Neurourology and Urodynamics 29:1272–1275 (2010)

# Voiding Dysfunctions in Children with Mental Retardation

**Pei-Yu Yang,[1] Nai-Hsin Meng,[1] and Eric Chieh-lung Chou[2]***
[1]*Department of Physical Medicine and Rehabilitation*
[2]*Department of Urology, China Medical University Hospital, Taichung, Taiwan*

**Aims:** This study aims to evaluate the voiding disorder and lower urinary tract symptoms in mentally retarded children. **Methods:** Fifty-one mentally retarded children (age 7.7 years) was assessed. A volunteer sample comprised of 36 typically developing children (age 6.4 years) served as the comparative group. All participants underwent uroflometric investigation, and residual urine was detected by sonography. Urological history including history of urinary tract infection, incontinence, frequency, and dysurea was collected. In addition, the mentally retarded group was classified according to IQ: severe mentally retarded group (IQ below 40) (n = 11), moderate mentally retarded group (IQ: 41 to 55) (n = 19), mild mentally retarded group (IQ: 56 to 70) (n = 21). Group comparisons were analyzed using Chi-square and Student's *t*-test. **Results:** Of the 51 mentally retarded children, 18(35.2%) were found to have voiding dysfunction, which is significantly higher than the control group (8.3%). The incidence of urine incontinence and frequency is also significantly higher in the mentally retarded group. The comparison of the three mentally retarded subgroups showed that the severe mentally retarded group had the highest incidence of voiding dysfunction and urinary incontinence. Overall, the mentally retarded group had higher percentage of small bladder capacity. **Conclusions:** We concluded that mentally retarded children have a higher incidence of voiding dysfunction and incontinence than the control group. Early detection of voiding dysfunction in an objective, non-invasive manner is important in mentally retarded children, particularly those with severe cognitive impairment. *Neurourol. Urodynam. 29:1272–1275, 2010.* © 2009 Wiley-Liss, Inc.

**Key words:** cystometry; mental retardation; residual urine; voiding dysfunction

## INTRODUCTION

Mental retardation involves a different group of disorders and is seldom affected by deficient intelligence alone.[1,2] Urinary incontinence and nocturnal enuresis occur more often in the mentally retarded population than in the normal one.[3–5] Several factors may predispose to incontinence including impairment of cognitive and communication skills, and reduced mobility.[5–7] A review of the literature reveals limited data on the causes and characteristics of voiding disorders in the mentally retarded population, although it appears that mentally retarded children have a higher incidence of lower urinary tract symptoms. Laecke used uroflowmetry in study of voiding dysfunction in mentally and motor disabled children. However, there is no study mentioned about voiding dysfunction in mentally retarded children without mobility impairment.[8] Therefore, the aim of this study is to investigate the prevalence of voiding disorders in the children with mental retardation and to correlate the findings with the severity of cognitive impairment. We use uroflowmetry and sonographic residual urine examination as the choice tools for investigation instead of invasive procedures such as cystometry.

## METHODS

### Participants

We recruited mentally retarded children in our rehabilitation clinic from April 2006 to May 2007. The inclusion criteria were: (1) diagnosed with mental retardation and (2) above 5 years of age. To reduce the influence of mobility impairment on voiding dysfunction, we excluded those who were diagnosed with cerebral palsy. All our participants were ambulatory. Those who have congenital urological anomalies and neurological defect that will interfere lower urinary tract function were also excluded. In addition, an age-matched sample comprised of typically developing children was recruited as the comparative group. The protocol for the clinical trial was approved by the institutional review board of the hospital. The informed consent of all participants was also obtained.

