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Urodynamic Effect of Transcutaneous Electrical Posterior Tibial Nerve Stimulation in Overactive Bladder after Partial Spinal Cord Injury

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ABSTRACT

Background: Overactive Bladder Syndrome (OAB) refers to individuals with the following symptoms: urinary urgency, excessive urinary frequency, or urge incontinence. These symptoms usually occur after partial spinal cord injury. **Objective**: to investigate the urodynamic effect of transcutaneous posterior tibial nerve stimulation in overactive bladder after partial spinal cord injury. **Subjects**: thirty subjects were divided into 2 groups: - Group (A): fifteen patients with overactive bladder after partial spinal cord injury above T12 (treated by transcutaneous posterior nerve stimulation and pelvic floor muscle exercises). Group (B): fifteen patients with overactive bladder after partial spinal cord injury above T12 (treated by pelvic floor muscle exercises) **Methods:** All subjects were submitted to complete clinical evaluation and assessed using urodynamic test and revised urinary incontinence scale (RUIS). **Results:** By comparison between both groups, the group which was treated by electrical stimulation and pelvic floor muscle exercise (group A) show increase in urodynamics parameters as bladder maximum cytometric capacity, bladder stability, maximum flow rate more than (group B) which was treated by pelvic floor muscle exercises only. **Conclusion:** Transcutaneous posterior tibial nerve stimulation has good urodynamic effect on overactive bladder in patients after partial spinal cord injury.

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Key words: urodynamics, over active bladder, posterior tibial nerve, partial spinal cord injury and transcutaneous electrical nerve stimulation.

Introduction

Overactive Bladder Syndrome (OAB) refers to individuals with the following symptoms: urinary urgency, excessive urinary frequency, or urge incontinence. These symptoms are not life threatening, but can cause embarrassment. Incontinence is the most problematic symptoms **(1).**

The effect of spinal cord transaction (e.g., in paraplegic patient) includes the initial state of spinal cord shock in which the bladder becomes overfilled and exhibits sporadic voiding (overflow incontinence). With time the voiding reflex is re-established but with no voluntary contraction. Bladder capacity is often reduced and reflex hyperactivity may lead to state called spastic neurogenic bladder. The bladder cannot empty completely resulting in residual urine **(2).** The use of electrical stimulation to control storage and evacuation of urine has become important tool in treatment of voiding dysfunction. The electrical stimulation can be used to treat incontinence caused by a lack of activity in the striated muscles of the urethral closure mechanism, where the electrical stimulation works by improving contraction of the sphincter mechanism. also used to overcome detrusor hyperactivity by reducing detrusor contractions **(3).**

Posterior tibial nerve stimulation (PTNS) by transcutaneous electrical nerve stimulation (TENS) is a technique of electrical neuromodulation for the treatment of voiding dysfunction in patient who have failed behavioral and/or pharmacologic therapies. Voiding dysfunction includes urinary frequency, urgency, incontinence, and non obstructive retention. Altering the function of the posterior tibial nerve is believed to improve voiding function and control. While the posterior tibial nerve is located near the ankle, it is derived from the lumbar-sacral nerves (L4-S3) which control the bladder detrusor and perineal floor **(4).**

(5) indicated that electrical stimulation is an effective and a safer modality in the treatment of bladder dysfunction; therefore, electrical stimulation was strongly recommended due to its low cost if compared to other modalities, easy application, and good results.

Purpose of the study:

To identify the effect of transcutaneous posterior tibial nerve electrical stimulation on urodynamic function of the bladder after partial spinal

cord injury.

Subjects and methods

The present study was held in the out-patient clinic in the faculty of physical therapy at Cairo University and faculty of medicine (Cairo University), this chapter includes subjects' selection, instruments and testing procedures, treatment procedure, data collection and statistical analysis.

A. Subjects:-

Subject selection.

