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ULTRASONOGRAPHIC EVALUATION OF URINARY TRACT IN CHILDREN WITH CHRONIC FUNCTIONAL CONSTIPATION*

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Urinary tract anomalies were prospectively investigated with ultrasound in 31 children with chronic functional constipation. These children were compared with 29 healthy controls without constipation both before and after treatment. Bladder residue and upper renal tract dilatation after micturition were significantly more common in the group with constipation than in the improved after-treatment and control groups.
Key words: functional constipation, pelvicalyceal dilatation, residue after micturition, urinary tract infection, ultrasonographic evaluation, children.

Constipation refers to both the frequency of defecation and the consistency of the stool. Functional constipation, defined as constipation without evidence of an underlying abnormality, is common and underdiagnosed pediatric problem[1, 2].

In patients with non-organic constipation, attention has been focused on the colons, with little thought being given to the association of urinary tract pathology. Kottmeier and Clattworthy[3] noted four incidental cases of megaureter in 13 children with functional magacolon[5], but only three cases of megaureter in 27 children with aganglionic megacolons. They presumed the cause to be a mechanical pressure phenomenon. O'Regan et al.[4] reported a series of 47 girls with recurrent urinary tract infection (UTI) and large fecal reservoirs. Intravenous urograms revealed that all had abnormal uninhibited bladder contractions and normal upper tracts.

We undertook a prospective controlled study using ultrasound to evaluate urinary tracts in patients with chronic functional constipation. We observed the effects of treatment and compared the children with controls.

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Material and Methods

This study population consisted of 31 patients (18 females and 13 males) with chronic functional constipation with or without encopresis, and 29 control children (16 males and 13 females). Without treatment, these 31 patients passed less than three stools per week. All constipated children had infrequent and abnormal stools for six months or more. All constipated children had a very large amount of stools present in the rectal ampulla. Heights and weights were appropriate for age in all subjects. We excluded from this study organic constipation induced by drugs (diuretics, anticonvulsants, codeine-containing cough syrups, hypotensives), neurogenic constipation (Hirschsprung's disease, paraplegia, myelomeningocele, diabetic neuropathy), constipation secondary to anal lesion (fistula, abscess, hemorrhoids), and constipation secondary to endocrine disorder (hypothyroidism, hypercalcemia, hypopituitarism). Mental retardation (demonstrated by clinical evidence of psychomotor retardation) was, likewise, a cause of exclusion[1,2].

The control subjects volunteered for this study. These children had between two bowel movements per day to one every other day. They had no history of previous gastrointestinal tract disease, and their physical examinations yielded normal results.

Urograms, urine cultures, and ultrasonographies were performed on all cases (constipated and control cases). Urinary tract infection (UTI) was confirmed as all pure growths of more than 10^5 CFU/ml of a single urinary pathogen from mid-stream urine and a bag specimen, and all pure growths of more than 50×10^3 CFU/ml of a single urinary pathogen in urine collected by catheterization[5]. The children were given a large drink 30-45 minutes before the ultrasound study, which was undertaken initially with a full bladder and then repeated after the bladder was emptied. The same consultant radiologist evaluated bladders, kidneys, and ureters using a standard technique by a 3.5 MHz probe on ultrasound machine (Toshiba SAL 77A). Bladder volume was estimated from three dimensional measurements and the diameters of the pelvicalyceal systems and upper ureters were measured. The measurements were repeated after micturition. Pelvicalyceal diameters greater than 7 mm were accepted as pelvicalyceal dilatation[6].

The 31 constipated patients received treatment. Treatment was initiated by emptying the rectal vault with an enema. Once the rectum had been cleared of stool, to prevent fecal impection and soiling and to allow the rectum to return to normal size, lactulose (1-2 ml/kg body weight daily, as necessary to induce one to two bowel movements per day) was used. In addition, these cases received a high-fiber diet, and instruction bowel training techniques[1,2]. The patients were followed up approximately one year later.

Urine cultures and ultrasound studies were repeated after treatment when a regular bowel habit had been established.

Cooperating patients with pelvicalyceal dilatation underwent voiding cystourethrograms (VCUG). VCUG was performed according to standard technique using a cystographic contrast agent instilled by catheter under gravity.

