Ped Urol Case Rep 2017; 4(1):256-261 DOI: 10.14534/PUCR.2017124188

Ped Urol Case Rep

PEDIATRIC UROLOGY CASE REPORTS

ISSN 2148-2969

Journal homepage: http://www.pediatricurologycasereports.com

Effects of percutaneous posterior tibial nerve stimulation on voiding dysfunctions in cerebral palsy: A case report

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ABSTRACT

The present study, conducted on three children with cerebral palsy who had voiding dysfunction. After collecting demographic information, symptoms of voiding dysfunctions were recorded. Then; we did an ultrasonographic evaluation of the bladder to measure residual urine volume. Physiotherapy treatment through percutaneous electrical stimulation of the posterior tibial nerve was performed in 12 sessions. Bladder ultrasonography was repeated after treatment. Abnormal residual urine volume became normal in patients with urinary retention. Percutaneous posterior tibial nerve stimulation reduces symptoms of voiding dysfunctions in children with cerebral palsy.

Key Words: Voiding dysfunction; cerebral palsy; percutaneous posterior tibial nerve stimulation.

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Accepted for publication: 14 October 2016

Introduction

Neurogenic bladder (NGB), a dysfunction of urinary bladder and urethra, is caused by damaging of neurons or diseases of the central, peripheral or autonomic nervous systems that found in many patients with neurologic disorders, including cerebral palsy [1], multiple sclerosis, Parkinson's disease, spinal cord injury, stroke, spine bifida, caudal equine syndrome, diabetes mellitus with autonomic neuropathy and unintended squeal following pelvic surgery [2].

Cerebral palsy (CP) describes a group of permanent disorders that occur during motor development and posture which refers to a non-progressive disorder that occurs in developing fetus' or infant's brain causing limitations in activity. Motor disorders of CP are often accompanied by disturbances of sensation, perception, cognition, communication, and behavior. Epilepsy and musculoskeletal problems are associated with secondary disorders [1]. Although upper urinary tract damage is not frequent in this patient group, the prevalence of dysfunctional voiding symptoms is about 30% [3]. Symptoms of urinary tract dysfunction in CP are frequently including increased post-void residual urine, urge incontinence, urgency,

hesitancy and enuresis [1]. Treatment of these urinary disorders includes medical therapy, physical therapy and surgery [4]. Implantation through surgery is an invasive procedure sometimes accompanied with pain and reoperation. Sacral neuromodulation, requiring a permanent implanted stimulator, is less suitable for children because implant doesn't grow with the patient [5]. Physiotherapy treatments including pelvic floor muscle training [6], biofeedback [7], posterior tibial nerve stimulation, interferential, para sacral, suprapubic, ano-genital and intra anal electrical stimulation [4]. The posterior tibial nerve is a mixed nerve containing (L5-S3) fibers, originating from the same spinal segments as the parasympathetic innervations to the bladder [5].

The aim of this study was to investigate the efficacy of the noninvasive technique of transcutaneous posterior tibial nerve stimulation (TPTNS) in CP children with non-obstructive urinary retention.

Methods

Children included in this study were seen at the Soroosh School in Tehran, Iran between October 2013 and July 2014. The procedure was approved by local ethic committee (the ethic committee number is116/424).

Three cerebral palsy males with neurogenic bladder, aged 13, 15 and 16 –years-old were enrolled in a prospective clinical trial of PTNS efficacy. Study inclusion criteria were age range of 7-16 years, absent lower urinary tract infection, the ability to sit on chair, be able to say they feel the need to urinate, voiding dysfunction symptoms for at least six months, no history of physical therapy, medication and surgery treatments for voiding dysfunction.

Ultrasound post void residual urine (PVR)], was performed before PTNS [1]. The criteria used for an increased in PVR was a volume higher than 20 ml [1]. PVR is the amount of residual urine in the bladder after a voluntary void which is measured by ultrasonography device. Ultrasonography is a noninvasive convenient and safe method for evaluating lower urinary tract dysfunction (LUTD) in children and adults [8]. The PTNS cycle consisted of 12 outpatient treatment sessions, each lasting 30 minutes. The residual urine volume was assessed using ultrasonography 24 hr after the last TPTNS [1,9].

Assessment

Urodynamic study was not available in our institution. Trans-abdominal ultrasound (V10 Accuvix, Medicine, South Korea, and 3.5 MHZ) and imaging of supine position with the legs straight was performed by the sonographer during complete relaxation of the hip. Abdomen was exposed from xiphoid to symphysis pubis. Transducer was pressed against the midline just above the symphysis pubis [10]. The bladder urine volume was measured by ultrasound before voiding and PVR volum was measured immediately after voiding [3]. Two ultrasonography were performed, one before and one after TPTNS. Various reports support the use of the bladder scanner in the pediatric setting [8].

Procedure

TPTNS was applied unilaterally with two adhesive electrodes placed above and behind the medial malleolus at the ankle on dominant side [9] [**Fig. 1**].

Electrical stimulation (Cefar, Swedish) (FDA's official approval) was applied by using charge-compensated 200 μsec pulses with a pulse rate of 20 Hz for 30 min 3 times per week, in 12 sessions for 1 month [11] [**Fig. 2**]. The intensity level was just above the perception

threshold but before that which caused pain [9]. Methods, and definitions conform to the standards recommended by the International Continence Society.

Fig. 1. Position of electrodes.

