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The State of Anorectal Zone as a Marker of Functional and Organic Gastrointestinal Disorders

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Authors' contributions

This work was carried out in collaboration between all authors. Author OS designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors OP, YC and TB managed the analyses of the study. Author AK managed the literature searches. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

Aims: This research was aimed at investigating both sensory and motor function of the rectum and anal canal in the patients with irritable bowel syndrome (IBS) and organic bowel disease.
Methodology: There were examined 45 children with age of 11-13 years suffering from IBS and organic bowel disease. 20 healthy children of same age were examined as a control. All patients were examined with the use of general clinical blood and urine tests, biochemical blood tests including direct and indirect bilirubin, alanin aminotransferase, aspartame aminotransferase, alkaline phosphatase, gamma-glutamyl transpeptidase, urea, creatinine. Coprogram and fecal dysbiosis were also analysed. Digital rectal examination, ultrasonography of the abdomen, multiphase duodenal intubation, colonoscopy or sigmoidoscopy or irigography (by the indications) was also performed.
Results: The average basal pressure was 6.5±0.6 mm Hg in the rectum and 44.5±1.5 mm Hg in the anal canal (mean ± s.e.m.). These indices were not dependent on the general health conditions and the clinical manifestations of IBS. However the threshold of reflective sensitivity was significantly greater (28.4±2.2 ml) in patients with chronic

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constipation associated with organic bowel disease compared with patients suffering from IBS with functional constipation (20.5±2.8 ml) and diarrhea (22.5 + 2.8 ml).
Conclusion: Anorectal manometry is a sensitive and specific method to differentiate IBS from organic bowel disease. The most informative test is anorectal manometry using rectal balloon slowly filled with water.

Keywords: Iritable bowel syndrome; anorectal manometry; chronic constipation; diarrhea; children.

1. INTRODUCTION

Bowel disease presenting with constipation alternating with diarrhea, bloating, abdominal pain is very common condition in children [1-5]. Constipation occurs from 10 to 40% of children with diseases of the gastrointestinal tract [3-7]. The causes of constipation could be related to the pathology of enteric nervous plexus (neuronal dysplasia type B, Hirschsprung's disease), extrahepatic pathology of the nervous system (neuronal dysplasia type A), congenital desmosys, anal achalasia (neurogenic, myogenic, rectoanal dissinegy), abnormal fixation of the colon (colonoptosis) [1,2,5].

In recent years, with the rapid development of neurogastroenterology the attention of the numerous researches is focused on irritable bowel syndrome in children population. Their results consider that the disorder of the interaction between the central nervous system and the enteric nervous systems could be main pathogenetic factors for this disease [7-12]. Enteric nervous system is represented by the complex of microganglionic structures located in the walls of gastrointestinal tract and having motoric activity [8]. Nerve ganglia are concentrated in subserous, intermuscular and submucosal plexus and contain three types of Dogiel cells. Ganglia function is released as transmition of the central effects and as independent integrative structure including local reflex arc, capable of operating at full decentralization [13]. There are various neurons represented in the entheric ganglia including adrenergic, cholinergic, serotoninergic, NO-dependent and ATP-dependent ones [13,14]. The imbalance of neurotransmitters and regulatory peptides (cholecystokinin, motilin, serotonin, neurotensin, endogenous opiates - enkephalins and endorphins, vasoactive intestinal peptide) play the important role in the pathogenesis of irritable bowel syndrome [15-17].

Some authors propose to assess the anorectal function as a marker of functional and organic gastrointestinal disorders manifested with constipation, fecal incontinence, diarrhea and abdominal pain [7,18-22]. Anorectal manometry is one of the most integrative and sensitive methods for studying local reflex activity (anorectal inhibitory reflex), elastic properties of the rectum (compliance), and the conditioned reflex activity [7,18,22].

2. MATERIALS AND METHODS

The study was conducted in 2009-2012. There were examined 45 children with median age 12.4 (range 11-13 years) suffering from IBS and organic bowel disease. As the control we examined 20 healthy children of same age. The gender structure was following: girls - 53.8%, boys – 46.2%. All children have normal body weight.

The diagnosis of IBS was verified accordingly to Rome criteria (2006). They include recurrent abdominal pain or discomfort at least 3 days/month in the last 3 months associated with *two or more* of the following symptoms: improvement with defecation, onset associated with a change in frequency of stool, onset associated with a change of stool's shape. These criteria fulfilled for the last 3 months with symptom onset at least 6 months prior to diagnosis.

The patients with organic bowel disease complained of straining during the defecation, feeling of the incomplete evacuation after defecation and the necessity of straining effort during the defecation.

All patients were examined with the use of general clinical blood and urine tests, biochemical blood tests including direct and indirect bilirubin, alanin aminotransferase, aspartame aminotransferase, alkaline phosphatase, gamma-glutamyl transpeptidase, urea, creatinine. Coprogram and fecal dysbiosis were also analysed. Digital rectal examination, ultrasonography of the abdomen, multiphase duodenal intubation, colonoscopy or sigmoidoscopy or irigography (according to the indications) were also performed.

