Measurement of Rectal Diameter and Anterior Wall Thickness by Ultrasonography in Children With Chronic Constipation

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Research Article

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Abstract

Introduction: Measurement of rectal diameter by ultrasonograpy helps the clinician in the diagnosis of chronic constipation in children for whom rectal examination cannot be performed.

The aim of the study is to determine the rectal diameter and anterior wall thickness values with constipated and healthy subjects, and to evaluate the usability of ultrasonography in the diagnosis of functional constipation in children for whom refuse digital rectal examination

Materials and Methods: The constipated group included 140 children, while the control group included 164 children. All patients were divided into four subgroups according to their ages and were referred to the radiology department for rectal measurements.

Results: At the symphysis pubis plane the rectal diameter measurement of the constipated patients with fecal retention positive group was statistically greater than the control group. At the ischial spine plane, rectum diameter of constipated children with fecal retention positive or negative was found to be statistically greater than the control group. At the bladder neck plane rectum diameter of constipated patients with fecal retention positive was statistically greater than the control group. Rectum anterior wall thickness measurement was found to be higher in constipated patients with fecal retention positive compared to the control ($p = 0.000$). It's measurements of constipated patients in group II, group III, and group IV with empty rectum were found to be statistically higher than the control group.

Conclusion: Measurement of rectal diameter and anterior wall thickness by ultrasonograpy as a noninvasive method in children who do not want the digital rectal examination and may be useful in the diagnosis of constipation.

Summary

What is known

- A full or empty rectum on physical examination is important for constipation diagnosis.
- Rectal touch is a part of physical examination in children with chronic constipation.
- Ultrasonography is routinely recommended in the diagnosis of constipation.

What is new

- The rectum diameter of constipated children is higher than the healty children.
- The rectum anterior wall thickness is increased in constipated children with fecal retention.
- The rectum anterior wall thickness is higher in constipated patients with an empty rectum.

Introduction

Constipation is the common causes of outpatient and emergency admissions in childhood. The etiology of constipation is mostly functional constipation and a small proportion is due to organic causes (1–4). A full or empty rectum on physical examination is important in the differential diagnosis of constipation. While detailed history and physical examination are routinely recommended in the diagnosis of constipation, abdominal radiography, transabdominal recto-ultrasonographic examination, colonic transit time, rectal biopsies, and colonic manometry are not routinely recommended (5–8). It is known that chronic stool retention is found in 40–100 % of children with functional constipation (9). Due to stool retention, rectum diameter may increase and megarectum may develop (10).

Rectal fullness is defined as the presence of a hard stool mass in the rectum on rectal examination or distal colon radiography according to the guidelines (11). Digital rectal examination is a part of physical examination in children with chronic constipation. However, rectal examination cannot always be performed due to reasons such as fear of the examination in young children, embarrassment in adolescents, and sometimes the families not giving permission. On the other hand, rectal diameter measurement in the ultrasonography (US) is a noninvasive method that gives an important idea about rectal fullness (12). Rectal diameter measurement can assist physicians in managing diagnosis and treatment for children and families who do not allow digital rectal examination.

The aim of our study is to determine the rectal diameter and anterior wall thickness values of children with functional constipation and to compare them with the values of healthy children, and to evaluate the usability of US in the diagnosis of functional constipation in children for whom digital rectal examination cannot be performed.

Materials And Methods

One hundred and forty children aged between 6 months and 18 years, who presented to the pediatric gastroenterology division and were diagnosed with functional constipation according to the Rome IV criteria, were included in the study as the patient group. This study was prospective. Children were excluded from the study if they had congenital anomalies of the anorectal region or Hirschsprung disease; if they had disorders such as cerebral palsy, spina bifida, hypothyroidism, diabetes mellitus, or diabetes insipidus; and if they had previously undergone abdominal surgery. A total of 164 children who applied to the pediatric gastroenterology division, did not have chronic constipation, and underwent US examination for a different reason were included in the study as a control group. Children were divided into four groups according to their ages. Those aged between 6 and 36 months constituted group I, those between 37 and 72 months group II, those between 73 and 144 months group III, and those aged ≥ 145 months group IV. A demographic data form containing the information of the patients was filled out. This study was conducted in conformity to the Declaration of Helsinki and was approved by the local research ethics committee (23.11.2016; 20478486-390), and written informed consent was obtained from parents or legal guardians.

