Clinical Science

Bladder and Bowel Control in Children with Cerebral Palsy: Case-Control Study

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Aim To determine the age of development of bladder and bowel control and the frequency of enuresis, encopresis, and urinary infections in children with cerebral palsy.

Methods The study included 45 children with cerebral palsy who regularly attended a rehabilitation center in Isparta, Turkey, and two groups of age- and sex-matched children, 37 siblings of the children with cerebral palsy and 37 healthy children. Demographic data and information on the age of development of total bladder and bowel control and presence of possible urinary symptoms in children were collected from their caregivers by use of a questionnaire. Frequency of enuresis and encopresis was estimated among the children aged ≥5 years. A mid-way urinary sample was obtained from 40, 22, and 21 children in the cerebral palsy, siblings, and healthy children, respectively.

Results The mean age of nighttime bladder and bowel control development was 47 months (95% confidence interval [CI], 35-58) and 45 (36-55) months, respectively, for the children with cerebral palsy, 35 months (95% CI, 24-46) and 26 months (95% CI, 24-28), respectively, for their siblings, and 27 months (95% CI, 22-33) and 25 months (95% CI, 23-27) months, respectively, for the healthy children. Among the children aged ≥5 years, enuresis was present in 11 of 34 children with cerebral palsy, 7 of 30 siblings, and 4 of 30 healthy children ($P = 0.200$), whereas encopresis was present in 5 children with cerebral palsy, one sibling, and one healthy child. Constipation was significantly more present in chidlren with cerebral palsy than in other two groups ($P<0.001$). Urine culture was positive in 13 children with cerebral palsy, 1 sibling, and 2 healthy chidlren ($P = 0.024$). There were no significant differences in other urinary symptoms and laboratory findings among the three groups.

Conclusion The children with cerebral palsy gained bladder and bowel control at older age in comparison with their siblings and healthy children. They also had more frequent enuresis and urinary infections.

Cerebral palsy represents a group of chronic, non-progressive motor disorders characterized by impaired voluntary movement resulting from prenatal developmental abnormalities or perinatal or postnatal central nervous system damage. Some people with cerebral palsy are also affected by other medical disorders, such as seizures, mental retardation, hearing and vision problems, and communication problems (1,2). The prevalence of cerebral palsy is approximately 2-3 per 1000 live births (1-3).

The involuntary voiding of urine beyond the age of anticipated bladder control is defined as enuresis. The ability to void or inhibit voiding voluntarily at any degree of bladder filling commonly develops during the second and third year of life, and most children acquire an adult pattern of urinary control by the age of 4 (4,5). The fourth edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) defines enuresis and encopresis as involuntary or unintentional repeated voiding of urine or feces, respectively, into bed or clothes, which occurs twice a week for at least 3 consecutive months, and the child must be at least 4 years old (5). The bladder and bowel control typically develops in the following sequence: nocturnal bowel control, daytime bowel control, daytime control of voiding, and nocturnal control of voiding (5).

Urinary incontinence or enuresis, fecal incontinence or encopresis, and constipation are common bowel and bladder problems among adults or children with cerebral palsy (6-11). Furthermore, age of achieving bladder and bowel control in the children with cerebral palsy are higher than in their healthy peers (9,12). The development of bladder and bowel control may be influenced by neurological impairment in the children with cerebral palsy. Additionally, the frequency of urinary tract infections in these children may be higher than in healthy ones (6,7). Thus it is important to think about the possibility of a bladder problem in any child with cerebral palsy who would be expected to be dry, particularly if there is a history of urinary tract infections (13).

The healthy siblings of disabled children, including children with cerebral palsy, are exposed to emotional distress more often than other healthy children without disabled siblings (14), but they do not differ in health, nutritional, or growth status (15). Moreover, the siblings of children with cerebral palsy encourage their brother or sister to be more independent and thus may contribute to improvement of the functional status of children with cerebral palsy (16).

Our aim was to determine the age of achieving bladder and bowel control and frequencies of enuresis, encopresis, and urinary infections in children with cerebral palsy in comparison with their healthy siblings and other healthy children.

