Biofeedback therapy in the treatment of bladder overactivity, vesico-ureteral reflux and urinary tract infection

Naziha Khen-Dunlop a,*, Anne Van Egroo b, Cécile Bouteiller c, Jacques Biserte a, Rémi Besson a

a Department of Paediatric Surgery, Hopital Jeanne de Flandre, rue Oscar Lambret, 59 800 Lille, France
b Department of Paediatric Nephrology, Hopital Jeanne de Flandre, rue Oscar Lambret, 59 800 Lille, France
c Paediatric Training Centre, Hopital Jeanne de Flandre, rue Oscar Lambret, 59 800 Lille, France

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Abstract
Objective: Voiding disorders are commonly encountered in paediatric urology practice. Urinary incontinence often leads to the impairment of self-esteem but can also cause renal damage, when recurrent urinary tract infection (UTI) or vesico-ureteral reflux (VUR) exists. The aim of this study was to assess the efficacy of a biofeedback training program in children with a long history of voiding disorders.

Patients and methods: Between 1998 and 2002, 60 children with voiding disorders without neuropathic disease, aged 5–14, were treated. There were 48 girls and 12 boys. The main symptoms were daytime incontinence for 90%, urge syndrome for 78%, and night-time incontinence for 60%. UTIs were noted in 62% of the children, for 37% of them in association with a VUR. Ten weekly sessions were planned for all the children. They were given instructions on toilet behaviour and posture, and pelvic floor training. They had to supervise their voiding frequency and liquid intake at home using a chart. Biofeedback procedure used surface perineal electrodes. The exercises focused on relaxation of the perineum.

Results: The first results were recorded 6 months after the last session: 96% of the children with daytime incontinence and 83% of the children with night-time incontinence were cured or improved; 84% of the children were free from infection and
VUR was cured in 50% of cases. After a mean follow-up of 21 months, 8% of the children with daytime incontinence and 33% with night-time incontinence relapsed, with a significant difference between primary and secondary enuresis. A breakthrough UTI was observed in 19% of cases.

Conclusion: This non-invasive training program was effective in the treatment of daytime incontinence, UTI and VUR. There was an improvement in secondary but not primary enuresis. To prevent relapse, additional support sessions seem to be necessary.

Introduction

Since Hinman’s first description in 1973, the consequences of voiding dysfunction on the urinary tract are well known [1]. In extreme cases of non-neurogenic bladder, secondary chronic renal insufficiency can be observed [2].

Even though the frequency of voiding disorders is difficult to evaluate, it seems to be very common among young children. In Sweden, in a large prospective study of 3556 7-year-old children, signs of ‘disturbed bladder function’ were found in 26% [3]. In another, Belgian, study of 4332 10–14-year-old children, the frequency of daytime incontinence rose to 12% [4]. The frequency of voiding disorders in children seems to have increased in the last few decades [5]; first, because physicians and parents are more aware of these troubles and probably also because children’s training habits have changed [6].

The natural evolution of dysfunctional voiding is regression in 15% of cases every year [7,8]. Because of the risk of self-esteem impairment and/or potential damage to the urinary tract, treatment is proposed if symptoms stay. A regularization of voiding frequency, supported by a voiding chart, is first used. Anticholinergic medication and antibiotics can be added if necessary. If this ‘standard’ therapy fails, pelvic floor training based on biofeedback therapy may be proposed. Since the early 80s, this therapy has been used in children with bladder–sphincter dyssynergia [9,10] and more recently in children with dysfunctional voiding [11]. In this study, we evaluate our pelvic floor training program, proposed for children followed for voiding disorder after at least 1 year of standard therapy without improvement.

Patients and methods

We review the results of our training program, between 1998 and 2002, on a group of 60 children with voiding disorders without neuropathic disease. There were 48 girls (80%) and 12 boys (20%) whose average age was 8 years (range 5–14; see Fig. 1). All the children had clinical signs of overactive bladder (urgency, urinary leak, frequency, squatting). They were referred after at least 12 months without any significant improvement on standard therapy. Forty-two children had anticholinergic medication (70%) and 25 (45%) had antibiotics.

The clinical evaluation consisted of a detailed voiding history, voiding habits and physical examination. The morphological evaluation consisted of US in the urinary tract, uroflowmetry with simultaneous pelvic floor electromyography (patch electrodes), and VCUG in cases of previous urinary tract infection (UTI).