After the examinations in the pediatric gastroenterology outpatient clinic, the participants were sent to the radiology department on the same day for an abdominal US examination. Each participant was examined by US without any sedation after at least two hours of fasting when there was no need for defecation. The participant was asked to have urine in the bladder to create a viewing window in the pelvis. Considering the possibility of the bladder pressing on the rectum from the front, however, care was taken to prevent bladder distension. The patients were instructed to urinate for the amount of urine in the bladder kept roughly constant. The examination was performed by two experienced radiologists in a supine position using a 4-MHz curved array transducer (Siemens Acuson x300, Siemens Health Care, Munich, Germany). After routine abdominal examination and checking for rectum wall thickness and edema, rectum evaluation was started transabdominally with a transducer placed perpendicular to the anterior abdominal wall of the midline. The measurement was made from the following points by marking from outer wall to outer wall (Fig. 1): 1) Above the symphysis pubis (Fig. 2a): The transducer was applied perpendicular to the anterior abdominal wall at the upper edge of the symphysis pubis. 2) Under the ischial spine (Fig. 2b): The transducer on the symphysis was angled towards the pelvis and the ischial spine level was determined by the echogenic appearance of the ischial spine and the detection of the acoustic shadow area behind it. 3) At the bladder neck (Fig. 2c): The transducer was readjusted to a downward angle following detection of the rectum under the ischial spine and rectal wall thickness measurement was performed at the level of the bladder neck from the anterior wall (Fig. 3). The measurements obtained were recorded. During the examination, the presence or absence of fecal material in the rectum was noted.

Statistical Analysis: When descriptive statistics (number, percentage distribution, mean, standard deviation, etc.) satisfied normal distribution conditions as evaluated by the Kolmogorov-Smirnov and Shapiro-Wilk tests, the t test was used in independent groups in the comparison of two groups in terms of numerical values. When normal distribution was not verified, comparisons were performed with the Mann-Whitney U test. The chi-square test was used in the comparison of categorical data. Pearson correlation analysis was also performed. Sample size was calculated with power analysis. When $\alpha = 0.05$ was taken, a minimum of 138 patients was calculated for every group with power of 85% and effect size(d) = 0.30.

Results

Three hundred and four patients were included in the study. Of the 140 constipated patients, 62 (44.3%) were boys, 78 (55.7%) were girls, and their mean age was 97.65 ± 62.31 months. Of the 164 children in the control group, 68 (41.5%) were boys, 96 (58.5%) were girls, and their mean age was 102.09 ± 62.36 months. The mean weight of the patient group was 30.74 ± 19.33 kg, their weight percentile was 43.13 ± 33.39, their mean height was 123.23 ± 31.84 cm, and their height percentile was 45.43 ± 31.69. In the control group, mean weight was 31.81 ± 19.15 kg, weight percentile was 43.52 ± 31.37, mean height was 126.81 ± 31.56 cm, and height percentile was 49.13 ± 31.32. There was no statistically significant difference between the groups in terms of demographic characteristics. Defecation frequency of the constipated group was 4.89 ± 4.32 days. Encopresis was present in 24 (17.1%), urinary incontinence in 14

(10.0%), and recurrent urinary tract infection in 17 (12.1%) patients. On examination, anal fissure was detected in 38 (27.1%) patients and skin tags in 19 (13.6%) patients.

Rectal diameter measurements for the patients who were grouped as fecal retention positive and negative were performed above the symphysis pubis, under the ischial spine, and at the bladder neck and are summarized in Tables 1, 2, and 3.