Patients and methods

Patients

The study included 45 children with cerebral palsy who regularly attended Isparta Spastic Children's Center for rehabilitation and two control groups of age- and sex-matched healthy children, 37 siblings of the children with cerebral palsy and 37 healthy children. Healthy children were chosen from those referred to a pediatric outpatient clinic in Suleyman Demirel University Hospital, where all children are periodically controlled for their development and growth. The mean age of the children with cerebral palsy, 27 boys and 18 girls, was 8.3 ± 4.1 years (range, 2-16 years). The mean age of the sibling group (21 boys and 16 girls), was 8.8 ± 4.1 years, and of the healthy group (21 boys and 16 girls), it was 8.2 ± 3.7 years.

The study was performed during March and April 2002. All caregivers of the children were interviewed and gave informed consent for the children to participate in the study.

Methods

The children were initially examined for possible abnormalities of the urinary system. Physical examination and collection of urine specimens from the children with cerebral palsy and their siblings were done in the rehabilitation center, whereas the assessment of healthy children for the other control group was done in the pediatric outpatient clinic of the Suleyman Demirel University Hospital. Demographic data and information on the bladder and bowel control and possible urinary symptoms in all children were collected from their caregivers by use of a questionnaire. Possible urinary symptoms included painful urination (dysuria), a compelling need to urinate (urgency), frequent micturition (frequency), and difficult or infrequent passages of feces (constipation) (17). Mothers were the caregivers in 44 children with cerebral palsy, 37 siblings, and 23 healthy children. Severity of impairment in the children with cerebral palsy was evaluated according to the Gross Motor Function Classification System (GMFCS) (18).

The age at which the children developed bowel and bladder control was defined as the age (in months) at which they gained complete bowel and bladder control (19). The frequencies of enuresis and encopresis, defined according to the DSM-IV (5), were estimated only in children aged ≥5 years, ie, in 34 children with cerebral palsy, 30 siblings, and 30 healthy controls.

A clean-catch midstream urine sample collected into a plastic urine collection bag could be obtained from 40 children with cerebral palsy, 22 siblings, and 21 healthy children. Urine nitrites, blood, leukocyte esterase, and pH were determined by urine strips (Combur test S, Hitachi-Boehringer, Mannheim, Germany). Urine samples (0.001 mL) were cultured on blood and MacConkey agars and incubated at 37°C. The following day, bacterial colonies were identified and quantified by use of classical and Analytical Profile Index (API) strips (BioMerieux S.A., La Balme les Grottes, France). A positive urine culture was defined as more than 10^5 colony-forming units/mL of a single microorganism (20).

Statistical analysis

Results were presented as mean values with either standard deviation (±SD) or 95% confidence interval (CI). The analysis of variance (ANOVA) was used to compare mean age of complete bladder and bowel control development in the three groups of children. If ANOVA was significant, post hoc Bonferroni test was performed. Nominal variables, such as frequencies of enuresis and encopresis, were analyzed by χ^2 test. Statistical analysis was performed with the Statistical Package for Social Sciences Version 9.05 (SPSS Inc., Chicago, IL, USA). $P<0.05$ was considered statistically significant.

Results

The three groups of children did not differ significantly in age and sex distribution. With respect to the type of cerebral palsy, 18 children with cerebral palsy had spastic diplegia, 14 had spastic quadriplegia, 4 had spastic hemiplegia, 2 had athetoid cerebral palsy, 2 hypotonic, 2 mixed, and 3 children had others types of cerebral palsy. With respect to severity, 21 of 45 children with cerebral palsy had GMFCS severity level III or higher.

Age of bladder and bowel control

The children with cerebral palsy gained nighttime and daytime bladder and bowel control at significantly older age than their siblings and other healthy children (Table 1). The mean age at which the siblings of children with cerebral palsy gained night and daytime bladder control was not significantly higher than that of healthy children (Table 1).

