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LETTER TO THE EDITOR

Reaction to Koppen et al., 'Assessing colonic anatomy normal values based on air contrast enemas in children younger than 6 years'

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Dear Editors,
In your journal was published an article titled "Assessing colonic anatomy normal values based on air contrast enemas in children younger than 6 years" [1]. It is an attempt to determine the normal limits of the width of the rectum and colon in children. This is a very important problem because without knowledge of the norm it is impossible to clearly define such concepts as "megarectum" and "megacolon." Without accurate parameters, it is impossible to diagnose chronic constipation in time, evaluate its pathophysiology, and choose the right treatment tactics. Question: Can the received results be used to solve this goal? The work was carried out with serious methodological errors.

The choice of patients with intussusception to determine normal parameters of the rectum and colon is not correct. First, in the study of the rectum and colon, the water-soluble contrast or barium is introduced into the colon under gravity to obtain radiographic images of the colonic anatomy. The mean pressure during hydrostatic diagnostic enema ranges 40–80 cm H_2O (i.e. mean pressure ranges 30–50 mmHg). During pneumatic reduction of intussusception the pressure was more than 100 mmHg. Excessive pressure in the colon leads to the expansion of its parts, the width of which cannot be accepted as a norm. The authors themselves confirmed, "We found a correlation between colonic diameter size and the maximal pressure during the procedure" [1].

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Second, in intussusception, the mesentery of the intestines is compressed. This causes a decrease in the tone of the colon. The stronger the compression, the more pronounced this decrease. It is manifested by the expansion of the colon. On the radiograph from the article under review (Fig. 1), we identified the expansion of the rectum relative to the norm using two different methods. Meunier et al. [2] in 1984 proposed to measure the width of the rectum on the basis of recto-pelvic ratio (RPR). The RPR was obtained by dividing the diameter of the rectal width by the diameter of the linea transversa (T) of the pelvis (Fig. 2).

The mean RPR in patients with fecal impaction was 0.68 (range 0.32–0.83). The rectal width in control was 0.52 with an upper limit of 0.61 [3]. On the radiograph (Fig. 1), RPR is 0.74, which corresponds to the concept of megarectum because it is significantly above the upper limit of the norm. This method has not found practical application because the normal and pathological indicators overlap. One of the reasons is that the rectum is curved into two projections, which are superimposed on each other in an anteroposterior projection (Fig. 3). Since then, the rectum has been examined only in lateral projection, including during the barium enema, CT, MRI and defecography [4, 5] (Fig. 4).

We propose a more accurate method for determining the width of different parts of the intestine. We calculated the true height of the first lumbar vertebra in children of different ages [6]. For this purpose, before the abdominal radiography a contrast marker was glued to the skin of the loin. Knowing the true diameter of the coin, you can determine the true height of the L1 vertebra (HL1). Table 1 gives the dimensions of these calculations.

Judging by the shape of the hip joints, the child's age in Fig. 1 is 2–4 years old. Therefore, the true height L-1

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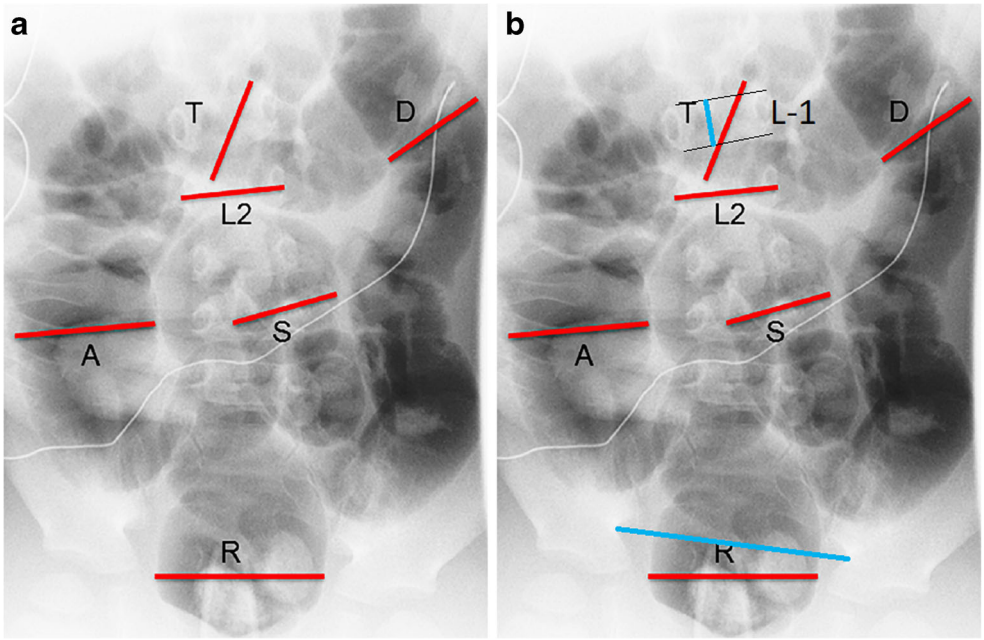