Table 1
Comparison of the rectal diameter values measured above the symphysis pubis

Groups	Fecal retention (+) Rectal diameter (mean ± SD)		p	Fecal retention (-) Rectal diameter (mean ± SD)		p
	Constipated	Control		Constipated	Control	
Group I	24.45 ± 7.89	24.26 ± 8.43	0.94*	18.09 ± 4.67	16.83 ± 4.43	0.47*
Group II	26.93 ± 5.72	22.00 ± 6.93	0.04*	18.57 ± 5.31	17.60 ± 2.79	0.57*
Group III	33.41 ± 7.21	27.55 ± 7.11	0.003**	23.55 ± 8.19	19.20 ± 3.64	0.05**
Group IV	32.00 ± 6.03	33.16 ± 6.79	0.59**	22.80 ± 6.30	22.76 ± 5.22	0.98**
*t test						
**Mann-Whitney U test						

Table 2
Comparison of the rectal diameter measured under the ischial spine

Groups	Fecal retention (+) Rectal diameter (mean ± SD)		p	Fecal retention (-) Rectal diameter (mean ± SD)		p
	Constipated	Control		Constipated	Control	
Group I	11.22 ± 2.13	12.60 ± 3.68	0.16*	9.63 ± 1.36	9.94 ± 1.73	0.62*
Group II	12.18 ± 4.05	11.00 ± 1.96	0.31*	10.00 ± 3.69	9.80 ± 2.98	0.89*
Group III	14.58 ± 5.18	12.18 ± 2.74	0.03**	11.94 ± 2.73	10.33 ± 1.65	0.04**
Group IV	14.42 ± 2.47	15.75 ± 3.56	0.22**	13.28 ± 4.80	12.11 ± 2.25	0.31**
*t test						
**Mann-Whitney U test						

Table 3
Comparison of the rectal diameter measured at the bladder neck

Groups	Fecal retention (+) Rectal diameter (mean ± SD)		p	Fecal retention (-) Rectal diameter (mean ± SD)		p
	Constipated	Control		Constipated	Control	
Group I	18.00 ± 6.00	17.80 ± 4.91	0.92*	13.68 ± 3.40	12.33 ± 2.22	0.21*
Group II	19.03 ± 3.96	15.86 ± 4.70	0.05*	12.42 ± 2.99	12.40 ± 1.63	0.98*
Group III	23.74 ± 5.71	18.74 ± 4.94	0.001**	16.11 ± 4.08	14.45 ± 3.42	0.16**
Group IV	19.71 ± 6.92	22.25 ± 5.31	0.25**	17.71 ± 6.29	17.30 ± 4.63	0.80**
*t test						
**Mann-Whitney U test						

At the symphysis pubis plane the rectal diameter measurement of constipated patients with fecal retention positive aged between 37 and 72 months and between 73 and 144 months was found to be significantly greater than the control group ($p = 0.04$ and $p = 0.003$, respectively). The rectal diameter measurement of constipated patients with fecal retention negative between 73 and 144 months was found significantly greater than the control group ($p = 0.05$) (Table 1).

At the ischial spine plane, rectal diameter of constipated children aged between 73 and 144 months with fecal retention positive or negative was found to be statistically greater than the control group ($p = 0.03$ and $p = 0.04$, respectively) (Table 2).

At the bladder neck plane, the rectal diameter of constipated children with fecal retention positive aged between 37 and 72 months and between 73 and 144 months was found significantly higher than the control group ($p = 0.05$ and $p = 0.001$, respectively). There was no statistically significant difference between the fecal retention negative constipated groups and controls (Table 3).

Rectum anterior wall thickness was found significantly higher in fecal retention positive constipated patients aged between 73 and 144 months compared to the control group ($p = 0.000$). The rectum anterior wall thickness measurements of fecal retention negative constipated patients aged 37–72 months, 73–144 months, and ≥ 145 months were found to be significantly higher than the control group ($p = 0.02$, $p = 0.001$, and $p = 0.000$, respectively)(Table 4). It was found that as the duration of constipation increased, the thickness of the anterior rectum wall increased ($r = 0.40$, $p = 0.000$).