Enuresis and encopresis frequency

Among the children older than 4 years, enuresis was more frequent in the children with cere-

Table 1. Age of bladder and bowel control in children with cerebral palsy, their siblings, and healthy children

	Group of children					
	with cerebral palsy (n = 45)		siblings (n = 37)		healthy controls (n = 37)	
Control gained at age (months)	No.	mean (95% CI)	No.	mean (95% CI)	No.	mean (95% CI)
Nighttime bladder control	26	47 (35-58)*	26	35 (24-46)	30	27 (22-33)
Daytime bladder control	28	47 (35-59)†	34	31 (25-36)	36	26 (23-29)
Nighttime bowel control	34	45 (36-55)†	35	26 (24-28)	35	25 (23-27)
Daytime bowel control	34	45 (35-55)†	35	27 (24-29)	36	26 (24-28)

*Statistically significant difference from healthy children, *P*<0.001, ANOVA and post hoc Bonferroni test.
†Statistically significant difference from both siblings and healthy children, *P*<0.001, ANOVA and post hoc Bonferroni test.

Table 2. Enuresis at age ≥5 years in children with cerebral palsy, their siblings, and healthy children*

	Bladder control (No. of children)								
	with cerebral palsy			siblings			healthy children		
Characteristic	total (n = 34)	enuretic (n = 11)	P*	total (n = 30)	enuretic (n = 7)	P	total (n = 30)	enuretic (n = 4)	P
Sex:									
boys	21	4	0.035	17	6	0.077	17	3	0.427
girls	13	7		13	1		13	1	
Age (y):									
5-8	11	5	0.443	11	5	0.093	11	4	0.019
9-11	14	3		9	1		9	0	
≥12	9	3		10	1		10	0	
Enuresis pattern:									
primary		10			2			3	0.021
secondary		1			5			1	
Family history of enuresis:									
present	9	5	0.083	7	2	0.527	10	2	0.773
absent	25	6		23	5		20	2	
Constipation:									
present	16	8	0.090	4	1	0.932	2	0	0.566
absent	18	3		26	6		28	4	
Encopresis:									
present	5	5	<0.001	2	1	0.356	1	1	0.010
absent	29	6		28	6		29	3	
Urine culture results:	(n = 31)	(n = 9)		(n = 17)	(n = 6)		(n = 17)	(n = 4)	
positive	10	6	0.009	0	0	–	2	1	0.347
negative	21	3		17	6		15	3	

*Statistics: χ² test.

bral palsy (11 of 34) than in their siblings (7 of 30) and healthy children (4 of 30; *P*=0.200). Enuresis was more frequent among the boys than among the girls with cerebral palsy, whereas in the groups of siblings and healthy children, it was higher among the girls than among the boys (Table 2). Out of 11 enuretic children with cerebral palsy, 5 had encopresis and 6 had positive urine culture results (Table 2). Primary enuresis was present in 10 of 11 children with cerebral palsy, 2 of 7 siblings, and 3 of 4 healthy children (*P*=0.021, Table 2). Additionally, 3 children with cerebral palsy were daytime enuretic, while other children with enuresis had only nocturnal enuresis.

With respect to the types of cerebral palsy, enuresis was more frequent among children with spastic quadriplegia (6 of 11) than in children with other types of cerebral palsy, but the difference was not significant (*P*=0.128). Similarly, enuresis was more frequent among the children with GMFCS level III-V of cerebral palsy (7 of 16) than among the children with GMFCS level I-II (*P*=0.331).

Physical examination

Physical examination excluded undescended testicle, phimosis or hypospadia in the boys. There was a single child with inguinal hernia, in the siblings group. Urinary projection was abnormal in

3 children with cerebral palsy, one sibling, and one healthy child. With respect of urinary symptoms, the rates of frequent micturition and constipation were significantly higher in children with cerebral palsy than in other groups (Table 3).

Table 3. Urinary symptoms, constipation, and laboratory findings in children with cerebral palsy, siblings, and healthy children

	No. of children			
Symptom*	with cerebral palsy (n = 45)	siblings (n = 37)	healthy children (n = 37)	$P^†$
Frequent urination	14	7	3	0.034
Dysuria	8	5	1	0.101
Constipation	18	6	2	<0.001
Urgent urinatinon	10	5	2	0.094
Laboratory findings:	(n = 40)	(n = 22)	(n = 21)	
nitrite (+)	3	1	1	0.861
blood (+)	6	2	2	0.747
leukocyte esterase (+)	5	3	3	0.964
pH (mean±SD)	5.6±1.0	5.3±0.6	5.5±0.5	0.469
gravity (mean±SD)	1018±6	1019±7	1023±3	0.057
urine culture (+)	13	1	2	0.024

*SD, standard deviation; (+) – positive detection in urine.
†χ^2 test.