Thirty males' patients were included in this study. The patients were diagnosed as over active bladder due to partial lesion of spinal cord above T12, based on both clinical assessment and radiological investigations of the spine including Computed Tomography (C.T scan) and/or Magnetic Resonance Imaging (MRI). Study includes Male patients diagnosed as partial spinal cord lesion above T12 and over active bladder. Duration of illness was six months or more and Patients' age ranged from 20 to 40 years old and exclude Patients with over active bladder due to other neurological disorders as sensory manifestations of bladder in polyneuropathic and diabetic patients, history of bladder trauma or surgery as fracture pelvis, orthopedic disorders of the pelvis as chronic pelvic syndrome, Spinal cord lesion below T12 and overactive bladder associated with stress urinary incontinence (mixed incontinence).

Study design:

Pre-test, post-test, design was used. Subjects were divided randomly into two equal groups GA and GB.

- Group GA (15 male patients) represents the study group A.
- Group GB (15 male patients) represents the study group B.

Assessment: - Both groups assessed before and after treatment by

Urodynamic and flowmetry test:

Dantic urodynamic 5000/5500. Urodynamic investigation system was used to perform the urodynamic investigation, as voiding cystometry Urodynamic machine is comprised of a trolley-mounted unit with integral printer and monitor. A mobile patient unit with built in H2O and CO2 pumps, a standard mounted uroflow transducer and a standard –mounted puller mechanism.

Revised Urinary Incontinence Scale (RUIS).

Revised urinary incontinence scale includes both questions from the incontinence severity index **(6).** Revised urinary incontinence scale is a valid and

reliable scale used to assess the severity of incontinence **(7).**

Treatment:-

- Group GA (the study group) treated by TENS applied on posterior tibia nerve the stimulator had an adjustable pulse intensity of zero-10MA. A fixed pulse width of 200 microseconds and a frequency of 10Hz.The device produce an adjustable electrical impulse that travels to the sacral nerve plexus via the tibial nerve. the TENS was applied for 30 Minutes, three times per week for six weeks and this group also treated by pelvic floor muscle exercises for 15 minutes 3times per week for six weeks

- Group GB they treated by pelvic floor muscle exercises for 15 minutes 3times per week for six weeks.

Results

All data were recorded on two phases; the pre-testing and the post-testing phase of the study. The results were statistically compared within each group and between both groups using the SPSS version 11.0. In addition, correlation between revised urinary incontinence scale and urodynamic measurements in the study groups A and B. The level of significance was set at ($p < 0.05$) for all tests.

Table (5): Comparison between the pre- and the post-testing phases for the pressure of the bladder at maximum flow rate for group GA and group GB.

Pressure of the bladder at maximum flow rate				
Paired t-test	GA		GB	
	pre-testing	post-testing	pre-testing	post-testing
Mean	55.4	57.67	54.8	55.53
SD	±17.79	±12.94	±15.157	± 12.1
Imp %	4.1%		1.3%	
t-value	0.484		0.190	
p-value	0.636		0.852	
S	NS		NS	

Table (1): General characteristics of patients in both GA and GB groups.

General Characteristics	GA		GB		Comparison		S
	Mean	SD	Mean	SD	t-value	p-value	
Age (yrs)	33.8	± 4.07	33.67	± 3.31	0.080	0.937	NS
Weight (Kg)	75.267	± 7.23	72.933	± 6.68	0.918	0.366	NS
Height (cm)	171.13	± 4.03	171.20	± 2.78	0.38	0.053	NS
D.I. (months)	4.8	± 1.08	4.67	± 1.05	0.343	0.734	NS

P: probability, S: significance, NS: non-significant (p>0.05), *S: significant (p<0.05).

Table (2) Comparison of the mean values of the first desire to void of patients between GA and GB in the pre- and the post-testing phases.

First desire to void of the patients In group (A&B)							
	G A		G B		Independent	P	Significance
	Mean	SD	Mean	SD	t-value	value	
Pre-treatment	174.33	±30.307	175.53	±19.35	0.129	0.898	NS
Post-treatment	192.6	±33.299	188.87	±19.29	0.376	0.710	NS

Table (3): Comparison of the mean values of the maximum cytometric capacity of the bladder between GA and GB in the pre- and the post-testing phases.