Results were compared before and after treatment and with controls using the χ^2, and Wilcoxon matched-pairs signed-ranks tests.

Results

Thirty-one constipated and twenty-nine control cases were included in this study. Their ages ranged from two to 14 years. The mean ages of the constipated children (5.6 years) and of the control children (6.8 years) were not significantly different.

Chronic recurrent abdominal pain was one of symptoms associated with constipation, and it occurred in 15 patients (48.4%). Five children (29.4%) of 17 children more than five years old suffered from nocturnal enuresis, and 12 children (60.0%) of 20 children more than four years old suffered from encopresis before treatment. After treatment, cases of enuresis and encopresis improved to 23.5% and 15.0%, respectively (Table I). While there was a statistically significant difference in the decrease of encopresis, there was no significant difference in the decrease of nocturnal enuresis.

Table I: Occurrence (Number and Percentage) of Encopresis and Nocturnal Enuresis in Children with Constipation (Before and After Treatment)

	Constipated Children				
	Before Treatment		After Treatment		
	n	%	n	%	p
Encopresis	12	60	3	15	< 0.01
Nocturnal Enuresis	2	29	4	24	> 0.05

Twenty-two percent of the constipated patients had urinary tract infections at initial assessment, a finding significantly different from controls and improved patients ($p < 0.05$, $p < 0.01$, respectively) (Table II).

Table II: Occurrence (Number and Percentage) of a Residue After Micturition and Urinary Tract Infection in Child with Constipation (Before and After Treatment) and in Controls

	Constipated Children					
	Before Treatment		After Treatment		Controls	
	n	%	n	%	n	%
A residue after micturition	12	39*,**	3	10***	4	14
Urinary tract infection	7	22*,**	0	0***	1	3

* Before treatment vs controls $p < 0.05$.
** Before treatment vs after treatment $p < 0.01$.
*** After treatment vs controls $p > 0.05$.

A residue after micturition was detected in 12 of 31 children (38.7%) at initial assessment and three of 31 children (9.7%) at assessment after treatment, compared with four of 29 controls (13.8%) (Table II). The residue after micturition was significantly more common in constipated children before treatment compared with controls ($p < 0.05$), and was significantly reduced by treatment ($p < 0.01$). After treatment, the patients showed no more significant a residue after micturition than that shown in the controls ($p > 0.05$).

Pelvicalyceal dilatation was present in 13 of 31 (41.9%) constipated children before treatment, compared with three of 29 (10.3%) controls ($p < 0.05$). There was a reduction in the number of children with pelvicalyceal dilatation after treatment and these improvements reached statistical significance ($p < 0.01$) (Table III).

Table III: Occurrence of Pelvicalyceal Dilatation in Children with Constipation (Before and After Treatment) and in Controls

	Constipated Children		
Pelvicalyceal Dilatation	Before Treatment	After Treatment	Controls
Right kidney	8	3	2
Left kidney	7	2	2
Bilateral	2	1	1
Total	13 (41.9%)*,**	4 (12.9%)***	3 (10.3%)

* Before treatment vs controls $p < 0.05$.
** Before treatment vs after treatment $p < 0.01$.
*** After treatment vs controls $p > 0.05$.

Five of the 13 patients with pelvicalyceal dilatation had a residue after micturition. There was no significant difference between the residue after micturition and pelvicalyceal dilatation ($p > 0.05$). The number of patients with pelvicalyceal dilatation increased with the duration of constipation. Pelvicalyceal dilatation was present in three (21.4%) of 14 patients who had a duration of constipation of less than one year, and in 10 (58.8%) of 17 patients who had a duration of constipation of more than one year ($\chi^2 = 3.86$, $p < 0.05$). The number of patients with a residue after micturition also increased with the duration of constipation. A residue after micturition was present in three (35.7%) of 14 patients who had a duration of constipation of less than one year and in nine (52.9%) of 17 patients who had duration of constipation of more than one year ($\chi^2 = 4.12$, $p < 0.05$). Six of seven patients with UTI had pelvicalyceal dilatation, and there was a significant difference between UTI and pelvicalyceal dilatation ($p < 0.01$).

Significant differences between a residue after micturition and nocturnal enuresis or UTI were also found ($p < 0.05$).

None of the children with pelvicalyceal dilatation was shown to have vesicoureteral reflux during micturating cystourethrography.

