Electrical Stimulation of the Transcutaneous Posterior Tibial Nerve for the Treatment of Patients with Detrusor Overactivity Due to Neurogenic Hiperactive Bladder in Multiple Sclerosis
A Case Study

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Abstract: This case study evaluates the therapeutic use of Transcutaneous Electrical Nerve Stimulation (TENS) of the posterior tibial nerve for treating one patient with multiple sclerosis (MS) showing signs of urinary incontinence (UI) due to detrusor overactivity (DO). *Patient:* MS with UI and sensory loss. *Method:* Using the current therapy twice a week for 20 minutes in 10 sessions and monitoring electrodes during electrical stimulation. *Results:* We observed an improvement in urge incontinence with reduced trips to the bathroom during the day and night. Both the post voiding sense of desire and pain during urination disappeared. *Conclusions:* This study shows an indication that the use of TENS in the current technique of posterior tibial nerve can reduce the uninhibited detrusor contractions and improve the quality of life of patients with MS due to a reduction of urinary incontinence and also reduce the number of times that the patient's urinates, thus providing better quality of sleep, humor, personal relationship, less embarrassment and reduction of stress. In this way, this study justifies a wide investigation with multiple subjects.

1 INTRODUCTION

Multiple sclerosis (MS) is a neurological disease of high incidence in young adults with a picture of multifocal demyelination in the central nervous system (Coelho, 2009; Poser , 1986; Misulis, 2008). The urgency or urinary incontinence (UI) may occur as the initial manifestation in most patients with MS (Stephen, 1995).

Involuntary loss of urine is a problem of social order and hygiene, causing embarrassment and changes in behavior such as social isolation, low self-esteem and psychosocial disorders (Oliveira, 2010). The most common etiology of urinary incontinence is neurogenic (Monteiro, 2009).

The four handles or neurological pathways in the control of urination, and which are related to each other, are: the core trunk detrusor cerebral cortex (loop I), the core detrusor muscle spinal / sacral brainstem (loop II)-sacral urethral sphincter of the bladder (loop III), and the sacral-brain (loop IV). Pathways I and IV are responsible for voluntary control of urination. Pathways II and III, on the other hand, regulate the contractions of the detrusor bladder emptying to promote and coordinate efforts between the detrusor and urethra (Stephenson and O'Connor, 2004).

The neurogenic bladder dysfunction is defined as a neurological disease produced by nerve damage that interferes with the mechanisms of voluntary and involuntary urination, thus causing changes in normal bladder function. The neurogenic bladder corresponds to the overactive and/or underactivity of the detrusor (Azevedo *et al*, 1990).

The underactive bladder retention or overflow is characterized by urinary loss that occurs when intravesical pressure exceeds urethral pressure. This is associated with bladder distention, but in the absence of detrusor activity. This overflow happens when one reaches the limits of distensibility or compliance of the bladder (Miltrano, 2009).

According to the International Continence Society, the overactive bladder is defined as a neurogenic injury due to the presence of involuntary

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detrusor contractions during the filling phase (Coelho, 2009). This is characterized by urinary incontinence, urinary frequency, nocturia and urgency (Fischer-Sgrott *et al*, 2009).

The existent techniques of treatment for UI are electrostimulation applications directed to the perineum muscle, using either internal anal electrodes for men or surface electrodes in the region. These two techniques are embarrassing, invasive (in the first case) and may cause discomfort and burns if the patient has abnormal sensibility (Marques, 2008).

Treatments with transcutaneous electrical stimulation in the posterior tibial nerve aim at reducing UI and assume that the path of the nerve there are neuronais projections of the bladder (Fischer-Sgrott *et al*, 2009).

The TENS current is used for the treatment of urinary incontinence by bladder hyperactive (BH). The electrodes are placed bilaterally in the medial region of the legs, causing motor and sensory stimulation as the current is applied. During each session, the patient's neurological physiotherapist observes the stimulation caused by the motor current, and the sensory way is not changed to modulate the current flow. This technique promotes the reduction of involuntary detrusor contractions (Marques, 2008). Regarding the TENS current for the treatment of BH, some researchers propose a sequence of pulses with a frequency of around 20 Hz and with a duration of around 200 miliseconds per pulse (Amarenco, 2003).