Fig. 1 Anteroposterior radiograph from the article. **a** The image of an air contrast enema from this study. Red lines indicate characteristics (by authors) that were measured to calculate the colonic diameter. *A* ascending colon diameter, *D* descending colon diameter, *L2* width vertebral body L2, *R* rectum diameter, *S* sigmoid colon diameter, *T* transverse colon diameter. **b** The same radiograph with my additions. The blue line at is the height of the body L-1 vertebra (HL1). The blue line in the pelvis is the maximal pelvis diameter (linea transversa)

should be 1.4 cm. After measuring the height L1 vertebra on the radiograph (HL1) and the diameter, which the authors of the article called the width of the rectum (R), we composed the equation where the true size of this gut r=(R × 1.4) /HL1. The true width "r" is 4.7 cm. Because the dimensions on the roentgenogram are larger than the true anatomical dimensions, the value of the "rectal" width on the radiograph at standard shooting conditions would be equal to 6.5 cm. Thus the supposedly normal width of the rectum in a child of 2–3 years was greater than the upper limit of the norm determined for adults (6.3 cm) [4]. You can compare this value with the norm for each part of the intestine according to Table 2 [6, 7]. The true width of the sigmoid colon on the Fig. 1 is 3 cm, wider than the maximum limit of norm even for children 15 years of age.

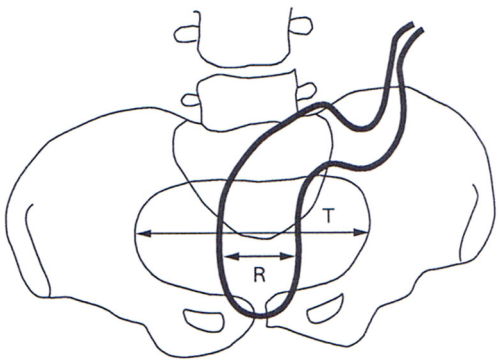

Fig. 2 Determination of the recto-pelvic ratio. The maximal pelvis diameter (linea transversa – *T*) and the rectum diameter (*R*) at this level are shown [2]

Thus as a result of methodological errors the authors came to the incorrect conclusion that in normal children younger than 5 years, the width of the rectum can reach 6.5 cm. They directly state this in another article with

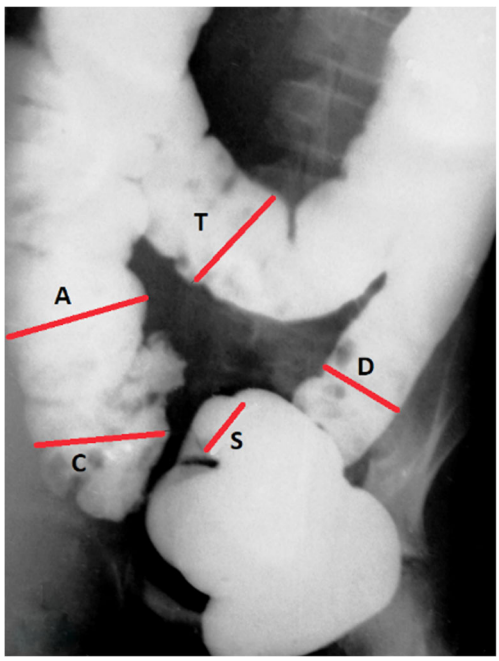

Fig. 3 Hydrostatic barium enema. Anteroposterior radiograph of a 15-year-old boy performed to identify the cause of chronic abdominal pain. Lines indicate characteristics same as in Fig. 1. Conglomerate of the bowel loops is determined in the pelvis. The rectum is not visible and cannot be measured. *A* ascending colon diameter, *C* cecum diameter, *D* descending colon diameter, *S* sigmoid colon diameter, *T* transverse colon diameter

