

## Effect of Transcutaneous Electrical Nerve Stimulation on Acupoints in Type 2 Diabetes Mellitus – A Blood Glucose Analysis

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### Abstract:

**Background and objective:** *The mortality rate of type 2 diabetes is higher in India. Changing lifestyle and environment have contributory effect in increase rate of type 2 diabetes mellitus. Hypothesis was that the transcutaneous electrical nerve stimulation (TENS) on ST36 as a complementary therapy for controlling plasma glucose in type 2 diabetes mellitus patients.*

**Methods:** *The study designed a single blind convenient clinical study of type 2 diabetes patients who already taking oral hypoglycemic agents to control blood glucose. In this study 50 patients were selected on the basis of inclusion and exclusion criteria and were assigned to receive either TENS (experimental group, n = 25 and placebo group, n= 25) on the bilateral ST36 acupoints at a frequency of 25 Hz with intensity of 9 mA for 5 minutes for 7days. The blood glucose level was measured at both pre and post stimulation.*

**Result:** *There was significant improvement ( $P<0.05$ ) in random blood sugar level of type 2 diabetes mellitus.*

**Conclusion:** *It has been found transcutaneous electrical nerve stimulation (TENS) on bilateral ST36 acupoints have an effect to control plasma glucose level for type 2 diabetic mellitus patients and can be used without having any side effect.*

**Key words:** Type 2 diabetic mellitus, TENS, Acupoint, plasma glucose level.

## **I. Introduction**

The commonness of diabetic increasing speedily all over the world in a shocking rate, according to the world health organization (World health organization 2006), diabetes mellitus affects at least 171 million people and causes 3.2 million deaths, six deaths every minute and 8700 deaths every day. WHO calculate approximately 70% of cases of diabetes increase in developed countries and 42% in the developing countries in 2030. This is to be expected to affect 366 million people by 2030 (World health organization 2006) due to population growth, aging, urbanization, and increasing prevalence of obesity and physical inactivity (Wild et al. 2004) According to an estimate there was a 31.7 million people suffering from the diabetes that will be increased up to 79.4 million by the year of 2030 (Wild et al. 2004). In developing countries, the majority of people with diabetes age groups are 35-64 years, while people in developed countries suffer more above 64 years of ages. It is estimated that by the year 2030, the number of people with diabetes ages64+ will be more than 82 million in developing countries and 48 million in developed countries (Wild et al. 2004).

Diabetics affect not only in health status but also in the economic status of the country. Currently the overall direct health care costs of diabetes mellitus ranges from 2.5% to 15% of annual health care budgets of developed and developing countries (Bishwas 2006). The increasing rate of diabetes patient and the economical cost on the diabetes has put a burden on the country as well as on the individual one also who have been suffering from diabetes.

There are different risk factors which are increased of age, gender, country and place of residence, society, socioeconomic status, lifestyle and obesity involve type 2 diabetes (Gads, 2002). The type 2 diabetes have some sever complication that can lead to death due to cardiovascular

problem, renal failure etc (Kumar et al. 2005). There are also some micro and macro vascular problem for long duration of diabetes such as – arthrosclerosis, retinopathy, nephropathy, foot complications, skin complications, mental health, hearing loss, gastroparesis, ketoacidosis (DKA), neuropathy, nephropathy, peripheral arterial disease (PAD), stroke (Marvin E et al,2009)