### Measures

Patient evaluation was based on simple and non-invasive methods. A questionnaire on the patients' medical history and urological symptoms including history of urinary tract infection, daytime incontinence, frequency, and dysurea was completed by the parents or caregivers. All participants underwent uroflowmetric investigation, and residual urine was detected by sonography (Bladder Scan®, Verathon, Inc., Bothell, USA). These examinations were measured at least twice. The results of uroflowmetry were analyzed by an independent observer. The data on uroflowmetry and residual urine were analyzed according to the diagnostic criteria of the Standardization Committee of the International Children's Continence Society 2006.[9] Residual urine of more than 20 ml indicates abnormal or incomplete emptying. Voiding dysfunc-

Conflicts of interest: none.
Christopher Chapple led the review process.
Source of funding: China Medical University Hospital, DMR-95-055.
*Correspondence to: Dr. Eric Chieh-lung Chou, No. 2, Yu-Der Rd., Taichung 404, Taiwan. E-mail: ericchou66@yahoo.com.tw
Received 30 May 2009; Accepted 11 August 2009
Published online 22 October 2009 in wileyonlinelibrary.com
DOI 10.1002/nau.20824

tion is defined as abnormal uroflowmetry finding or a large volume of residual urine (more than 20 ml).

### Data Analysis

The incidence of voiding dysfunction and history of urinary tract infection, incontinence, frequency, and dysurea were obtained. To identify the influence of mental retardation severity on the incidence of voiding dysfunction, we classified the mentally retarded group according to IQ: severe mentally retarded group (IQ below 40), moderate mentally retarded group (IQ between 41 and 55), and mild mentally retarded group (IQ between 56 and 70). We then compared the incidence of voiding dysfunction, urinary tract infection, urinary frequency, and dysurea between the mentally retarded group and control group. A comparison of incidence among the three subgroups of the mentally retarded group was also obtained. Group comparisons were analyzed using Chi-square, and Student's *t*-test. The level of significance was set at 0.05.

Chi-square was used to identify the correlation between abnormal voiding dysfunction and lower urinary tract symptom such as a history of urinary tract infection, incontinence, frequency, and dysurea in the mentally retarded group.

The voided volume of the subjects was obtained by uroflowmetry. The voided volume is considered small if found to be less than 65% of the expected bladder capacity (EBC). The EBC of the subjects is estimated by the following formula: 30+ (age in years $\times$ 30) in ml.[9] This formula is used for patients up to 12 years of age. The EBC is set at 390 ml above 12 years of age. Between-groups comparison of the percentage of small bladder capacity (less than 65% EBC) was calculated using Chi-square.

## RESULTS

Table I shows the demographic characteristics of the subjects. Fifty-one mentally retarded children were recruited in the present study. Of the 51 children, 31 were boys and 20 were girls. Their mean age was $7.7 \pm 2$ years. An age-matched sample comprised of 36 typically developing children was recruited as the comparative group (28 boys, 8 girls, mean age: $6.4 \pm 1$ years). The mentally retarded group was classified according to IQ:

Severe mentally retarded group: 11 children with IQ below 40 (5 boys, 6 girls, mean age: $10.5 \pm 3.2$ years).
Moderate mentally retarded group: 19 children with IQ between 41 and 55 (14 boys, 5 girls, mean age: $7.4 \pm 2.3$ years).
Mild mentally retarded group: 21 children with IQ between 56 and 70 (12 boys, 9 girls, mean age: $6.3 \pm 1.2$ years).

**TABLE I. The Demographic Characteristics of Subjects**

| | | Sex | | |
|---|---|---|---|---|
| | Number | Male | Female | Age (years) |
| MR group (all) | 51 | 31 | 20 | $7.7 \pm 2$ |
| Mild MR group | 21 | 12 | 9 | $6.3 \pm 1.2$ |
| Moderate MR group | 19 | 14 | 5 | $7.4 \pm 2.3$ |
| Severe MR group | 11 | 5 | 6 | $10.5 \pm 3.2$ |
| Control group | 36 | 28 | 8 | $6.4 \pm 1$ |

MR, mental retardation.