Table 4
Comparison of the anterior wall thickness

Groups	Fecal retention (+)		p	Fecal retention (-)		p
	Constipated	Control		Constipated	Control	
Group I	1.52 ± 0.26	1.57 ± 0.34	0.59*	1.35 ± 0.45	1.28 ± 0.17	0.59*
Group II	1.72 ± 0.56	1.45 ± 0.21	0.09*	1.67 ± 0.42	1.34 ± 0.22	0.02*
Group III	2.24 ± 0.84	1.54 ± 0.34	0.000**	2.52 ± 0.95	1.59 ± 0.26	0.001**
Group IV	2.19 ± 0.70	1.85 ± 0.38	0.06**	3.14 ± 1.43	1.79 ± 0.27	0.000**
*t test						
**Mann-Whitney U test						

Discussion

Constipation is one of the most common reasons for referral to the pediatric gastroenterology department. Patients are evaluated according to their history and physical examination. Diseases such as encopresis, urinary incontinence, and recurrent urinary tract infections may accompany chronic constipation in children (2, 4). In current study, the rate of encopresis was found to be 17% in the constipation group, which is consistent with the literature (15). In another study conducted from Turkey, the coexistence of encopresis was reported at a rate of 51.7% in chronically constipated children (16). The lower incidence of encopresis in our study may be due to the increased awareness of families in Turkey about chronic constipation compared to previous years, with the treatment of children before encopresis having improved. Nephrologic problems such as urinary incontinence and recurrent urinary tract infections were also detected in our constipated patients, as stated in the literature (17).

In a study evaluating the clinical findings of chronically constipated children, the rate of fecal impaction was found as 59.9% and anal fissure as 7.2% (18). In another study, anal fissure was reported at a rate of 26.9% in constipated children (16). Thus, our data are similar to those of other studies carried out in Turkey (27.1%).

Prolonged fecal retention in constipated children causes megarectum development. Various techniques are used in the radiological evaluation of megarectum and constipation. Abdominal X-ray can show the stool mass in the colon, but it is insufficient to identify megarectum (14). The contrast enema technique is difficult to apply in children due to the radiation risk, the invasiveness of the procedure, and the aspect of fright for the child. Rectal impaction may be detected most accurately via digital rectal examination. However, many constipated children and their parents find this procedure unpleasant. There is therefore a need to find a noninvasive method as an alternative to digital rectal examination to determine normal rectum diameter in children, to define thresholds for megarectum, and to detect fecal retention. Recently, measurement of the rectal diameter via US was reported as a noninvasive diagnostic tool for childhood

functional constipation. Di Pace et al. reported that pelvic ultrasound was a quick and child-friendly investigation that could be used to document the presence of megarectum (19).

Studies have shown that children with chronic constipation have larger rectal diameters than healthy children. In a study conducted with 82 healthy children and 95 children with chronic constipation, rectal crescent size was measured as 2.4 cm in healthy children and 3.4 cm in constipated children, and this was statistically significant. The researchers reported that they used a cut-off point of 3.0 cm for defining megarectum in children (14). In a study conducted in Turkey, the rectal diameter of constipated children was evaluated when the bladder was empty and full. It was concluded that it was more meaningful to evaluate the rectum diameter when the bladder was empty, and it was shown that the rectum wall thickness was higher in children with constipation (10). Therefore, we evaluated the US measurements of our patients after urination. In a study by Klijn et al., the mean diameter of the rectum was 4.9 cm in children with constipation and 2.1 cm in a control group (20). In a different study, rectum diameters were measured from three different areas: the symphysis pubis, under the ischial spine, and at the bladder neck. It was found that the symphysis pubis, ischial spine, and bladder neck measurements of children with fecal retention were significantly higher than those of children without fecal retention. To define fecal retention, the cut-off value for the rectal diameter measured at the symphysis was taken as 27 mm with high sensitivity and specificity (95.5% and 94.1%, respectively). These authors concluded that rectal diameter measurement at the symphysis pubis by US is useful for detecting fecal retention easily and accurately (7). In our study, rectal diameter measurement at the symphysis pubis level was found to be significantly higher in children with constipation with stool retention in groups II and III compared to the control group. Significantly higher values were obtained in rectal diameter measurements made from symphysis pubis and ischial spine levels in 73–144 months old children with fecal retention compared to the control group. This result is similar to other studies in the literature.