Maximum cytometric capacity of the bladder In group (A&B)							
	G A		G B		Independent t-value	P value	Significance
	Mean	SD	Mean	SD			
Pre-treatment	298.53	±29.49	296.6	±23.65	0.215	0.831	NS
Post-treatment	347.73	±26.59	312.87	±21.17	3.973	**0.001	VHS

Discussion

(4) Mentioned that transcutaneous stimulation of the posterior tibial nerve seems to be effective; non invasive option worth trying in patients with idiopathic voiding dysfunction. Improvement was seen in objective micturition parameters. Also, **(8)** Stated that transcutaneous electrical posterior tibial nerve stimulation offers a nondestructive alternative for patients with urge incontinence caused by over active bladder that is refractory to conservative treatment modalities. Detrusor over activity inhibition is achieved by acute electrical stimulation of afferent somatic sacral nerve fibers by PTNS, the rational of treatment is based on the existence of spinal Inhibitory systems that are capable of interrupting detrusor contraction this showed effect of PTNS synchronized between bladder and sphincter muscles contraction and relaxation. **(9)** Indicated that electrical stimulation is an effective and a safer modality in the treatment of bladder dysfunction, therefore electrical stimulation was strongly recommended in this study due to its low cost if compared to other modalities, easy application, and good results. Moreover, (**10)** found that the improvement rate in stress incontinent patients was 66%, while it was 72% in patients with detrusor instability after applying electrical stimulation, and detrusor instability became stable in 89% of men with detrusor instability. **(11)** Indicated that pelvic floor muscle exercises may help patients suffering from stress or urge incontinence, it may be practiced during lying down, sitting, standing, or even during walking, and the patient is instructed to contract as if he tries to interrupt his urine stream. Also, **(12)** approved that a biphasic, continuous pulse with a pulse width of 200 microseconds excites muscle fibers at a relatively low current intensity, and this is more comfortable than shorter pulse widths, which may require current intensity high enough to be perceived as painful before a tetanic muscle contraction is produced. Moreover, **(13)** stated that electrical stimulation

Table (4): Comparison of the mean values of stability of the bladder between GA and GB in the pre- and the post-testing phases.

Stability of the bladder In group (A&B)							
	G A		G B		Independent t-value	P value	Significance
	Mean	SD	Mean	SD			
Pre-treatment	1.13	±0.351	1.13	±0.352	1.56	1	NS
Post-treatment	1.47	±0.516	1.2	±4.14	1.3	**0.001	VHS

of the pelvic floor reduced symptoms of urinary urgency or frequency. The mechanism might involve decreasing bladder over activity by stimulating peripheral nerves that represent the same sacral (S_3) area as posterior tibial nerve. most experts believe that non-implanted electrical stimulation works by stimulating the pudendal nerve afferents, with the efferent outflow causing contraction of the striated pelvic musculature, there was also inhibition of inappropriate detrusor activity **(14)** indicated that the effectiveness in training of pelvic floor muscles is based on targeting a muscle group, taking into consideration the composition of the muscle fibers such as the ratio of Type I and Type II fibers. Consideration is also given to the contractile properties and endurance capacity of the muscle fibers in order to increase its performance for a specific need. Also, **(15)** indicated that pelvic floor exercise (PFE) entails the voluntary contraction of the pelvic floor muscles; Pelvic floor exercise regimens generally involve rapid and sustained contractions in order to strengthen the fast and slow-twitch fibers. Pelvic floor muscle exercises increase muscle volume and strength, so it is recommended as a treatment for men with urinary frequency, terminal dribbling, and urinary incontinence, pelvic floor exercises seem to help in reducing symptoms and provides better psychological and social quality and effective in treatment of neurological bladder. Moreover,(**8)** stated that posterior tibial nerve electrical stimulation was chosen as the physiotherapeutic method because it is an interesting alternative for the treatment of neurogenic overactive bladder, which is effective, without side effects and noninvasive and easy to apply form of peripheral sacral stimulation that is well tolerated by patients and more affordable.

Conclusion

From the obtained results, it was concluded that posterior tibial nerve electrical stimulation (PTNS) is an effective, non invasive option for treatment of patients' complaint of overactive bladder after partial spinal cord injury

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