

# Effects of Electrotherapy in Treatment of Neurogenic Bladder in Children with Occult Spinal Dysraphism

Dragana Ćirović, Ivana Petronić, Dejan Nikolić, Radivoj Brdar, Polina Pavićević, Tatjana Knežević

University Children's Hospital, Belgrade, Serbia

## SUMMARY

**Introduction** Neurogenic bladder can develop as a result of various degrees of neurogenic lesion in spina bifida. The degree of bladder dysfunction depends on the level and type of spina bifida. Due to results upon complete diagnostic protocols, treatment options are applied.

**Objective** Comparison of therapy results of patients with occult spinal dysraphism with neurogenic bladder that underwent medicamentous therapy and medicamentous with electrotherapy treatment.

**Methods** We had 49 patients with neurogenic bladder that were treated at the University Children's Hospital in Belgrade in the period 2003-2008. The first group of children received medicamentous therapy and the second group received medicamentous therapy with transcutaneous electric nerve stimulation. In both groups we evaluated 4 symptoms: daily enuresis, enuresis nocturna, urgency and frequency and 4 urodynamic parameters: lower bladder capacity, unstable contractions and residual urine and detrusor sphincter dyssynergia. Follow-up urodynamic evaluation was done after 3, 6 and 12 months respectively.

**Results** Our findings pointed out a high statistical significance of improvement in all evaluated urodynamic parameters of neurogenic bladder (predominantly in bladder capacity) in the group of children with combined therapy as well in resolution of symptoms (predominantly enuresis nocturna, urgency and frequency).

**Conclusion** Combined therapy is more efficient in treatment of children with neurogenic bladder. Electrotherapy is non-invasive, easily applicable and has had a significant place in treatment of children with dysfunctional voiding.

**Key words:** spina bifida; neurogenic bladder; electrotherapy; children

## INTRODUCTION

Under normal circumstances, for adequate storage and complete evacuation of urine, a synergistic unit that is composed of the detrusor muscle, bladder neck, and striated external sphincter should function properly. In healthy bladders, the normal range pressures difference of less than 10–15 cm H<sub>2</sub>O is between empty and full bladder. Normal voiding pressures for males and females are from 50 to 80 cm H<sub>2</sub>O and from 40 to 65 cm H<sub>2</sub>O, respectively [1, 2].

Neurogenic bladder can develop as a result of a lesion at any level in the nervous system, including the cerebral cortex, spinal cord, or peripheral nervous system. Neurogenic bladder dysfunction in children is a result of congenital neural tube defects that include: myelomeningocele, lipomeningocele, sacral agenesis, spina bifida occulta and tethered cord, spinal cord tumours or trauma and transverse myelitis [3, 4].

Leak-point pressure is one of urodynamic parameters that help clinicians to differentiate patients with relatively low or high risk for subsequent upper urinary tract deterioration. Detrusor sphincter dyssynergia (DSD) leads to dysfunctional voiding implicating inadequate filling and emptying of bladder [5].

Timely diagnostics and treatment are beneficial in prevention of renal complications and secondary bladder wall changes in children with spina bifida [6].

## OBJECTIVE

The aim of our study was to analyse effects of medicamentous treatment and physical therapy in patients

with neurogenic bladder due to the fact that the control group was administered only medicamentous therapy. It is important to stress that, in a mild degree of pathological effect, the use of clean intermittent catheterisation (CIC) can be reduced or postponed.

## METHODS

We evaluated 49 patients treated at the University Children's Hospital in Belgrade in the period 2003-2008. The study design was retrospective-prospective and included the children's age between 6 and 12 years with average age of 8.25 years. The evaluated age interval was due to the most frequent population that was observed. Since it is known that maturation of centres for voiding control are established until a child is 4 years old, we did not have a representative group between the age of 4 and 6 years (only 2 patients). There were 21 boys and 28 girls with structural lesions. All patients were randomly collected with diagnosis of neurogenic bladder on first visit. The children of the parents refusing CIC were also included in this study.

In the first group, 19 patients were administered only medicamentous therapy with anticholinergic drugs. In the second group, 30 patients were applied combined anticholinergic and physical therapy. Physical therapy methods that we induced were transcutaneous electric nerve stimulation (TENS) and exponential current (EC). A greater number of children in the second group were with no influence on statistical results of this study, since 19 patients from the first group represented an optimal number for compar-

**Table 1.** Results of treatment of children with neurogenic bladder

Symptoms	Group with medicamentous therapy				Group with combined therapy			
	Before therapy	After 3 months	After 6 months	After 12 months	Before therapy	After 3 months	After 6 months	After 12 months
Daily enuresis	5	2	2	0	7	4	0	0
Enuresis nocturna	12	10	9	6	27	21	4	2
Urgency	7	7	5	4	19	9	1	0
Frequency	10	6	6	4	18	8	2	2

ison. Further, there was not statistical difference ( $p>0.05$ ) in average age between the evaluated groups (8.12 years in the first group and 8.37 years in the second group).