### Voiding Dysfunction

Voiding dysfunction is defined as abnormal uroflowmetric finding or a residual urine of more than 20 ml. Of the 51 mentally retarded children, 18 (35.2%) were found to have voiding dysfunction, which is significantly higher than the control group (8.3%) (Fig. 1). Among the 18 mentally retarded children with voiding dysfunction, 7 had both abnormal uroflowmetric finding and incomplete bladder emptying (residual urine of more than 20 ml), 10 had only abnormal uroflowmetric finding, and 1 had incomplete bladder emptying. All the three control groups with voiding dysfunction had abnormal uroflowmetric finding without incomplete bladder emptying. The most common abnormal uroflowmetric finding is interrupted flow pattern. To determine the correlation between the severity of cognitive impairment and voiding dysfunction, we analyzed the data of the three mentally retarded subgroups. The results showed that the incidence of voiding dysfunction in the severe mental retardation group is much higher than in the mild and moderate mental retardation groups ($P = 0.026$, see Fig. 2).

### Lower Urinary Tract Symptom

The data on lower urinary tract symptoms including a history of urinary tract infection, incontinence, frequency, and dysurea were analyzed. The incidence of incontinence and frequency is higher in the mentally retarded group than in the control group (Fig. 1). The comparison of the three mentally retarded subgroups showed a higher incidence of incontinence in the severe mental retardation group than in the mild and moderate mental retardation groups (Fig. 2).

We also studied the relationship between voiding dysfunction and lower urinary tract symptoms in the mentally retarded group. There is no statistically significant relationship between the variables (Table II).

### Voided Volume

The voided volume was obtained by uroflowmetry. The voided volume is thought to be small if less than 65% EBC.[9] The percentage of small bladder capacity is significantly higher in the mentally retarded group (Table III). Compared with the three mentally retarded subgroups, the more severe the cognitive impairment is, the higher the percentage of small bladder capacity.

## DISCUSSION

This study appears to be the first controlled study to investigate the incidence of voiding dysfunction in the

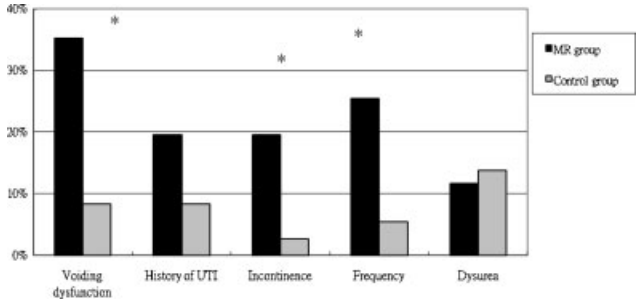


**Fig. 1.** The incidence of voiding dysfunction and lower urinary tract symptom in mental retardation and control group. *$P < 0.05$.

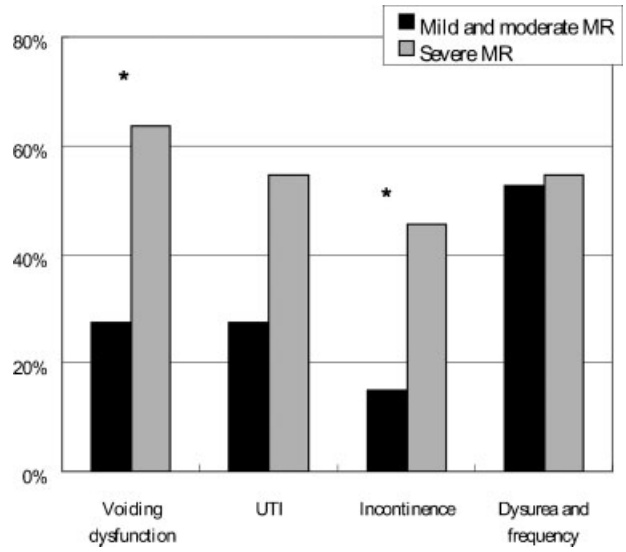


**Fig. 2.** Comparison of the incidence of voiding dysfunction and lower urinary tract symptom between the mental retardation subgroups. *$P < 0.05$. MR, mental retardation; UTI, urinarytraet infection.