The main symptoms were urge syndrome in 47 cases (78%), daytime incontinence in 54 cases (90%), and night-time incontinence in 36 cases (60%). Detrusor–sphincter dyscoordination was noted on uroflowmetry in 17 cases (28%). Thirty-seven children (62%) had a history of UTI and a VCUG was performed. Vesico-ureteral reflux (VUR) was noted in 22 children (37%). There was associated constipation in 25 children (42%). The division of these symptoms between girls and boys is shown in Fig. 2.

Daytime and night-time incontinences were quantified from the frequency of leakages per week (Table 1). Twenty children (33%) had daytime
without night-time incontinence whereas only two children had isolated night-time incontinence. Two groups were identified among children with night-time incontinence: those with a history of primary nocturnal enuresis (11 girls and three boys) and those with secondary nocturnal symptoms, enuresis or leakage (18 girls and four boys).

On VCUG, reflux was unilateral in 17 cases and bilateral in five (thus a total of 27 refluxing units). There was low-grade reflux (I–II) in 21 units and grade III in six units. There was no high-grade reflux.

Although the classical description of voiding disorders in children is divided between bladder dysfunction and sphincter dysfunction, the filling and the voiding phases are physiologically linked through detrusor-sphincteric co-ordination. Because classical treatments failed in this population, we based our program on pelvic floor training and control of the inhibitory reflex to try and improve the bladder disorders.

Ten weekly sessions were first planned for all the children. Additional sessions were added if the initial results were considered incomplete by the physician. The first session lasted about 1 h, with the child and their parents. The training program was presented in detail to make sure the child was motivated and the family would co-operate. At subsequent sessions, the child was alone with the therapist.

Each day, on a voiding chart, the child, with the help of their parents, was asked to record voiding frequency, fluid intake, number of leaks during the day and the number of wet nights. During the day, a regular voiding frequency of 3 h was advised, associated with a regular fluid intake. At each session the charts of the past week were reviewed with the physician. The child was also taught about urinary tract anatomy and functioning, and given simple rules for application at home such as how to sit properly on the toilet and relax during voiding.

The biofeedback procedure used surface perineal electrodes. The exercises were based on relaxation of the perineum. Short sequences of 10 s alternated with rest periods (Software Elite 1.04, ECL communications). The muscle activity was followed on the computer screen, allowing modifications by the child (Fig. 3).

Results

The average number of sessions was 12, over a mean period of 14 weeks. The first results were recorded 6 months after the last session. The mean follow-up was 21 months.

Of the 54 children with daytime incontinence, 31 (57%) were cured and 21 (39%) had improved, with a decrease by half of the number of leaks per day or more. Only two girls (4%) showed no improvement. The results are detailed in Table 2. At the last review, eight of the children who were cured or improved (8%) had relapsed.

Of the 36 children with night-time incontinence, 18 (50%) were cured and 12 (33%) had improved, with a decrease by half of the number of wet nights per week or more. Six (17%) did not show any improvement, and all of them had primary nocturnal enuresis. The results are detailed in

<table>
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<tr>
<th>Table 1</th>
<th>Number of wet episodes per week</th>
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<tr>
<td></td>
<td>Daytime (n = 54)</td>
</tr>
<tr>
<td>Six to seven episodes/wk</td>
<td>35 (65%)</td>
</tr>
<tr>
<td>Four to five episodes/wk</td>
<td>12 (22%)</td>
</tr>
<tr>
<td>Two to three episodes/wk</td>
<td>7 (13%)</td>
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<tr>
<td>One episode/wk</td>
<td>0 (0)</td>
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Table 3 and a comparison between the children with primary nocturnal enuresis (14 children) and the others (22 children) is given in Table 4. At the last review, 10 of the children who were cured or improved (33%) had relapsed. Six of them were children with primary nocturnal enuresis, with a relapse rate of 75% in this group.

Of the 37 children with a previous history of UTI, 31 (84%) were free from infection during the study period and six girls (16%) had recurrences. At the last review, six children (19%) had relapsed.

A VCUG control was performed on 15 children among the 22 with VUR. In seven cases (47%) the reflux was cured, in one case (6%) the grade decreased and in seven cases (47%) the reflux remained unchanged. At the last review, four children with persistent reflux were operated on.