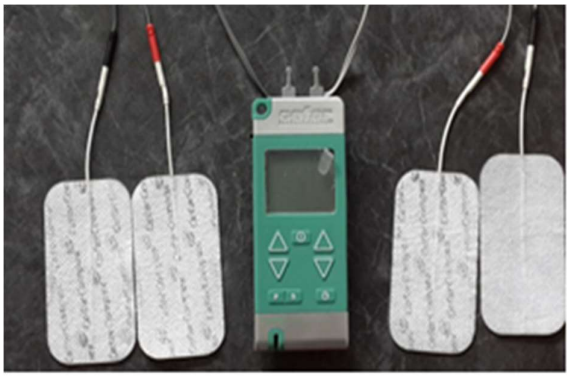

Fig. 2. TENS device.

Case 1

Case one was a 15 year old boy who was suffering from Spastic diplegia cerebral palsy, had a, urinary retention but mentally was normal. His height was measured 157 cm, weight 56 kg and BMI 23.3 kg/m^2. A tranquilizer administrated in sake of concentration of the patient. He had kyphosis, and able to walk without aid. No medication, physical therapy, and surgery had been done for his voiding dysfunction. He didn't have urinary tract infection. Bladder trans-abdominal ultrasonography was done before intervention. Residual urine volume was abnormal (58 ml). Bladder wall thickness was normal according to ultrasonography results (3.5 mm). Number of urinate was 4-5 times a day before the intervention. TPTNS was applied in 12 sessions. Average intensity was 27 MA. PVR was assessed 24 hr after the last TPTNS (PVR=0). Daily frequent urination unchanged (Table 1). No side effects were reported.

Table 1. Post void residual before and after TPTNS of the patients.

Cases	PVR (Before TPTNS)	PVR (After TPTNS)
1	58 (ml)	0
2	350 (ml)	2 (ml)
3	52 (ml)	15.7 (ml)

Case 2

The second case was a 13 year old boy who was suffering from Spastic diplegia cerebral palsy, had urinary retention and also was mentally educable. His height was measured 143 cm, weight 40 kg and BMI 19.6 kg/m^2. He has not been administrated nervous drug. He had scoliosis, didn't walk and dependent on wheelchair. No medication, physical therapy, and surgery had been for his voiding dysfunction. He didn't have urinary tract infection. Bladder trans-abdominal ultrasonography was done before intervention. Residual urine volume was abnormal (350 ml). Bladder wall thickness was normal according to ultrasonography results (4 mm). Number of urinate was 4 times a day before the intervention. Treatment was similar to case 1. Average intensity was 16 MA. PVR was assessed 24 hr after the last TPTNS and was

normal (2 ml). Daily frequent urination changed to 5-6 (Table 1). No side effects were reported.

Case 3

The third case was a 16 year old boy who was suffering from mixed diplegia cerebral palsy, had urinary retention, and was mentally educable. His height was measured 160 cm, weight 49 kg and BMI 19.6 kg/m^2. He has not been administered nervous drug. Vertebral column was normal, and able to walk by aid. No medication, physical therapy, and surgery was done for his voiding dysfunction. He didn't have urinary tract infection. Bladder trans-abdominal ultrasonography was done before intervention. Residual urine volume was abnormal (52 ml). Bladder wall thickness was normal according to ultrasonography results (4 mm). Number of urinate was 8-10 times a day before the intervention. Treatment was similar to case 1 and 2. Average intensity was 17 MA. PVR was assessed 24 hr after the last TPTNS and was normal (15/7 ml). Daily frequent urination changed to 5-6 (Table 1). No side effects were reported.

Discussion

The concept of neuromodulation or nerve stimulation for voiding dysfunction emerged in 1811 by Bell on the spinal nerve roots. He concluded that sensory and motor nerves of the anterior roots conduct impulses, while the posterior nerve roots responsible for vital functions [5].

In 1983, McGuire and colleagues first reported the posterior tibial nerve electrical stimulation [5]. Many other studies reported the use of PTNS in neurogenic and non-neurogenic patients with urgency, frequency, urge incontinence and voiding dysfunctions [9, 11, 12]. To date no studies have been published on PTNS in cerebral palsy children with LUTD. The results of this study evaluate the effect of TPTNS on voiding dysfunction in CP and shows the relief of clinical symptoms and improve the bladder emptying. The presence of a significant amount of residual urine is indicative of voiding dysfunction [13]. Our data, showing a trend to a decrease in PVR, support the case for using TPTNS in CP with preserved voluntary voiding. Our results confirm the findings of other studies which used peripheral stimulation of posterior tibial nerve [9,13]. Centrally the PTN projects to the sacral spinal cord in the same area where the bladder projection is located. The sacral micturition center and Onuf's nucleus are most probably areas where the therapeutic effect of neuromodulation of the bladder, by PTNS, take place [12]. PTNS effects are mediated by supra sacral centers of stimulus elaboration involving finally cortical associative areas [14]. TPTNS seems to regulate the activity of the bladder and urethra through facilitating voiding reflex, increases the contraction of the detrusor and relaxes sphincter and pelvic floor muscles [13, 15]. It seems that a treatment course of 12 sessions each lasting 30 minutes will be effective. The continuation of the effect after 12 sessions remains unknown and further studies should be carried out to evaluate the optimal timing of TPTNS administration.

Conclusion

Chronic TPTNS may be effective to relieve intractable clinical symptoms of voiding dysfunctions in CP children without side effects. The feasibility of TPTNS which can be easily used at home, by patient or by their carrier, represents a real advantage compare to PTNS which requires the insertion of a needle close to the Tibial nerve. The optimal modality

of chronic stimulation and the maintenance of effects in the long term need to be investigated.

Acknowledgements

This case was a part of research project with acceptance number: 398/90/p/f.

The author(s) declare that they have no competing interest and financial support.

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