The therapies using electric currents can be used in neurological patients with abnormal sensitivity, because applying electrical stimulation displays rhythmic flexion of the hallux, thus indicating the correct placement of electrodes and confirming this to be intact innervation (Maciel and Souto, 2009). However, in individuals with Babinski's reflex, it is difficult to dispense the current therapeutic modulation due to incorrect motor response they have, so that it becomes impossible to control the intensity offered by the device and electro-motor response.

In the case of hyposensitivity, the dose should be applied until it causes rhythmic inflections of the big toe, and it should then be reduced until the motor action disappears. The provided dose agrees with several studies arguing that the ideal intensity must be maintained according to the threshold of each patient and below the motor threshold (Fischer-Sgrott *et al*, 2008; Maciel and Souto, 2009; Amarenco *et al,* 2003; Kabay et al, 2009).

2 CLINICAL CASE

A 36 year-old black male, married and with one son. At the age of 28, after suffering a crisis caused by the disease, the patient was diagnosed with MS. After a few years, another MS crisis occurred, with the same characteristics aforementioned, and the patient again recovered later. The patient reported having suffered from UI starting 6 years after the MS was found, and that the UI was diagnosed as caused by neurogenic overactive bladder, as confirmed by urodynamic examination.

During the evaluation, the patient was lethargic, with initiative and responsive. In neurological evaluation, we noted sensory deficit and the presence of cutaneous reflex - planting. In the evaluation of urogynecologic history, we noted that the main complaint consisted of dysuria, urinary frequency and incontinence urge. We found that the frequency of urination during the day corresponded to 15 trips to the bathroom to urinate and during the night corresponded to 9 trips to the bathroom, which confirmed the picture of urinary urgency and nocturia. The patient reported pain and post-voiding desire during the act of micturition. He also reported the presence of active sexual activity with urination, as well as hypertension. He denied making use of liners even with urinary incontinence in clothes.

3 METHOD

On the first evaluation day, we applied the physiotherapy assessment protocol forms, which the patient completed in the Urogynecology laboratory at Unifesp. We instructed the patient to complete a voiding diary for three days after treatment.

During the neurological assessment, a physical examination showed no sensory deficit and bilateral Babinski's reflex. Given that no pathological reflex existed, we positioned the electrodes in the path of the posterior tibial nerve, to detect whether innervation was intact, by using electrical stimulation (we used the TENS NEURODYN/FES portable device, by Ibramed Ltda). This stimulation was based on a sequence of 200-milisecond puses, with a frequency of 20 Hz, following the recommendation by (Amarenco, 2003). Since the patient had reported hypertension before the treatment, his blood pressure (BP) was monitored in all the sessions.

The treatment protocol consisted of 10 sessions, twice a week and lasting 20 minutes each. We applied the TENS current through two channels, using four electrodes positioned transcutaneously and bilaterally in the lower limb (2 electrodes per channel). For each channel, one electrode was fixed to the posterior medial malleolus and the other 10 cm above. The intensity parameter due to hyposensitivity was measured through the signal engine rhythmic inflections of hallux. A maximum intensity of 30 mA was applied, for safety reasons.

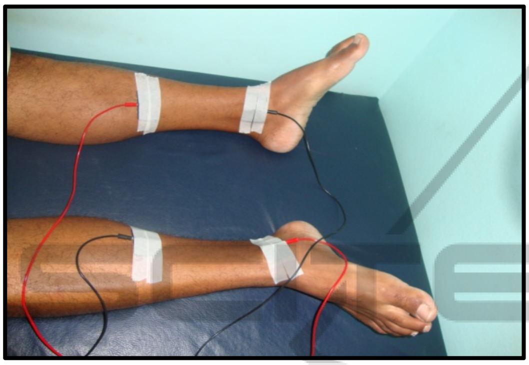

Figure 1: Positioning of the 4 eletrodes, two for each channel, used to apply the electric currents during the TENS sessions.