Urine culture

Urine culture was positive in significantly more children with cerebral palsy (13 of 40), than in their siblings (1 of 22) and healthy children (2 of 21) (Table 3). The most frequently isolated microorganism in the group of children with cerebral palsy was *Esherichia coli* (n = 4), followed by *Proteus vulgaris* (n = 3), *Enterococcus feacalis* (n = 3), *Klebsiella oxytoca* (n = 1), *Staphylococcus saprophiticus* (n = 1), and *Proteus vulgaris* with *Serratia marcencens* (n = 1). There were no differences in other urinary biochemical parameters among the groups.

Discussion

The age of achieving bladder and bowel control was higher in children with cerebral palsy than in healthy children. Most healthy children achieve bladder and bowel control at the age between 2 and 4 years (21). However, disabled children gain this control at older age (9).

The studies in development of bladder and bowel control in preterm children who are at increased risk of disability, such as cerebral palsy

(22), produced controversial results. For example, Drillien (12) reported that prematurely born children, in particular those with neurodevelopmental impairment, acquired sphincter control later than term-born children. On the contrary, Largo et al (19) showed that prematurity, intrauterine growth retardation, and frequency of adverse prenatal, perinatal, and neonatal conditions do not significantly affect the development of bladder and bowel control. However, their study included children with mild to moderate degree of cerebral palsy impairment.

Other children with disabilities also have delayed development of bladder and bowel control. For example, children with moderate and severe mental retardation achieve that control at a significantly older age than healthy children, although no such difference was found for children with mild mental retardation (23).

In Turkey, only a few studies have been performed in children with cerebral palsy. Erkin et al (24) evaluated the functional disability of Turkish children with cerebral palsy by using the Functional Independence Measure of Children (WeeFIM) and found that the sphincter control subset scores of WeeFIM increased in children with cerebral palsy as they grew up, whereas in healthy controls, such a change was not observed.

Generally, childhood enuresis affects 15%-30% of 5-year-olds. This prevalence decreases with age and drops to 1%-2% by the age of 18 years (25). Serel et al (26) found the same trends among children in Turkey (26), although enuresis did not decrease at the rate among the children with cerebral palsy. In our study, the frequency of enuresis in the children with cerebral palsy was higher than in healthy children, especially in children with spastic quadriplega and those with GMFCS III-V levels of cerebral palsy severity. These results were in accordance with other studies (9,25). We found that constipation and frequent micturition were more frequent in children with cerebral palsy than in the other groups. Krogh et al (7) also showed that constipa-

tion and fecal incontinence were common symptoms in patients with neurological diseases, such as cerebral palsy. We also found delayed bowel and bladder control and increased frequency of enuresis in siblings group compared to healthy children, although not significantly. Possible reason could be of emotional nature, because it was shown that having a disabled sibling may cause emotional distress in a healthy child (14).

Approximately 3% of prepubertal girls and 1% of prepubertal boys are diagnosed with urinary tract infection (27). In our study, urine culture in the children with cerebral palsy was positive more often than in healthy control children.

The case-control design is a limitation to our study, as it prevented us from drawing causative conclusions (28). To investigate the clinical etiology of the enuresis or encopresis in children with cerebral palsy, further studies should be carried out with collaboration of related specialists. However, this study is one of the few carried out in Turkey on this topic.

In conclusion, we showed that children with cerebral palsy develop bladder and bowel control at older age and have enuresis and urinary infections more often than their healthy peers. We also found that siblings of children with cerebral palsy achieved bladder and bowel control at slightly older age than healthy children. Thus, both children with cerebral palsy and their siblings should be carefully evaluated for possible urinary problems.

Acknowledgment

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