The measurement of rectal diameter by age was evaluated for the first time in a study from Poland. The patients were grouped as under 3 years old, 3–6 years old, 6–12 years old, and over 12 years old and were compared with control group subjects of the same ages. It was determined that the rectum diameter values of the constipated groups of all ages were significantly higher than those of the control groups and that the difference was most prominent in children under 3 years of age. As the patients got older, the difference between them was smaller, but still significant (12). In a different study by Doniger et al., a strong correlation was found between enlarged transrectal diameter and constipation (21). When rectal diameter was measured from the axial plane, it was found to be 31.72 ± 6.93 mm in a constipated patient group and 19.85 ± 4.37 mm in a control group (p: 0.001) (1). In these studies, the patient groups were not divided into subgroups according to the presence or absence of fecal retention. Since rectal diameter values are affected by defecation and fecal retention (9), the study groups were divided into subgroups according to the presence or absence of stool in the rectum. The detailed evaluation of the data in this way makes our study different from other similar works to date. In our study, we found that the rectum diameter values measured from the symphysis pubis, bladder neck, and ischial spine planes of the group aged 73–144 months with fecal retention positive groups were statistically significantly higher than the control groups. We also found that the symphysis pubis and bladder neck planes measurements of

children aged 73–144 months with fecal retention negative groups were statistically significantly higher than the control group. The mean rectal diameter measurements of the constipated group with fecal retention positive or negative increased with age, and this finding was compatible with the literature (12). We also found that the mean rectal diameters of constipated children with fecal retention positive and negative groups were similar between group III and IV despite the increasing age. In another different study re-evaluated rectum diameters after constipation treatment and showed that measurements decreased after 4 weeks of polyethylene glycol treatment (22). However, we could not re-evaluate our patients' rectum diameter measurements after constipation treatment.

Berger et al., reported that they could not show a relationship between the clinical findings of constipation such as constipation duration, fecal retention, and fecal incontinence and ultrasonographic rectal diameter measurement, contrary to the literature data (8). According to our results, we found that the anterior rectal wall thickness increased as the duration of constipation increased. Contrary to the data of our study, in another study, the rectum wall thickness measurement of the constipated group was found to be lower. In that study, the correlation between constipation duration and anterior rectum wall thickness was not investigated (1). In addition, the difference in the anterior rectum wall thickness compared to the control group in that study may be due to the different constipation durations of the children in the patient group. In our study, anterior rectum wall thickness was higher in the constipated group with fecal retention positive compared to the control group only in Group III, while it was statistically significantly higher in the constipated group with fecal retention negative in Group II, Group III, Group IV. The fact that the constipated patients' anterior rectum wall thickness, which was measured when the rectum was empty, was statistically significantly higher than in non-constipated children suggests that it could be a useful measurement as a marker of chronic constipation.

This study is conducted in healthy children with constipation complaints in four different age groups; This is the first study in which rectal diameter and anterior rectal wall thickness measurements in different planes were evaluated in detail in groups with and without stool retention. In addition, the number of patients is higher than in other studies conducted on this subject so far, and it is an important study in terms of determining the mean rectal diameter measurements and mean anterior wall thickness values of children in certain age ranges.

Limitations:

The limitations of our study are that we could not give a cut-off value for rectum diameter and anterior wall thickness due to the low number of children in the subgroups of the study. The other limitation is that unable to re-evaluate the rectum diameters of constipated patients after treatment.

In conclusion; while investigating chronic constipation, measurement of rectal diameter and anterior wall thickness with US technique as a noninvasive method in children who do not want to have a digital rectal examination may be useful in the diagnosis of constipation.

List Of Abbreviation

US: Ultrasound

Declarations

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Conflicts of interest/Competing interests: The Authors declare that there is no conflict of interest.

Availability of data and material: Available.

Code availability: N/A

Authors' contributions: GD,EK participated in the design of the study and drafted the manuscript and carried out the statistical analysis. GD, SY, MK participated in the design of the study and drafted the manuscript and collected the clinical data. GD, MK, AT, SY collected the clinical data and helped to draft the manuscript. GD,MK collected the clinical data and participated in the design of the study and critical revision of the article for the important content. EK collected the clinical data and participated in the design of the study and critical revision of the article for the important content. All authors had read and approved the final manuscript.

