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Pathophysiology of chronic childhood constipation: Functional and morphological evaluation by anorectal manometry and endosonography and colonic transit study

Alireza S. Keshtgar[a,b,*], Harry C. Ward[c], Graham S. Clayden[a]

[a]*Evelina Children Hospital, Guy's and St. Thomas' NHS Foundation Trust, London, United Kingdom*
[b]*University Hospital Lewisham NHS Trust, London, United Kingdom*
[c]*Barts Health NHS Trust, London, United Kingdom*

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Abstract

Background: Chronic idiopathic constipation (IC) is a common problem in children. We hypothesised that hypertonicity and overactivity of the internal anal sphincter (IAS) contributed to childhood IC.

Method: This was a prospective study of children who were admitted for investigation and treatment of chronic constipation at the gastrointestinal motility clinic in Guy's and St. Thomas' Hospital, NHS Foundation Trust, London. All children had a colonic transit marker study followed by anorectal manometry and anal endosonography under ketamine anesthesia. We used a validated symptom severity (SS) score questionnaire for assessment of constipation and fecal incontinence on admission to hospital and during follow-up for 12 months. The SS score of 0 was the best and 65 the worst.

Results: Of 92 children, 57 were male and median (range) age was 8.46 years (3.35–14.97). Duration of symptoms was 4.7 years (0.3–13). Soiling was present in 88 (96%) patients, delay in defecation of once every 2 to 3 days or less frequently in 86 (93%) and a palpable fecaloma (megarectum) on abdominal examination in 76 (83%). 42 children had 'fecal impaction' requiring disimpaction of stool from the rectum under general anesthesia and 50 had 'no impaction'.

The median IAS resting pressure was within the normal range measuring 55 mm Hg (25–107) and median amplitude and frequency of the IAS contractions were 10 mm Hg (2.0–58) and 17 cycles per min (5.0–34), respectively. The median IAS thickness was 0.93 mm (0.5–2.0). There was no correlation between amplitude and frequency of anorectal contractions and anal sphincter resting pressure. The mean right colonic transit time was 8.55 (standard deviation ±13.22) h, left colonic transit time was 11.51 h (±13.21), rectosigmoid transit time was 25.91 h (±18.89) and total colonic transit time was 45.97 h (±17.69).

Conclusion: The anal sphincter resting pressure is normal in children with chronic IC. Increased frequency and amplitude of IAS contractions seen in these patients do not cause raised anal sphincter resting pressure or obstructive defecation. Further studies should be done to investigate the role of external anal sphincter dysfunction in pathophysiology of childhood constipation and fecal incontinence.

* Corresponding author. Evelina Children Hospital, Guy's and St. Thomas' NHS Foundation Trust, Westminster Bridge Road, London SE1 7EH, UK. Tel.: +44 020 7188 4674; fax: +44 020 7188 4556.
E-mail addresses: ali.keshtgar@gstt.nhs.uk, ali.keshtgar@nhs.net (A.S. Keshtgar).

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Chronic constipation is a common symptom in children with an estimated prevalence rate of 8.9% ranging between 0.7% to 29.6% [1-3]. In most children the cause of constipation is not identifiable and diagnosis of functional or idiopathic constipation (IC) is made. In recent years anorectal manometry, anal endosonography and colonic transit studies have shown underlying physiological and structural abnormalities in these children [4-6]. It has been speculative whether these abnormalities are primary or secondary. Some investigators advocated that sphincter weakening procedures involving anal dilatation and myectomy of the IAS were beneficial in children with chronic IC because of observed hypertonicity and overactivity of the IAS muscle [5,7].

We hypothesised hypertonicity of the IAS contributed to childhood constipation. The aim of this research study was to investigate overactivity of the IAS muscle and anal sphincter resting pressure and its relation to morphology of the IAS and colonic transit time in children with chronic IC.