4 RESULTS AND DISCUSSION

This paper presents results of a case study monitored by descriptive assessments from the Unifesp Physiotherapeutic Protocol in Urogynecology and the voiding diary for three days. The patient was submitted to physiotherapeutic treatment with transcutaneous electrical stimulation in order to attenuate urological clinical complaints. This justifies the choice of a treatment by elective electrostimulation – separated from other techniques such as kinesiotherapy. Both evaluation procedures were applied i) before treatment, ii) after 20 TENS sessions, iii) within a year after being treated with TENS. It should be noted that the patient was still followed and evaluated after discharge from physiotherapeutic urological attendance and the same clinical signs obtained after 20 TENS sessions were preserved.

This case study of urinary incontinence treatment in a MS patient was made possible because the same therapist followed the patient throughout the study, even though the latter was also attended for treatment of other neurological symptoms such as unsteadiness and difficulties with static and dynamic coordination, aggravated during crises. MS patients commonly face periods of illness aggravation and remission. Nevertheless, clinical urological results obtained in this case study remained constant even after a year.

According to Kabay *et al* (2009), when applied to people suffering from multiple sclerosis, the technique noticeably decreased nocturia in 75% of patients. Marques (2008) reports decrease in nocturia with 38% of symptoms relief. Another study found improvement in nighttime urination in 21% of cases (Govier *et al*, 2001). Table 1 shows that after 10 sessions of electrical stimulation of the posterior tibial nerve, there was decrease in the signs of urinating discomfort, as well as reduction in the number of urinary frequency during the day, nocturia, and urgency incontinence episodes. We can justify improvement of urinary urgency conditions through a study in which urodynamic evaluation with electrical stimulation of the posterior tibial nerve revealed maximum bladder capacity can increase together with a decrease of involuntary detrusor contractions during standard cystometry (Amarenco, 2003).

Table 1: Urologic evaluation of signs frequency before treatment (f_{before}), after 10 sessions (f_{10}) and after one year of treatment (f_{1year}) with electrical stimulation sessions.

Main complaint	**F_{before}**	**$F_{10\ sessions}$**	**$F_{20sessions}$[1]**	**F1year**
Nocturia	9	5	0	0
Void desire during the day	15	3 a 4	normal	normal
Sensation act voing	pain and desire after voing	burning	confortable	Confortable
Urge incontinence	2.7	1.3	normal	normal
Cause of urinary loss	urge incon-tinence	urge incontinence	normal	normal

[1] **after 20 sessions**

In general, urinary incontinence treatment was considered effective given the observation that urinary loss episodes were reduced by 50%. With regard to this parameter, involuntary loss of urine onto clothes was reported 5 times by the patient before treatment due urge incontinence and 2 times after 10 electrical stimulation sessions. This reduction may be explained in terms of possible neuromodulation provoked by the TENS current.

This research found a limitation in the loss of patient sensibility caused by MS.

According to Tilbery (2006), it is common for patients with MS to present paraparesis of varying intensity, especially in the lower limbs. Therefore, the difficulty of using electrotherapy with these patients consists in adjusting the intensities of the current. We propose to perform the sensitivity test before applying the therapeutic current. During electrical stimulation it is important to carefully observe the threshold of individuals with hypersensibility. For that reason, the current intensity should be slowly graded until reaching an individualized parameter below the stimulation threshold of motor innervation (Kabay *et al*, 2009; Amarenco, 2003; Fischer-Sgrott *et al*, 2009; Maciel and Souto, 2009).

5 CONCLUSIONS

The transcutaneous electrical stimulation in the posterior tibial nerve can be considered as an alternative in the treatment of urinary incontinence in detrusor hyperactivity. Our results suggest that the technique may be effective in reducing the uninhibited detrusor contractions after 10 sessions of electrostimulation.

This technique is also relatively inexpensive, non-invasive, non-embarrassing, comfortable, painless, effective, with targeted action on the detrusor muscle, easy to apply and free of side effects of medications. Also, we believe that it can have high acceptance and adherence by the patients, since it does not result in great discomfort and each session takes 20 minutes.

We emphasize that, in this study, the technique resulted in a reduction in daytime and nighttime urinary frequency and in the number of episodes of urge incontinence. It can then have an impact in reducing stress and embarrassment and the number of urinary tract infections, as well as improving sleep quality and mood and thus providing a better quality of life for individuals with MS. It is then a good alternative in the treatment of lower urinary tract dysfunction, as suggested by the patient in this study.

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