Ethics approval : Available

Consent to participate: Available

Consent for publication: Available

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Figures

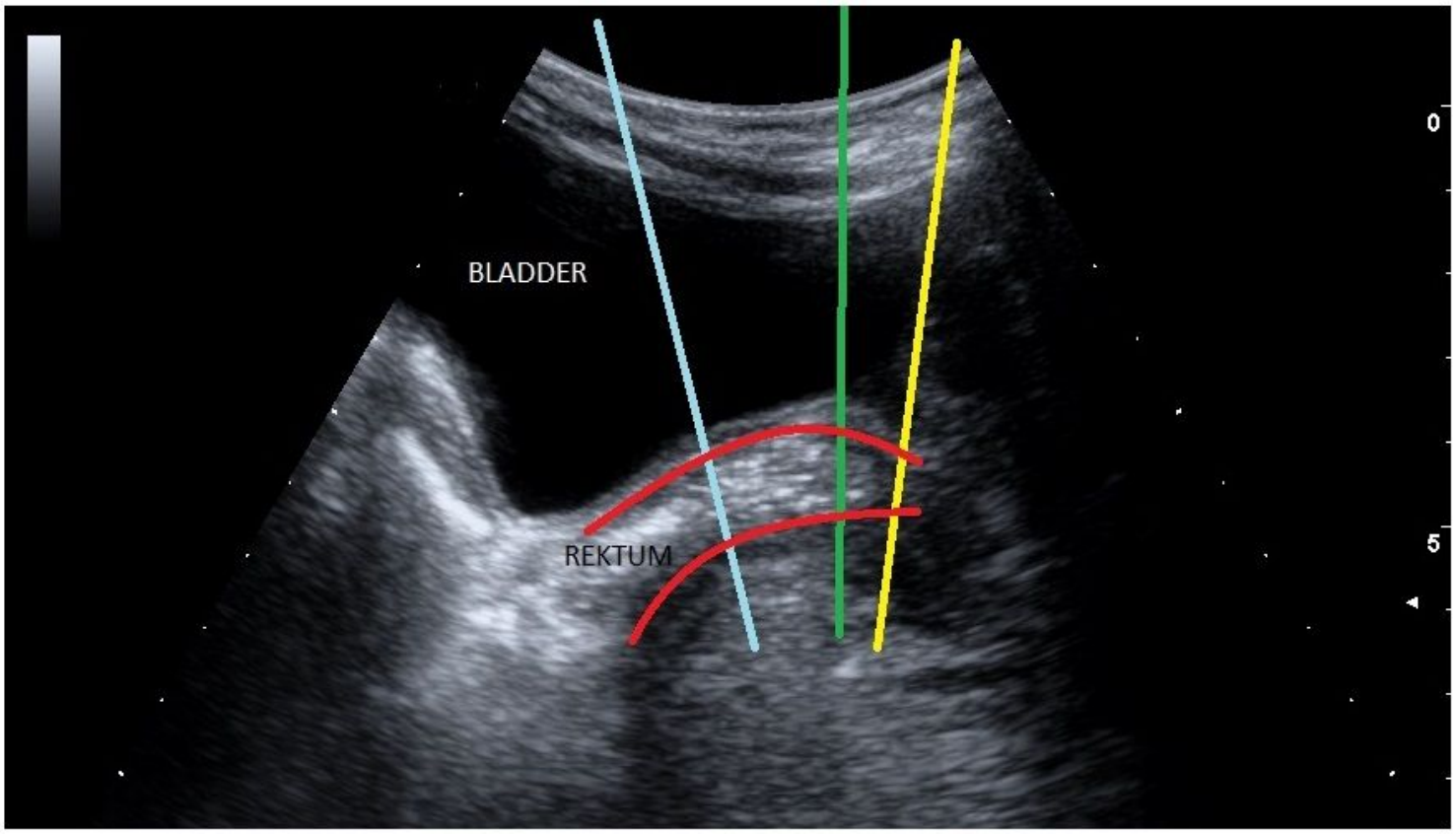

Figure 1

Five-year-old boy. Image obtained from the sagittal plane of the pelvis midline shows the rectum between two red lines. The echogenic area seen in the middle section shows the rectum mucosa and fecal material in the lumen. Blue line: Imaging plane passing through the symphysis level. Green line: Imaging

plane passing through the ischial spine. Yellow line: Imaging plane passing through the bladder neck level.