All authors hereby declare that all clinical experiments have been examined and approved by the institutional review board.

The anorectal manometry was carried out after evacuative enema in the morning. The patient was in the left lateral position with legs adducted to the anterior abdominal wall. Graphic record of investigated parameters was performed on the computer connected via pressure gauge "Rhythm" (Kiev, Ukraine) with the sensor. As a final balloon catheters it was used special container with a volume of 0.5 liters and an endotracheal tube type "Portex" balloon with a volume of up to 3 cc. The study was conducted as follows. The balloon was introduced in ano and was set at the level of the middle third of the anal canal at a distance of 1.0 cm from the external opening. After 5-7 minutes to allow the patient to adapt and establish basal tone of the anal sphincter, both anal and rectal pressure was recorded. Then the balloon fractional quickly injected air for 10, 20, 30 ml while defining the presence, magnitude and duration of the reflex relaxation of the internal sphincter.

Determined the threshold of the reflex sensitivity of the rectum - the minimum amount of air introduced into the rectal balloon, causing breaking rectoanal reflex threshold of subjective sensitivity - the minimum amount of air that causes a subjective sensation of filling of the rectum, the threshold of the urge to defecate - the minimum amount of air that causes the urge to stool, the threshold of complete relaxation of the internal sphincter - the minimum amount of air that completely relax the internal sphincter. The air was completely removed from the rectal bulb syringe and water was continuously injected slowly until the internal sphincter relaxation reflex amplitude of at least 8 mm Hg. Then there was determined the minimum amount of liquid in the rectal balloon, in which the urgency to defecate does not disappear or become weaker over time. In this case, the fixed volume and pressure in the rectal balloon were measured. The follow-up supervision on the examined patients was conducted in six months after the diagnosis was verified.

Statistical analysis was performed using on-line calculator placed on the web-site http://www.biometrica.tomsk.ru [23]. The difference amongst the groups was considered to be statistically significant at $p < 0.05$.

3. RESULTS

The patients suffering from IBS had complaints for abdominal pain and constipation - 18 (75.0%), abdominal pain and diarrhea -6 (25.0%), belching - 10 (41.7%), nausea - 22 (91.7%), bitter taste in the mouth - 16 (66.7%), flatulence – in 19 (79.2%) cases. The main complaints in children with organic bowel disease were abdominal pain and constipation alternating with diarrhea - 21 (100%), eructation - 20 (95.2%), nausea - 16 (76.2%), bitter taste in the mouth - 10 (47.6%), flatulence - 28 (90.3%).

According to the results of the general clinical analysis of blood, urine, feces, blood chemistry no abnormality was found. At sigmoidoscopy no pathological changes were observed.

The basal pressure in the rectum was not very different in patients (Table 1). The basal pressure in the anal canal was also similar in all groups. The average basal pressure was 6.5±0.6 mm Hg in the rectum and 44.5±1.5 mm (mean ± s.e.m.). Hg in the anal canal. These data were not dependent on the general health conditions and the clinical manifestations of IBS.

With the rapid filling of the rectal balloon with air the threshold of reflective sensitivity was significantly greater (p=.03) in patients with organic bowel disease (28.4±2.2 ml) compared with patients suffering from IBS with functional constipation (20.5±2.8 ml) and diarrhea (22.5+2.8 ml).

Table 1. Pattern of rectal sensation at manometry when rectal balloon was filled with air

Patients	Basal pressure in the rectum, mm Hg		Basal pressure in the anal canal, mm Hg		The threshold of reflective sensitivity			
					Volume, ml		Reflex amplitude, mm Hg	
	Me	25%; 75%	Me	25%; 75%	Me	25%; 75%	Me	25%; 75%
IBS with constipation (n=18)	6.5	4.8; 8.1	44.0	34.6; 53.5	20.5	18.2; 22.8	9.2	8.1; 10.3
IBS with diarrhea (n=6)	6.4	4.4; 8.5	43.5	33.1; 44.6	22.2	18.0; 26.2	9.7	8.0; 11.4
Organic bowel disease (n=21)	7.2	6.1; 8.3	44.5	36.5; 52.6	28.5	23.1; 33.8	8.7	7.5; 9.9
Control (n=20)	6.6	6.0; 7.2	43.3	39.2; 47.3	21.6	18.6; 24.7	9.5	7.9; 11.1

When slow rectal balloon filled with water was used (Table 2) the significant difference in performance was determined. Thus the volume of cylinder filling was significantly higher in patients suffering from IBS with constipation (p=.04) compared with other patients. Inhibitory reflex duration was significantly higher in the patients suffering from IBS with diarrhea (p=.05) and the amplitude of the breaking reflex was noted to be significantly lower in the patients with organic bowel disease (p=.04). When comparing the rectal filling volume and the pressure in the anal canal it was determined that these values were significantly higher

in patients suffering from organic bowel disease (p=.04). This circumstance could be explained by the incomplete relaxation of the internal anal sphincter or, in some cases, by the rigidity of the sphincter occurred in the patients with organic bowel disease. Threshold pressure in the rectum was not different in the patients with IBS and organic bowel disease.