mentally retarded population. We found that the incidence of voiding dysfunction is 35.2% in the mentally retarded group, which is significantly higher than the control group. The incidence of voiding dysfunction in the cerebral palsy population has been estimated at more than 30% in early studies.[5,6,10] McNeal et al.[6] investigated a group of patients with cerebral palsy and reported that 36% of them had symptoms of a neurogenic bladder. Decter et al.[10] performed urodynamic tests in children with cerebral palsy, some of whom were also mentally retarded, and found that more than one-third had symptoms of dysfunctional voiding. Although the participants of the previous study had cerebral palsy, most of them were also mentally retarded. The factors associated with urinary continence are age, bilateral involvement, and impairments in cognitive function, communication skills, mobility, and upper arm function.[5–7,11] In our study, we focused on the mentally retarded population without mobility impairment and we found that the incidence of voiding dysfunction in the ambulatory mental retardation population is higher than in the normal one. There is a correlation between the increased severity of mental retardation and the higher rates of voiding dysfunction.

The causes of voiding dysfunction in mental retardation remain unknown. Several factors have been proposed as the cause of voiding dysfunction. McNeal reported that cognitive function, upper limb weakness, communication ability, mobility, and arm function will predispose to urinary incontinence in mental retardation.[6] The study of Roijen et al.[5] on mental retardation showed that quadriplegia and the severe mentally disabled group had a higher rate of urinary incontinence. In Laecke et al.'s study,[8] mobility and swallow function were the predisposing factors of voiding dysfunction. To reduce the influence of mobility impairment on voiding dysfunction, we choose mentally retarded children without mobility impairment. In our study, the incidence of voiding dysfunction is correlated with the severity of cognitive function. By observation of higher rates of voiding symptom in children with attention deficit hyperactivity disorder, Feldman pointed out that central nervous system development delay or behavioral issues were proposed to be the cause of dysfunctional voiding in children.[12,13] This hypothesis explains the higher incidence of voiding dysfunction in the severe mental retardation group in our study. The influences of other factors such as age, swallow function, and communication skills on voiding dysfunction still need to be examined further in the future.

**TABLE II. The Relationship Between Voiding Dysfunction and Lower Urinary Tract Symptom in MR Group**

| | Voiding dysfunction (n = 18) | Without voiding dysfunction (n = 33) | *P*-value |
|---|---|---|---|
| History of UTI | 2 | 8 | 0.26 |
| Without history of UTI | 16 | 25 | |
| Incontinence | 3 | 8 | 0.53 |
| Without incontinence | 15 | 25 | |
| Frequency | 2 | 7 | 0.57 |
| Without frequency | 16 | 26 | |
| Dysuria | 3 | 3 | 0.42 |
| Without dysuria | 15 | 30 | |

**TABLE III. The Voided Volume in MR and Control Group**

| | Number of voided volume less than 65% EBC | Number of voided volume more than 65% EBC |
|---|---|---|
| MR group (all) (n = 51) | 29 | 22 |
| Mild MR group (n = 21) | 6 | 15 |
| Moderate MR group (n = 19) | 12 | 7 |
| Severe MR group (n = 11) | 11 | 0 |
| Control group (n = 36) | 9 | 27 |

Mental retardation group versus control group: $P = 0.03$**; mild versus moderate group: $P = 0.028$**; moderate versus severe group: $P = 0.021$**; mild versus severe group: $P < 0.0004$**.
MR, mental retardation; EBC, expected bladder capacity.