The diagnosis of neurogenic bladder was established upon miction urethrocytography findings, history taken from parents and urodynamics.

Transcutaneous electric nerve stimulation (TENS) was induced by application of surface electrodes on the skin at the paravertebral site at the level S2-S4 and, for the EC surface, electrodes were applied on the suprapubic part of the anterior abdominal wall. Duration of one session included one month of stimulations with a 3-week break. Stimulations were administered once per day with duration of one hour. During this study, constipation was not treated.

Bladder function was estimated by urodynamic investigations on first visit in order to make a diagnosis and after treatment after 3, 6 and 12 months, respectively.

We monitored the following parameters: daily enuresis, enuresis nocturna, urgency and frequency. All data were collected from patients daily during treatment with written consent from parents. Urodynamic evaluation included: bladder capacity, onset of unstable contractions, residual urine (RU) and detrusor sphincter dyssynergy (DSD).

For statistical analysis of data, we used methods of analytic and descriptive statistics. Results were analysed by the SPSS Inc. statistical programme.

## RESULTS

Effects of medicamentous and combined medicamentous and physical therapy due to daily enuresis, enuresis nocturna, urgency and frequency are shown in Table 1. For comparison of constant parameters between the two evaluated groups after 3, 6 and 12 months, respectively, we used Fisher's test.

When comparing the results between these two groups, significantly better results were achieved in the group with combined therapy.

**Table 2.** Results of statistical analysis of symptoms between two evaluated groups

Symptoms	3 months	6 months	12 months
Daily enuresis	$p>0.05$	$p>0.05$	$p>0.05$
Enuresis nocturna	$p>0.05$	$p<0.01$	$p<0.01$
Urgency	$p<0.05$	$p<0.01$	$p<0.01$
Frequency	$p>0.05$	$p<0.05$	$p>0.05$

**Table 4.** Results of statistical analysis of urodynamic parameters between two evaluated groups

Urodynamic parameters	3 months	6 months	12 months
Lower bladder capacity	$p>0.05$	$p>0.05$	$p>0.05$
Unstable contractions	$p>0.05$	$p>0.05$	$p<0.05$
RU	$p>0.05$	$p>0.05$	$p>0.05$
DSD	$p<0.05$	$p<0.05$	$p<0.05$

In Table 2, the statistical analysis for comparison of the two evaluated groups is presented. The results of comparison were performed as  $p$  values for every category after 3, 6 and 12 months, respectively.

The results of urodynamic parameters in the group of children that were treated with medicamentous and combined therapy are shown in Table 3.

In Table 4, the statistical analysis for comparison of the two evaluated groups is presented. The results of comparison were performed as  $p$  values for every category after 3, 6 and 12 months, respectively.

All urodynamic parameters showed a positive trend in patients treated with combined therapy.

## DISCUSSION

The lower urinary tract differs from other visceral structures due to its dependence on the central nervous system (CNS) control. Coordination between the central and peripheral motor neurone contributes to adequate functioning of bladder storage and emptying [7].

For the normal function of the bladder, a perfect coordination between autonomic and somatic innervation modu-

**Table 3.** Urodynamic evaluation of parameters of patients treated from neurogenic bladder

Urodynamic parameters	Group with medicamentous therapy				Group with combined therapy			
	Before therapy	After 3 months	After 6 months	After 12 months	Before therapy	After 3 months	After 6 months	After 12 months
Lower bladder capacity	19	16	11	7	30	22	9	4
Unstable contractions	11	7	4	4	22	9	2	1
RU	7	5	2	2	14	7	0	0
DSD	10	9	5	4	17	7	1	0

lated with adequate motoric activity of pelvic and abdominal muscles is needed.

Voiding control is constituted at 4 years of age when maturation of the CNS is complete. In childhood, dysfunctional voiding that is caused by delayed maturation of the CNS is also caused by irregular habits in more than 50% of patients without structural defects.

These children often present with overactive detrusor and incoordination between sphincter activity and the pelvic floor muscles. As a result of such pathology, they usually have frequent voiding.

Modern highly selective drugs that are active on every segment of the lower urinary tract independently have less side effects compared to the previous ones [8].

Detrusor overactivity is treated with anticholinergics and every dysfunctional voiding caused by sphincter dyssynergy is treated with mictional training and correction of irregular habits. A biofeedback method showed good effects in solving such problems.

