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Impact of transcutaneous electrical nerve stimulation (TENS) on hyposalivation in type 2 diabetics.

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Salivary production enhanced by electro stimulation but research covering this area in diabetes is limited. Current study aimed to find out impact of TENS on hypo salivation in type 2 diabetics. One hundred hyposalivated type 2 diabetic patients from both sexes their age ranged from 43 to 76 years were randomly selected and assigned to one experimental group receiving one extra oral 5-minutes TENS session. TENS applied bilaterally on skin over parotid gland with frequency 50 Hz and pulse duration 250µs. Using low forced spitting method, un-stimulated saliva collected for 5 minutes immediately before the session and stimulated saliva collected during TENS application in graduated test tube. Results revealed that 90 out of 100 patients responded positively to TENS by increased both salivary volume and flow rate. It was concluded that TENS unit can be added to mainstream therapy of hyposalivation in type 2 diabetic patients

Keywords: TENS, Hyposalivation, Xerostomia, Type 2 diabetes mellitus.

INTRODUCTION

Diabetes mellitus (DM) has been described as a group of metabolic diseases indicated by hyperglycemia resulting from defects in insulin secretion, insulin action, or both (Cicmil et al., 2018). Hypofunction of different organs in the body is associated with DM, including in the oral cavity (Munemasa et al., 2018). Type 2 diabetes and hypo salivation are linked due to dysfunction of the parenchyma of the major salivary glands (Ogunbodede et al., 2005), diabetic micro angiopathy and neuropathy (Moore et al., 2001). Xerostomia is subjective sensation of dry mouth caused due to reduction or absent salivary secretion (Kayalvizhi et al., 2015) and hyposalivation is an objective sign of saliva reduction (Millsop et al., 2017). Navazesh et al., (1992) and Bardow et al., (2001) suggested that an un-stimulated salivary flow rate ≤ 0.16 ml/min is considered hyposalivation. Decreased salivary production lead to transient and persistent oral disorders due to its important role in maintaining oropharyngeal health (Kayalvizhi et al., 2015).

Treating hyposalivation with salivary substitutes and pharmacologic methods has side effects (Wong et al., 2003) like profuse sweating, urinary frequency, rhinitis, and dyspepsia (Blom and Lundeberg, 2000). There is a need to find out alternative device treating hyposalivation over others which are noninvasive, economical and having no side effect (Smriti et al., 2014). TENS device is powerful in improving saliva produced by parotid gland (Dhillon et al., 2016). TENS can be used easily while eating, comfortable to patients

not able to chew gum due to tempromandibular joint disorders and safe for diabetics unwilling to consume gum containing sugar components (Dyasnoor et al., 2017).
Therefore the purpose of this study was to find out the impact of TENS on hyposalivation.

MATERIALS AND METHODS

Subjects and study design:

Study subjects

One hundred patients (39 men and 61 women) were recruited from Internal Medicine out Clinic, Cairo University Hospitals; their ages ranged from 44-74 years old. Patients with whole resting saliva flow rate ≤ 0.16 ml/min considered to be abnormally hyposalivated (Navazesh et al., 1992), (Bardow et al., 2001) and included in the study. The study was conducted in Out Clinic of Physical Therapy for Internal Medicine, Faculty of Physical Therapy, Cairo University, Cairo; from December 2016 to May 2018. All the procedures of the study were approved by Ethical Committee for Scientific Researches of Faculty of Physical Therapy, Cairo University. All participated patients in the study were non-smokers, non-alcoholic and diagnosed diabetics with fasting blood glucose level ≥ 126 mg/dl or currently taking diabetic medications. Excluded patients by physician were: pregnant females, cancer and cardiac ones, patients undergoing medical management for xerostomia, patients with neurological disorders (stroke, parkinson's disease, epilepsy and Bell's palsy), salivary gland diseases, endocrine diseases and acute oral inflammatory disorders.

Evaluated parameters

Salivary flow rate assessment:

Salivary collection was planned to be performed between 9 and 11 am. The patients advised not to eat, drink, chew gum, intake coffee and oral hygiene before the test at least by one hour. To collect whole resting saliva, patient ' arms relaxed over their knees while lowering heads and facing slightly forward over the graduated test tube so as to collect the saliva in the anterior region of mouth floor. With little body movement and or facial movements, patients spit into the test tube using 'low forced spitting' movement. Collection period was done for 5 min. The salivary liquid component, not the foam, only was measured. The salivary flow rate (ml/min) calculated by dividing the collected salivary amount (volume in ml) by the time of collection period (5 minutes). TENS stimulating saliva was collected with the same previous procedures but during 5 minutes TENS session.

TENS protocol:

All patients were assigned into one experimental group received one session of extra-oral TENS applied externally on skin overlying parotid gland, in the pre-auricular area bilaterally, 1 cm in front of the tragus area. The TENS unit then activated at fixed frequency 50 HZ and pulse duration 250 μs for 5 minutes. Optimal intensity of TENS was gradually increased to the maximum comfortable tolerated intensity to patient.

Statistical analysis:

Paired-t test was used to compare between unstimulated and stimulated saliva. All statistical analyses were significant at 0.05 level of probability (P ≤ 0.05).