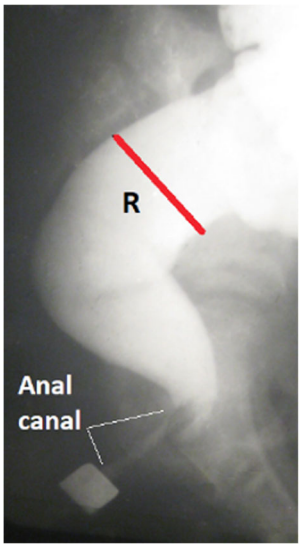

Fig. 4 Lateral radiograph of the anorectal zone of an 11-year-old boy. The red line determines the width of the rectum. The distance between the rectum and the contrast marker is the length of the contracted anal canal

reference to the article we analyze here: "Finally, we compared colonic diameter measurements in our sample with the predefined cutoff value of 6.5 cm, which is commonly used to define megacolon and megarectum in adults" [8]. In the human body there is not a single organ that does not increase in size from 1 year to 15–70 years. This is an axiom!

Any error in science entails a chain of associated errors. Considering the sharply expanded rectum as normal, the authors concluded that segmental colonic dilation in children with functional constipation is possible, which is not only incorrect, but contradicts physiological laws. The next error in this chain is the surgical deletion of the extended segment [9].

In conclusion, the obtained parameters of the width of the colon and rectum cannot be considered as the norm. The application of these normative data will inevitably lead to an erroneous diagnosis and treatment of children with chronic constipation.

Table 1 Height L1 in children of different ages (modified from Levin MD [6])

Age (years)	1	2	3	4	5	6	7	8	9	10	11	12	13	14–15
Height (cm)	1.3	1.4	1.4	1.5	1.5	1.6	1.7	1.8	1.8	1.8	1.9	2.0	2.1	2.2

Table 2 Normal size of the anal canal, rectum and colon in children of different ages (modified from Levin MD [6])

Age	Statistical indicators	Anal canal length	Widths of different parts of the intestine (cm)						Height of the cecum dome	Volume of the colon (mL)
			Rectum	Sigmoid colon	Descending colon	Transverse colon	Ascending colon	Cecum		
1–11 months	*n*	7	12	12	11	10	10	10	9	9
	Fluctuations	1.7–2.5	1.3–3.0	1.4–2.0	1.7–2.4	2.3–2.7	2.4–3.4	2.4–3.0	1.4–2.7	350–800
	Mean (M±m)	2.2±0.15	2.24±0.09	1.73±0.06	2.05±0.06	2.51±0.07	2.71±0.13	2.62 ±0.10	2.13±0.12	562±38
1–3 years	*n*	7	9	9	8	7	6	6	6	6
	Fluctuations	2.3–2.8	3.0–3.7	1.8–2.4	2.3–2.5	2.4–3.8	2.5–3.6	2.5–3.6	2.4–3.5	600–800
	Mean (M±m)	2.55±0.10	3.21±0.11	2.11±0.08	2.54±0.08	3.02±0.23	3.09±0.27	3.26±0.21	2.95±0.13	675±12
4–7 years	*n*	9	9	8	9	8	7	6	7	8
	Fluctuations	2.5–3.6	3.0–3.9	2.4–2.6	2.6–2.9	2.9–4.2	3.2–5.4	3.2–4.6	3.5–4.2	650–1,100
	Mean (M±m)	3.17±0.14	3.43±0.14	2.52±0.03	2.76±0.07	3.75±0.15	4.24±0.35	3.95±0.26	3.72±0.10	910±16
8–10 years	*n*	18	19	19	19	18	18	15	13	17
	Fluctuations	2.6–3.7	3.2–4.1	2.1–2.6	2.5–3.2	3.0–4.3	3.6–5.7	3.6–5.4	3.5–4.9	750–1,200
	Mean (M±m)	3.11±0.10	3.72±0.05	2.41±0.03	2.81±0.06	3.56±0.09	4.62±0.17	4.35±0.16	4.02±0.24	1,000±21
11–15 years	*n*	13	15	13	15	14	11	13	11	15
	n	3.1–3.9	3.6–4.6	2.2–2.6	2.5–3.2	3.6–4.4	3.9–6.4	3.9–6.0	3.8–5.2	900–1,200
	Fluctuations	3.43±0.10	3.95±0.07	2.36±0.03	2.82±0.05	3.89±0.15	5.28±0.32	5.10±0.21	4.46±0.19	1,050±32
	Mean (M±m)									

Compliance with ethical standards

Conflicts of interest None

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