Discussion

We chose a pelvic floor training program to treat bladder disorders. Based on the fact that the filling and the voiding phases are physiologically linked through detrusor–sphincteric co-ordination, some authors had already tried and reported success with pelvic floor therapy in the overactive bladder [12,13]. The aim of such a biofeedback program was to increase the children’s awareness of their pelvic floor and to teach them how to control it for a relaxed voiding. In the treatment of dysfunctional voiding, many different programs are proposed. Some of them, invasive, use a catheter in the bladder [14,15], others only patch electrodes [12,16]. Some recommend an expensive intensive 'day course' [17], while others are based on weekly sessions [18]. For all of them, the results obtained do not seem very different, which led Schulman et al. to ask about biofeedback methodology: "does it matter how we teach children how to relax pelvic floor during voiding?" [19].

In this study, comparing two different non-invasive methods of biofeedback in 102 children presenting dysfunctional voiding, no difference was found regarding the resolution of daytime wetting symptoms or decrease in UTI. It appears that if the 'method' itself does not really matter,
some elements do matter. First, the relationship between the patient, the parents and the therapist is essential. When a good relationship is set up, it ensures the indispensable motivation for this long work. Secondly, when interactive computer games are used, the concentration of the children is better, providing optimal collaboration, and visualization of the work in progress helps them to better understand the relaxation of the pelvic floor.

We did not carry out invasive urodynamic studies before including children in the training program, as there are clear clinical indicators for the diagnosis of ‘clinical bladder instability’. As proposed by Sillen [20], urgency, pollakiurie, incontinence and squatting are the usual symptoms used to define the urge syndrome. Where urodynamic studies have been systematically performed on children with dysfunctional voiding, 30–60% of them had a normal bladder evaluation [21–23]. Rather than the results of urodynamic studies, the discomfort of the children, because of their symptoms, seemed to us to be a sufficient reason for beginning the treatment.

In children with voiding dysfunction or bladder instability, the rate of UTI is reported to be from 34% to 66.6% [24,25] and the rate of VUR from 20.6% to 43% [25,26]. Both residual urine and poor bladder emptying play an important role in the genetics of infections and are very common in this population. In these children, VUR is the consequence of elevation of the intravesical pressure secondary to bladder instability or detrusor—sphincter dyssynergia. In our population, the proportion of children with a history of UTI (62%) or VUR (37%) was high. We probably selected these children because they appeared to us to be the most exposed to the risk of renal injury.

Results for daytime incontinence were good with 81% of the children cured or improved at the last follow-up. This rate was only 56% for nighttime incontinence with a significant difference between primary (14%) and secondary (82%) enuresis. Because in secondary enuresis nighttime incontinence appears at the same time or slightly after the daytime symptoms, they can be considered as a functional sign. On the contrary, the genesis of primary enuresis is more complex. Even if nighttime incontinence can worsen with the appearance of a voiding dysfunction, it existed for years previously and can be considered as secondary to this functional disorder. As already recommended, to obtain results on primary nocturnal enuresis, specific treatment should be proposed in parallel to the treatment of the voiding disorder [18,27].

At the end of the training program, 50% of the VUR had resolved, which allowed us to stop antibiotics and avoid surgery. Such results confirm the functional origin of the reflux in this population, and argue for the diagnosis and systematic treatment of voiding disorders in older children with reflux. In half of the cases, we failed to treat the reflux. It can be explained by associated malformation of the ureteric junction or by a junction irremediably forced during the evolution of the bladder dysfunction [19]. But this conclusion could only be reached after resolution of the voiding disorders. Resolution is anyway essential for a good rate of success in reflux surgery [28].

At the last review, the relapse rate for daytime incontinence was 8%, which was low compared to the 15% found in other series [12,24]. Breakthrough infection was seen in 19%, which was comparable to other studies [29,16]. To improve the stability of the initial results, follow-up sessions may be proposed after the completion of the program [11,30]. The aim of such sessions is to prevent the recurrence of voiding disorder and thus bladder instability.

Because of the risk of deterioration of the urinary tract and/or renal function, the diagnosis of dysfunctional voiding should lead to early treatment. Biofeedback therapy can be considered as a possible treatment. In everyday practice, children older than 5 years with a history of recurrent UTI or recent diagnosis of VUR should be checked up. If signs of bladder overactivity are found too, an appropriate voiding training program should be first advised.

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References

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