RESULTS

The study involved 100 type 2 diabetics from both sexes (39 men and 61 women). Mean age of participants was58.53±8.82 years old. All patients received only one session of extra-oral TENS on bilateral parotid salivary glands with pulse duration 250 μs and frequency 50 HZ for 5 minutes

The statistical analysis by paired-t test revealed that there was significant different (P=0.0001; P<0.05) between pre- and post-treatments of both salivary volume and rate as shown in table (1).

Table (1): Comparison between pre-treatment and post-treatment of salivary volume and salivary flow rate

	Mean±SD	Mean diff.	Mean diff.	P-value
		Pre-ttt	Post-ttt	0.0001*
Salivary volume (ml	0.43±0.29	0.68±0.26	0.25	0.0001*
Salivary flow rate (ml/min)	0.10±0.10	0.15±0.09	0.05	

SD: standard deviation; diff.: difference; ttt: treatment; Level of significance at P<0.05, * = significant.

Table (2): Comparison mean (mean±SD) values between pre- and post-salivary volume and flow rate within gender.

	Salivary volume (ml)		Salivary flow rate (ml/min)	
	Males	**Females**	**Males**	**Females**
Pre-ttt	0.31 ±0.13	0.52 ±0.16	0.06 ±0.01	0.12 ±0.02
Post-ttt	0.56 ±0.14	0.84 ±0.18	0.11 ±0.01	0.17 ±0.01
Mean diff.	0.25	0.32	0.05	0.05
P-value	0.0001*	0.0001*	0.0001*	0.010*

diff. : difference; ttt: treatment; Level of significance at P<0.05, * = significant.

Results revealed that 90 out of 100 patients responded positively to TENS by increased both salivary volume and flow rate with mean 0.68 ± 0.26 ml, 0.15 ± 0.09 ml/minute respectively, compared to mean whole resting salivary volume and flow rate 0.43 ± 0.29 ml, 0.10 ± 0.10 ml/minute respectively.

DISCUSSION

Hyposalivation is linked with diabetes. Research is sparse regarding electro stimulation as a mainstream therapy for hypofunction of salivary gland (Dyasnoor et al., 2017). The aim of current study was to find out impact of TENS on hyposalivation in type 2 diabetics. Analysis of the results of the present study indicated that one 5-minute extraoral TENS session on bilateral parotid glands led to a highly significant improvement in salivary volume and flow rate in 90 patients (90%) with increased percentage 58.14 %, 50.00% respectively.

The mechanism by which the TENS unit works on parotid gland is still not obvious. TENS mechanism working on the parotid gland may be due to stimulating directly the auriculo temporal nerve which supplies secretomotor drive to the parotid gland. It is assumed that afferent nerves transfer such impulses to the salivary nuclei (salivation center) in the medulla oblongata which in turn directs signals to the efferent part of the reflex leading to beginning of salivation (Vilas et al., 2009).

Salivation was decreased among 5 patients (3 females and 2 males) during TENS application in present study. The mechanism for this may relate to the frequency and intensity parameters and whether the brain may claim the stimulus as a painful one (Chavez et al., 2000).

For not increased salivation in 5 female patients in this study during TENS application, TENS is less probably to be efficacious in cases where there is no baseline salivary flow where full destruction of the salivary gland unit has existed. However, TENS appears to have potential in cases where there is residual salivary function (Dyasnoor et al., 2017).

The results of present study agreed with recent results obtained by (Dyasnoor et al., 2017) who reported statistically significant increase in stimulated whole saliva after continuous mode extraoral TENS application in 36 out of 40 diabetic patients between age 30 to 75 years. Whole salivary flow was decreased among four patients.

In accordance with current study, (Smriti et al., 2014) evaluated the effectiveness of extra oral TENS in 6 diabetic patients (2 males and 4 females) with hyposalivation. Mean stimulated saliva increased (3.33 ml/minute) in comparison to resting one (2.53 ml/minute).

Consistent with this, (Aggarwal et al., 2015) reported that 65 of the 80 healthy subjects demonstrated an increase in the salivary flow rate on application of 5-minutes extraoral TENS. 12 subjects demonstrated no increase in the salivary flow rate while 3 subjects showed a decrease.

The result of the current study was also supported by (Dhillon et al., 2016) who found that 87 of 100 subjects demonstrated increased salivary flow when stimulated via 5 minutes extra oral TENS unit. Ten patients experienced no increase and 3 ones experienced a decrease.

In current study, although smaller male mean resting saliva due to smaller number than women, their percentage of stimulated saliva by extra oral TENS was better than in females 83.33, 41.67% respectively (Table 2) .

Study results came in accordance with (Vilas et al., 2009) and (Aparna et al., 2017) who reported that men produced more saliva during TENS than women did and responded better and related to postmenopausal changes and smaller salivary glands in females.

Against current study, (Dyasnoor et al., 2017) reported that there was no significant clinical difference between gender and TENS stimulating saliva in DM type 2 patients and this was correlated with lower females number in the mentioned study.

The results of current study not agreed results of (Kumud et al., 2012) who found no significant statistical difference between males and females at whole resting and stimulating saliva flow

CONCLUSION

From results of current study, it was concluded that TENS had a hopeful effective role in improving hyposalivation related to diabetic complications. With its encouraging results, it was recommended to study the response of hyposalivation after several sessions of extra oral TENS in type 2 diabetics.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

AMAI designed and performed the experiments and also wrote the manuscript. HMEE and MEMAA performed continuous guidance and suggestions during the performance of experiments, data analysis and reviewed the manuscript. All authors read and approved the final version.

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