With improvement of technology, modern tools that are implemented in physical therapy are also used in treating children with overactive detrusor. TENS can be low frequent (1-20Hz) and high frequent (above 70 Hz). For stimulation, the low frequent TENS 1-4 Hz is used to achieve sensitive and motoric stimulation of the pelvic floor muscles [9]. EC was induced in mode of exponential current by using the parameters for relaxation of detrusor that would lead to modulation of overactivity of detrusor.

Our study stresses that there is no statistical difference for daily enuresis and frequency ( $p>0.05$ ) in both groups, indicating that medicamentous treatment is equally effective as the combined one for such symptoms. Patients with enuresis nocturna or with urgency that are included in combined therapy presented with highly significant statistical improvement after 6 months and the statistical significance remained till the complete follow-up period ( $p<0.01$ ). The proportion of recovered patients with enuresis nocturna after 12 months was 50% in the group that was treated with medicamentous therapy and 92.59% in the group that was treated with combined therapy. For those with urgency it was 42.86% in the group that was treated with medicamentous therapy and 100% in the group that was treated with combined therapy. Since there is a statistical differ-

ence after 3 months from the beginning of the treatment for urgency ( $p<0.05$ ), it indicates that combined therapy is more effective for treatment of patients with urgency.

Other parameters that are indicators of bladder dysfunction are urodynamic parameters. Our findings for lower bladder capacity and residual urine showed that there was no statistical difference for both parameters ( $p>0.05$ ). This study demonstrated that there was statistical significance ( $p<0.05$ ) for unstable contractions when both evaluated groups were compared after 12 months from the beginning of treatment. The proportion of recovery was 63.64% in the group that was treated with medicamentous therapy and 95.45% in the group that was treated with combined therapy. The most effectively responded urodynamic parameter was DSD. Within the first 3 months of therapy, we gained significant statistical improvement that remained even 9 months afterwards in the group that underwent combined therapy ( $p<0.05$ ). The proportion of recovery was 10% in the group that was treated with medicamentous therapy and 58.82% in the group that was treated with combined therapy after 3 months from the beginning of treatment. This clearly stresses the importance of physical therapy tools in treatment of these patients [10, 11].

Our results are in correlation with modern research results of Hoebeke and associates [8, 9].

## CONCLUSION

Due to comparison of these 2 groups, the improvement in all evaluated parameters was significantly higher in the patients that were treated with combined therapy. All patients were completely motivated to fully cooperate. It is important to point out that these children are prone to relapses and should be regularly controlled even after obtaining satisfactory results [12]. By implementation of combined medicamentous and physical therapy in children of parents refusing CIC with tight control of the upper urinary tract, satisfactory results can be accomplished, excluding in some cases the necessity of CIC. Due to a complex state, it is essential to underline that treatment should include a team of paediatric surgeons, physiotherapists and urologists.

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## Ефекти електротерапије у лечењу неурогене бешике деце с окултним спиналним дисрафизмом

Драгана Ћировић, Ивана Петронић, Дејан Николић, Радивој Брдар, Полина Павићевић, Татјана Кнежевић

Универзитетска дечја клиника, Београд, Србија

### КРАТАК САДРЖАЈ

**Увод** Неурогена бешика може да настане као резултат различитог степена неурогене лезије код спине бифиде. Степен дисфункције бешике зависи од степена и типа спине бифиде. Према налазима комплетне дијагностике одређује се протокол лечења.

**Циљ рада** Циљ рада је било поређење резултата лечења неурогене бешике деце с окултним спиналним дисрафизмом која су била подвргнута само медикаментној терапији или комбинованој медикаментној терапији и електротерапији.

**Методe рада** На Универзитетској дечјој клиници у Београду у периоду 2003-2008. године испитано је и лечено 49 деце с неурогеном бешиком. Прва група деце је подвргнута медикаментној терапији, а друга група и медикаментној терапији и транскутаној електронервној стимулацији. Код обе групе испитаника посматрана су четири симптома (дневна ену-

реза, ноћна енуреза, ургентност и фреквенција), као и четири уродинамска параметра (смањен капацитет бешике, нестабилне контракције, резидуални урин и дисинергија детрусорног сфинктера). Контролна уродинамска оцена рађена је после три месеца, шест и дванаест месеци.

**Резултати** Налази показују статистички значајно побољшање свих посматраних уродинамских параметара (пре свега капацитета мокраћне бешике) код деце која су примала комбиновану терапију као и повлачење симптома (углавном ноћно мокрење, ургенција и фреквенција).

**Закључак** Комбинована терапија је ефикаснија у лечењу деце с неурогеном бешиком. Електротерапија је неинвазивна, лака за примену и има значајно место у лечењу деце с неурогеном бешиком.

**Кључне речи:** спина бифида; неурогена бешика; електротерапија; деца