In previous studies, cystometry is the most common evaluation tool in voiding dysfunction.[3,4,6,9–11] The most commonly diagnosed problems were hyperreflexic detrusor contractions with reduced bladder capacity and detrusor hyperreflexia, the lack of detrusor inhibition. The performance of cystometry requires the patient's cooperation, which is impossible in the mentally retarded population. Measurement of urine flow and residual urine is by far the most common procedure in pediatric urodynamic practice. Laecke et al.[8] studied 38 mentally retarded children and found that 60% demonstrated dysfunction pattern in uroflowmetry. He reported that mental development is less correlated with the degree of continence. In comparison, we evaluated mentally retarded children through uroflowmetry performed in an environment familiar to them. In the mentally retarded group, 33.3% (17/51) of the children had an abnormal uroflow pattern, the most common of which was interrupted flow pattern. We recommend that uroflowmetry and residual urine examination by sonography as the choice of evaluation tool in mental retardation. In contrast to the invasive and time-consuming process of cystometry, uroflowmetry is more suitable for the evaluation of voiding dysfunction in the mentally retarded population.

Chen et al.[14] performed multivariate analysis and found that dysfunctional voiding is associated with urinary tract infection and vesicoureteral reflux in children. The authors pointed out that dysfunctional voiding is associated with urinary tract infection, urinary retention, and vesicoureteral reflux. In our study, there is no statistically significant

correlation between voiding dysfunction and lower urinary tract symptom. The prevalence of lower urinary tract symptom may be underestimated in the mentally retarded group due to the impairment of their communication ability, which may be the reason why there is no correlation between voiding dysfunction and lower urinary tract symptom in our study. This study showed that lower urinary tract symptom is not a good predictor for voiding dysfunction in the mentally retarded group. Thus, we suggest objective evaluation tools such as uroflowmetry and sonographic residual urine examination as choice evaluation tools for voiding dysfunction in the mentally retarded population.

In our study, the incidence of urinary tract infection is higher in the mentally retarded group although it is not statistically significant, which maybe due to the bias in recruiting the control group members. The control group is comprised of volunteers from our rehabilitation clinic. Those who have had urinary tract infection or urological problem were more willing to participate in the study. In addition, the history of urinary tract infection was obtained from the caregiver, so the incidence of urinary tract infection may be underestimated in the mentally retarded group. Thus afebrile urinary tract infection or mild urinary tract infection may have been neglected by the family due to impairment in communication skills in the mentally retarded population. The reliability of the questionnaire is likewise questionable in the mentally retarded group due to impaired communication ability. We therefore recommend that the questionnaire should be combined with other objective tools such as uroflowmetry or sonographic residual urine examination.

We found that the percentage of small bladder capacity is significantly higher in the mentally retarded group and is correlated with the severity of cognitive impairment. In Laecke et al.'s study,[8] bladder capacity deficit was found in nearly all subjects (92.1%). The result of this study showed that the presence of bladder capacity deficit was neither influenced by mental development or type of motor disability. Laecke proposed that decreased water intake due to swallowing disturbance is the cause of bladder capacity deficit. Swallowing disturbance was evident in some of our study's mentally retarded groups. Insufficient hydration due to their environment and poor self-care are additional main causes for small bladder capacity in the mentally retarded group. Therefore, the study reminds us of the importance of adequate hydration in the mentally retarded population.

Voiding dysfunction may result in upper tract deterioration, especially in the pediatric population. In our study, those who were diagnosed as voiding dysfunction were referred to urologist for further management. The treatment methods of voiding dysfunction include behavior modification, neuromodulation, and medications (such as antimuscarinic agents, α-adrenergic blockers, tricyclic antidepressants, etc.). The choice of treatment method depends on the symptom of the patient.[12] In those with large amount of residual urine, intermittent catheterization is an effective and safe option for bladder emptying.

## CONCLUSIONS

A higher incidence of voiding dysfunction is noted in the mentally retarded group and is found to be correlated with the severity of cognitive impairment. Voiding dysfunction has a significant influence on future lower urinary tract and renal function. Early detection of voiding dysfunction with objective and non-invasive tools such as uroflowmetry and residual urine examination by sonography is recommended in the mentally retarded population.

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