≥ 79.5* (75.95 ± 3.1) / (78 – 166)	< 0.05
	II	35.9 – 58.0 (47.7 ± 3.0)	49.9 – 77.0 (61.25 ± 3.0)	< 0.05
	III	≤ 35.8 (32.9 ± 1.6)	≤ 49.8 (46.0 ± 2.7)	< 0.05

Table 2. The sphincterometric indicators after surgery with the use of various techniques in the case of rectal prolapse, depending on the ASF severity degree

Parameters (mm Hg)	Severity degree	Women			Men			p
		After the Delorme's procedure	After the Altemeier's surgery	After the Ripstein's surgery	After the Delorme's procedure	After the Altemeier's surgery	After the Ripstein's surgery	
The average pressure at rest	I	36.9 - 42.2 (39.3 ± 1.1)	34.2 - 40.9 (37.6 ± 1.5)	33.5 - 41.8 (36.2 ± 1.5)	31.9 - 42.5 (37.6 ± 1.7)	36.1 - 42.7 (39.0 ± 1.9)	35.2 - 42.9 (38.3 ± 1.7)	< 0.05
	II	29.0 - 36.85 (31.5 ± 1.0)	26.5 - 34.1 (29.6 ± 1.7)	26.15 - 33.4 (28.7 ± 1.9)	25.8 - 31.8 (27.75 ± 0.9)	29.6 - 36.0 (32.8 ± 1.5)	28.6 - 35.1 (31.8 ± 1.5)	< 0.05
	III	≤ 28.95 (25.0 ± 2.3)	≤ 26.0 (23.7 ± 2.2)	≤ 26.1 (24.1 ± 2.0)	≤ 25.7 (23.8 ± 0.6)	≤ 29.5 (25.3 ± 2.9)	≤ 28.5 (26.0 ± 2.3)	< 0.05
The maximum contractile pressure	I	97.5 - 110.4 (102.7 ± 3.1)	95.0 - 107.7 (98.7 ± 2.4)	93.0 - 105.9 (98.3 ± 2.7)	115.0 - 120.0 (118.15 ± 2.8)	98.2 - 110.6 (102.5 ± 4.9)	95.1 - 109.3 (99.7 ± 3.4)	< 0.001
	II	62.0 - 97.4 (79.4 ± 3.9)	60.35 - 94.9 (77.9 ± 3.2)	60.1 - 92.9 (76.55 ± 3.0)	75.2 - 114.9 (96.05 ± 4.4)	68.7 - 98.1 (81.5 ± 3.8)	65.8 - 95.0 (79.2 ± 3.8)	< 0.05
	III	≤ 61.9 (56.2 ± 3.0)	≤ 60.3 (53.5 ± 2.7)	≤ 60.0 (54.9 ± 2.2)	≤ 75.1 (67.5 ± 3.15)	≤ 68.6 (59.25 ± 3.3)	≤ 65.7 (60.4 ± 3.1)	< 0.001
The average contractile pressure	I	69.7 - 88.25 (79.5 ± 3.7)	67.2 - 85.1 (77.2 ± 3.0)	65.5 - 81.9 (75.85 ± 4.2)	88.5 - 103.6 (95.9 ± 4.1)	70.1 - 89.6 (81.4 ± 3.5)	68.6 - 85.2 (79.8 ± 3.4)	< 0.05
	II	46.45 - 69.6 (52.7 ± 2.4)	44.4 - 67.1 (51.5 ± 2.0)	42.9 - 65.45 (49.8 ± 2.6)	54.2 - 88.4 (75.8 ± 3.0)	48.9 - 70.0 (62.25 ± 2.3)	48.4 - 68.5 (54.0 ± 2.3)	< 0.05
	III	≤ 46.4 (41.8 ± 3.3)	≤ 44.35 (39.6 ± 2.9)	≤ 42.8 (38.9 ± 3.0)	≤ 54.1 (48.0 ± 2.55)	≤ 48.8 (43.3 ± 2.5)	≤ 48.3 (41.1 ± 3.7)	< 0.05
The voluntary contractile gradient	I	64.2 - 76.7 (68.5 ± 3.2)	63.5 - 74.9 (66.15 ± 2.8)	63.1 - 75.5 (65.6 ± 3.1)	69.9 - 76.2 (73.5 ± 3.0)	63.5 - 74.9 (66.15 ± 2.8)	66.7 - 74.2 (70.3 ± 4.0)	< 0.05
	II	35.9 - 64.1 (47.7 ± 3.0)	34.0 - 63.4 (47.2 ± 2.6)	33.2 - 63.0 (45.75 ± 3.1)	56.5 - 69.8 (63.35 ± 3.2)	41.7 - 63.4 (54.4 ± 2.9)	45.9 - 66.6 (58.5 ± 3.7)	< 0.05
	III	≤ 35.85 (33.0 ± 1.2)	≤ 33.9 (32.5 ± 1.0)	≤ 33.15 (32.2 ± 1.7)	≤ 56.4 (46.0 ± 2.7)	≤ 41.6 (37.7 ± 1.4)	≤ 45.8 (42.7 ± 1.0)	< 0.05

Table 3. Assessment of the degree of fecal incontinence using the Wexner's score scale

The time of determination	Delorme's procedure (n = 28)	Altemeier's surgery (n = 12)	Ripstein's surgery (n = 9)
Before surgery	8.3 ± 2.1	8.1 ± 3.5	8.7 ± 3.3
After surgery	4.6 ± 2.7	4.4 ± 2.9	4.7 ± 3.0
p	p = 0.015	p = 0.017	p = 0.0092

DISCUSSION

The sphincterometric indicators were different, depending on the age, gender, and the physical state. For instance, according to A.P. Zbar et al., at rest, the strength of the rectal sphincter muscles obturator was within 60 mm Hg, in the patients with fecal and gas incontinence — 40 mm Hg, during anal relaxation — 55 mm Hg, and in the patients with anal fissure — 85 mm Hg. At rest, 65 – 85 % of the anal sphincter apparatus strength was provided by the anal muscles. The maximum strength of these muscles in healthy individuals was 203 mm Hg. In the patients with fecal and gas

incontinence — 114 mm Hg, during anal relaxation — 146 mm Hg, and the patients with anal fissure — 233 mm Hg.¹³ At the moment of relaxation of the anal muscles and the muscles in the anterior abdominal wall, the maximum strength in the patients with fecal and gas incontinence was much lower compared to healthy individuals. However, this value was significantly higher in patients with anismus and anal fissure.

The results of the authors were insignificantly different from those in the literature of recent years.^{7,14,15} In the authors' opinion, the unsatisfactory results of surgical treatment are related to the late patients' visits to the hospital, duration, and severity of the disease, and the inadequate choice of the surgical approach.

CONCLUSION

Thus, the obtained results may be used for assessing the functional and physical state of the anal sphincter complex in the surgical treatment of the patients with RPS, especially in those with ASFs of varying severity.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

FUNDING

The study has not been funded.

ETHICAL CLEARANCE

Ethical approval was obtained by the Academic Council of the Faculty of I General Medicine of Azerbaijan Medical University prior to the study being conducted.

AUTHOR CONTRIBUTION

All authors contributed equally.

ABBREVIATIONS

RPS, rectal prolapse syndrome; ASF, anal sphincter failure.

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