Discussion

Constipation represents a common problem in children, accounting for three percent of visits to the pediatric outpatient clinic and for 25 percent of visits to the pediatric gastroenterology clinic[7]. Chronic functional constipation is the most common cause of constipation with or without encopresis (90-95%)[2, 7]. Although the associated gastrointestinal and psychological symptoms are well recognized, the effects on the urinary tract are not so widely appreciated. Constipation may not be suspected when a child has a urinary tract infection and, conversely, urinary tract abnormalities are easily overlooked when a family faces the major anxiety of a child with constipation and encopresis.

In literature, the most common symptom associated with constipation is chronic recurrent abdominal pain, which occurs in about 60 percent of the patients. Enuresis is reported in about 30 percent of the cases of children with encopresis. Many have daytime as well as nocturnal enuresis, which resolve when the constipation is treated[1]. In our study, the most common symptoms were encopresis and abdominal pain. While there was a statistically significant difference in the decrease of encoprdesis. there was no significant difference in the decerease of nocturnal enuresis.

Literature on the association of urinary tract abnormalities and constipation in children is scarce. Bladder and ureteric abnormalities have been described in both organic and non-organic groups[3, 8, 9]. It is generally agreed that there is a higher incidence of urinary tract infection in both groups. The urinary tract evaluation must be performed as it plays a crucial part in management. Kottmeier and Clattworthy[3] noted megaureter in 30.7 percent of children with functional constipation and presumed the cause to be a mechanical pressure phenomenon. Shopfner[9] found 12 cases of urinary tract abnormalities in 39 children with severe functional constipation. Although he found no evidence of mechanical obstruction, he found a high incidence of bladder abnormalities, including a cone-shaped bladder base plate, elongated urethra and mural irregularity localized to the pressure area from the fecal mass. In the same study, there was normal ureteric peristalsis and emptying. Hence, he found no supporting evidence of an obstructive cause, but could not exclude mild dilatation secondary to chronically raised intravesical pressure[9]. In the study performed by Hebetko and Hyde[8], the incidence of dilatation of the upper renal tract and UTI was 12 percent and 31.4 percent, respectively, in the patients with non-organic constipation. In the same study, they observed a higher incidence of dilatation of the upper urinary tract in the organic constipation group (67%) than in the functional group (12%)[8].

The anatomic proximity of the bladder and urethra to the rectum, and the similar spinal innervation of the urethral and anal sphincters, make it likely that abnormalities in the gastrointestinal system may affect the urinary tract. Indeed, Shopfner[9] has shown that a fecally impacted rectum will cause irregularities in

the bladder wall. In constipated children, the pelvicalyceal dilatation had likely arisen from the mechanical compression of the urinary tract by the distended rectum. This could occur at the level of the urethra, bladder, or the vesicoureteric junction.

Although it was not intended in this study to determine the incidence of constipation in children with UTI, we showed that urinary tract abnormalities often occur in children with functional constipation and that these abnormalities appear to be reversible after adequate treatment. In our study, significant differences between a residue after micturition and nocturnal enuresis or UTI were found ($p < 0.05$). Inappropriate detrusor muscle contraction in children with constipation was noted[4]. Incomplete bladder emptying creates a reservoir for bacteria and may predispose one to UTI.

Similar to our findings, Dohil et al.[6] found that the bladder residue and upper renal tract dilatation after micturition were significantly more common in the group with constipation than in the improved after treatment group. Also, in the same study, none of the children with upper tract dilatation exhibited vesicoureteral reflux at micturating cystourethrography.

The number of patients with pelvicalyceal dilatation or with a residue after micturition both increased with the duration of constipation. However, there was no significant difference between the residue after micturition and pelvicalyceal dilatation ($p > 0.05$). We found that there was a significant difference between UTI and pelvicalyceal dilatation ($p < 0.01$), and significant differences between a residue after micturition and nocturnal enuresis or UTI ($p < 0.05$). We could not find any information in this regard in literature.

Our study showed that renal abnormalities are relatively common in children with functional constipation and that those are reversible. The etiology of upper tract dilatation may be related to increased bladder volume or pressure. We feel it is important to be aware that there might be an association with constipation. A case can be made for investigating through ultrasound the urinary tract system of all children with chronic constipation.

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