Table 2. Indicators of electromanometry test when rectal balloon was filled with water (M±SEM)

Indices		IBS with constipation (n=18)	IBS with diarrhea (n=6)	Organic bowel disease (n=21)	Control (n=20)
Threshold of reflective sensitivity	Volume, ml	45.0±2.5	41.0±1.8	52.6±3.1	44.5±2.8
	Amplitude of breaking reflex	12.7±1.4	12.5±1.8	9.2±0.9	12.2±1.2
	Duration of reflex, sec	20.0±1.2	23.0±1.9	16.2±2.2	22.3±2.2
Threshold of subjective sensitivity	Volume, ml	48.1±2.4	43.0±3.4	69.2±2.8	46.4±2.4
	Pressure in the balloon, mm Hg	16.2±0.9	14.1±1.2	14.8±1.1	15.0±1.2
	Pressure in the anal channel, mm Hg	36.5±0.9	32.4±1.8	44.0±1.1	35.6±1.2
The threshold of urge to defecate	Volume, ml	145.0±5.5	141.2±6.8	268.3±11.4	143.5±9.2
	Pressure in the rectal balloon, mm Hg	49.9±1.2	48.2±2.4	51.6±2.2	50.6±0.6
	Pressure in the anal channel, mm Hg	8.1±0.8	7.7±0.9	42.5±1.8	8.0±0.8
Defecometry values	Pressure in the rectal balloon, mm Hg	88.0 (80.1; 86.0)	79.0 (70.5; 87.3)	76.7 (68.2; 88.0)	85.4 (80.0; 89.8)
	Pressure in the anal channel, mm Hg	0	0	88.6±1.8	0

Straining pressure in the rectum was significantly (p=.04) higher in the patients suffering from IBS with constipation (88.2±2.1 mm Hg). All children with IBS and healthy children of control group had straining pressure in the anal canal reduced to zero so the expulsion rectal balloon was independent. Contrarily the children with organic bowel disease had drastically increased straining pressure in the anal canal - up to 88.7±7.6 mm Hg (p=.001).

4. DISCUSSION

Thus obtained data is quite controversial to the results published previously by other authors [1,4,5,9,18-20]. Zar et al. [19] stated that the sensory threshold for the urge to defecate and rectal compliance is significantly lower in the patients with IBS manifested mainly with diarrhea compared with the patients suffering from IBS with constipation and controls. However in our study these indices were similar for all IBS patients and for controls. Our

results are more similar to the study conducted by Mulak and Paradowski [18]. They found that manometric parameters characterizing anal sphincter function are not correlated with the predominant bowel movement pattern in IBS patients. Consequently the features of pelvic floor dyssynergia are significantly more frequent in all subgroups of IBS patients than in controls, suggesting that, in general, IBS patients show changes in the mobility of the pelvic floor. Hypersensitivity to rectal distension is commonly observed in IBS, but it does not seem to be a highly specific marker of the disorder.

Our data demonstrate that the anorectal manometry is more useful as a diagnostic test for differentiating organic bowel disease with functional gastrointestinal disorders amongst children. Greater rate of rectal pressure in children suffering from IBS with constipation compared with children suffering from IBS with diarrhea indicates a decline in the reflex activity of the rectum, which contributes to the development of constipation. Thus failure to expel the rectal balloon due to a negative pressure anorectal gradient in patients with megacolon and anal achalasia could be recommended as the simple test for differential diagnosis.

The anorectal manometry is used widely in the world however there are only several clinics used this method in Ukraine. This test can benefit a pediatric patient by diagnosing the problems associated with defecation and must be implemented in the Ukrainian health care institutions.

The limitations and strength of this prospective cohort study could be described as the following. This design allows calculating the incidence rates in all clinical groups and assessing multiple outcomes in the same study. However due to the relatively small size of the sample and the short follow-up stage of study its results could be biased.

4. CONCLUSION

Anorectal manometry is a sensitive and specific method to differentiate IBS from organic bowel disease. The most informative study is electromanometry of anorectal area using rectal balloon slowly filled with water. IBS patients had significantly reduced the sensitivity of the reflex threshold, the threshold of sensitivity and subjective threshold of urge to defecate, low yielding guts to stretch compared with those of patients with organic bowel disease. Failure to expel the rectal balloon due to a negative pressure anorectal gradient in patients with megacolon and anal achalasia may be recommended as a simple test for differentiate diagnosis.

CONSENT

All authors declare that written informed consent was obtained from the patient for publication of this case report and accompanying images.

ETHICAL APPROVAL

All authors hereby declare that all clinical experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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