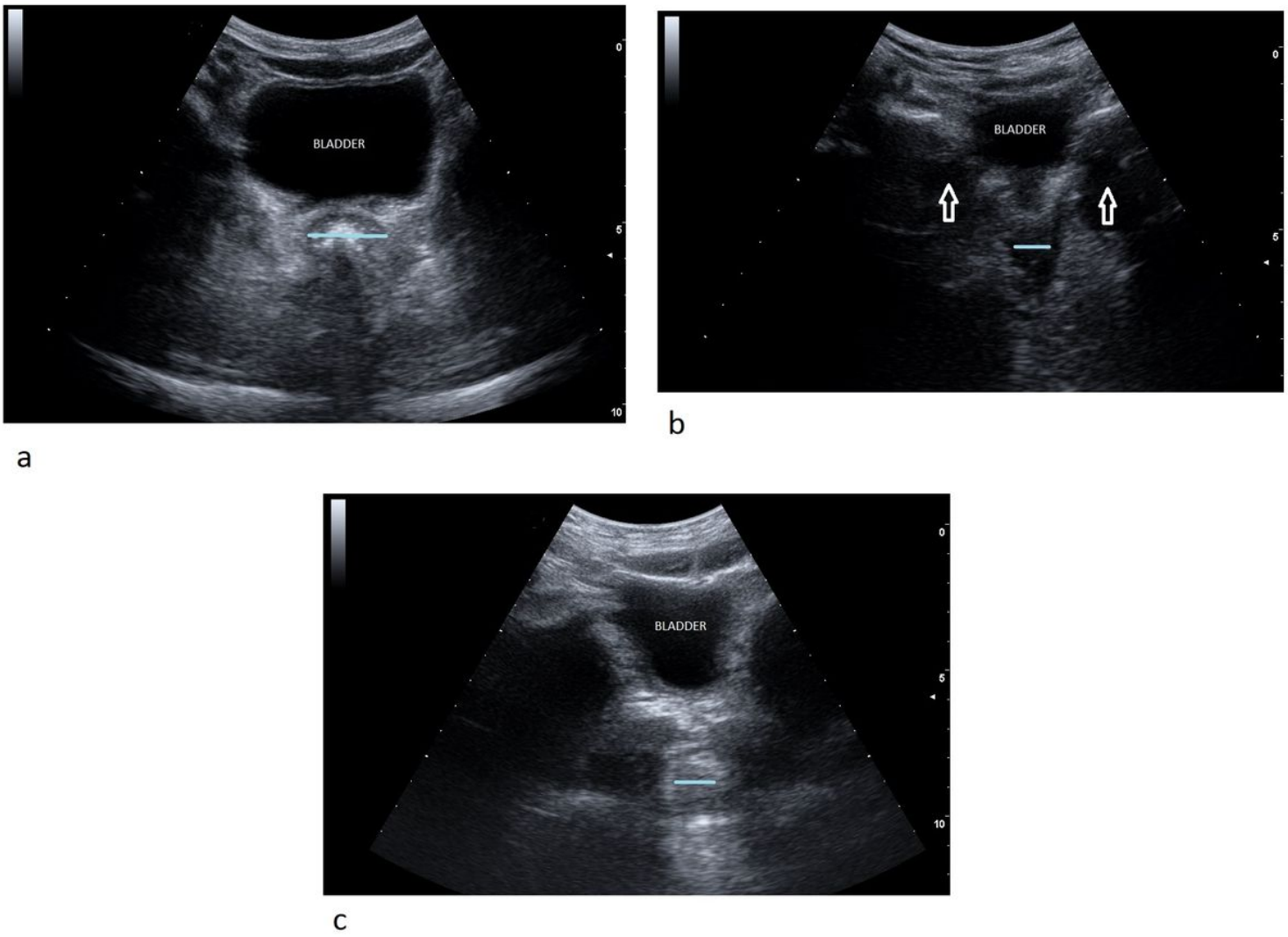

Figure 2

Five-year-old boy. In the axial plane USG image taken at the symphysis level (a), the rectum mediolateral diameter (blue line) was measured from outer wall to outer wall. The diameter of the rectum (blue line) was determined by a similar method at the level of the ischial spine (b). The white arrows show the areas with acoustic shadow created by the spine. The transducer angles downwards. When the ischial spine echo disappears, the bladder neck has been reached (c). The rectum diameter was measured from this level (blue line).