1. Method

This was a prospective study of children who were referred for further investigation and treatment of chronic constipation and/or soiling to our tertiary gastrointestinal motility clinic at Guy's and St. Thomas' Hospital NHS Foundation Trust, London between April 2001 and April 2004. The Ethics Committee of St. Thomas' Hospital had approved this study. We reviewed a cohort of 92 consecutive children prospectively, who underwent colonic transit study followed by anorectal manometry and endosonography. Ketamine anesthesia was used as a sole agent and was administered at induction dose of 1 to 2 mg/kg and if required repeat boluses to titrate to effect. Patients were investigated if they had failed to respond to dietary modification, high intake of fluid and fibres, toilet training and laxative treatment whilst under care of referring pediatrician and at least 1 month under our care. We included patients who fulfilled the requirement for diagnosis of constipation as defined by Rome II criteria [8]. Patients were excluded from the study if they had underlying anorectal anomaly, endocrine abnormality, neuropathic bowel, learning difficulties and evidence of anal sphincter damage on endosonography and low sphincter resting pressure of less than 30 mm Hg on anorectal manometry.

We obtained informed consent and recorded patients' demography including total and segmental colonic transit time, thickness of the internal anal sphincter (IAS) on endosonography, anorectal pressure profiles including resting sphincter pressure, rectal pressure, rectoanal inhibitory reflex (RAIR), rectal capacity at complete inhibition of the IAS, closing sphincter pressure, amplitude and frequency of rectal and IAS contractions on anorectal manometry. Patients had anorectal manometry and endosonography in left lateral position under ketamine anesthesia without using muscle relaxants. We used a rigid anorectal probe with four cylindrical microballoons on the stem at 1-cm intervals, which was positioned in anal canal. A latex disposable balloon (condom) was tied to the flexible end of probe and it was placed in the rectum to record simultaneously the anorectal pressure profiles as described previously [9]. Patients did not have bowel preparation before the anorectal studies and manual disimpaction of stool was done at the end of procedure. Rectal compliance was not measured because it would have required evaluation by barometry using a compliant low-pressure balloon. We used the anorectal manometry analyser software, AMA version 3.11, developed by one of the authors (Keshtgar) for detailed analysis of pressure profiles [10]. The data were exported to Microsoft Access®, Excel ® and SPSS® package version 17 (SPSS Inc, Chicago, Ill) for statistical analysis.

We used Bruer and Krajer ultrasound system (B&K, Gentofte, Denmark) for anal endosonography with axial endosonic probe type 1850, and a 10-MHz rotating transducer. The integrity of anal sphincters was assessed and thickness of the IAS was measured at mid-anal canal at 3, 6, and 9 o'clock positions and mean value of the three measurements was used for statistical tests.

Colonic transit study was done by using radiopaque solid markers. Patients were advised to stop laxatives 24 h before ingesting 10 markers of different shapes at 24 h intervals for three consecutive days. A plain radiograph of the abdomen was taken on day five when the child was admitted to hospital for investigations. We adopted the method described by Metcalf and modified the technique and formula for calculating the colonic transit time by taking a radiograph of the abdomen 48 h after ingestion of the third day markers [11]. As such our method did not underestimate the total colonic transit time ranging between 72 and 96 h in constipated children. It also reduced exposure of the child to radiation by taking a single radiograph rather than a series of radiographs. Markers located to the right of the spinal processes of vertebrae in the midline and above an imaginary line from the body of the fifth lumbar vertebra to the pelvic outlet were assigned to right colon, markers to the left of the midline and above a line from the fifth lumbar vertebra to the iliac crest were assigned to left colon and markers below a line from the pelvic brim on the right and the iliac crest on the left were assigned to the rectosigmoid colon. The colonic transit time was calculated and analysed as mean and standard deviation. We did not use radioisotope scintigraphy for measurement of gastrointestinal transit study, however the results of scintigraphy have been comparable with the radiopaque markers study [12].

We used a symptom severity (SS) score questionnaire filled in by parents, which was validated by prospective review of 2000 questionnaires in 1050 patients for assessment of severity of constipation and outcome of treatments [13]. The sum of SS score ranged between 0 (best) and 65 (worst) and consisted of: delay in defecation (range 0–10), difficulty and pain with passing stool (0–5), soiling