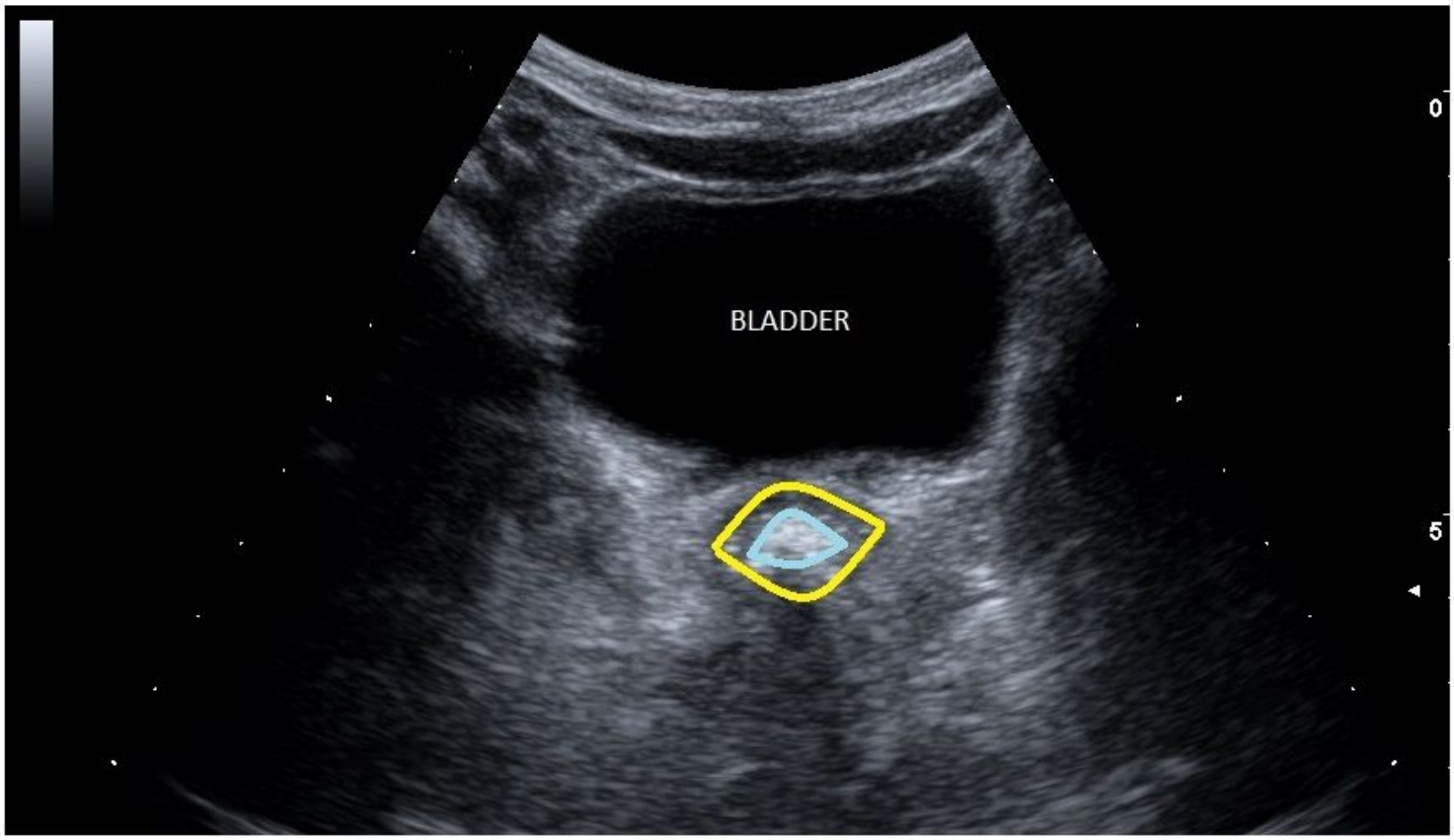

Figure 3

Five-year-old boy. Axial plane USG images at bladder neck. The inner wall (blue line) and outer wall (yellow line) of the rectum are shown. The rectum wall thickness was measured from the front wall near the bladder.