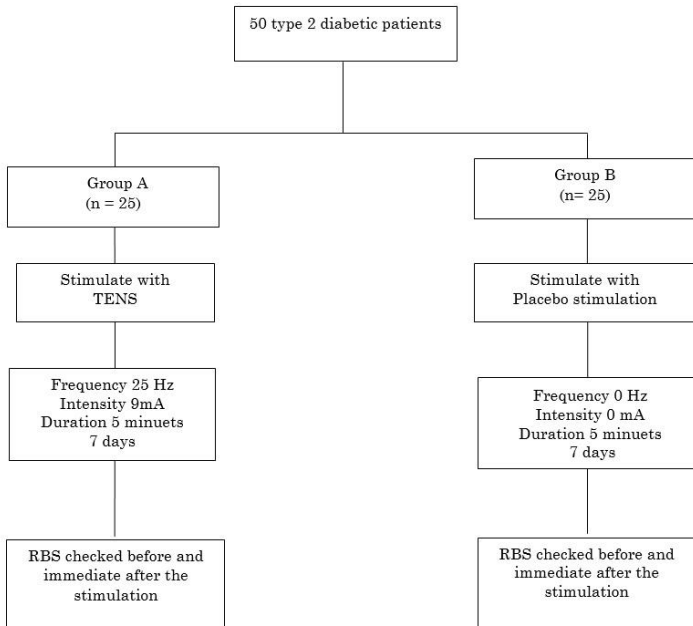
To control the blood sugar level and to prevent complication which arise from the constant high blood sugar there are some treatment available, which includes both modern and ancient treatment protocol and both chemical and organic remedy. There are several types of medication used to treat diabetes it includes oral hypoglycemic tablets and injectable insulin inhibit the release of glucose from the liver, improve the cells sensitivity to insulin, slow the breakdown of starches and sugars to glucose (Venkataraman et al 2010). Alternative treatment for diabetes has become increasingly popular from last several years, which include medicinal herbs, nutritional supplements and hot tub therapy (Laakso 2008)

Now a day the traditional Chinese treatment, acupuncture is going to be famous in some countries to treat diabetes, Acupuncture is not only effective in treating diabetes but it also helps in preventing and managing complications of diabetes (Hu 1995). The effects of acupuncture on diabetes have been observed experimentally and clinically (Chen 1985). The above treatments are having some certain side effect and are not so cost effective that all the patient who suffering from diabetes can afford these.

So it's necessary to introduce some cost effective and less side effect treatment for the rapidly growing diabetes. In this study transcutaneous electrical nerve stimulation used on the acupoint to control the blood glucose level. This is the very first time use of transculaneous electrical nerve stimulation to control the blood glucose level in type 2 diabetic patients.

## II. Material and Methodology

50 subjects, both male and female aged between 45- 65 years who were pre diagnosed type 2 diabetes since 2 - 10 years and taking only oral hypoglycemic agents included in this study. Subjects were informed about the procedure and were signed an inform consent form prior to enroll in this study. Those who have cardiac, neurological, nephorological, gastrointestinal, gynecological, skin disease, sensory impairment over the acupoint, psychiatric disorder were excluded from the study. Selected subjects were divided into two groups, 25 subjects in each group. Group A taken TENS at the frequency of 25 Hz and intensity of 9mA and group B taken placebo stimulation of 0 Hz and 0mA over the ST36 acupoint, with a common duration of 5 minutes for 7 days. Random blood sugar was checked by gluco meter before and immediately after the stimulation for both of the groups, stimulation was given after 3 hours of food on every day regularly on stipulated time.



**Figure 1: Flow chart of methodology**

### III. Result

The result was analyzed by using SPSS 16.0 version and the significant level  $P < 0.05$ . There was no significant difference of age between group A and group B ( $52.92 \pm 6.18$  vs  $56.44 \pm 6.93$  years) [table1, figure1], baseline level of RBS ( $239.76 \pm 84.05$  vs  $210.80 \pm 72.82$  mm/dl), and the duration of disease ( $4.28 \pm 1.88$  vs  $5.36 \pm 2.20$  years) [Table 2, Figure 2a&2b]. The random blood sugar, which was checked before and immediately after the stimulation shows the significant difference in group A from day 1 to day 7 of stimulation ( $239.76 \pm 84.05$  vs  $148.2 \pm 48.58$ ) and not such statistical significant difference in group B from day 1 to day 7 of stimulation ( $210.80 \pm 72.82$  vs  $230.2 \pm 58.11$ ) [Table:3, Figure:3]. There was also a gradual decrease of RBS in group A which was the statistically significant. In group A level of RBS post stimulation day 1 and pre stimulation of day 2 stimulation shows no significant difference ( $209.5 \pm 72.58$  vs  $209.4 \pm 63.58$ ) [Table:4, Figure:4] this showed the maintenance of blood sugar level between the two stimulation.

### IV. Figures and Tables

SN	Parameter	Group A			Group B			't' value	'P' value
		mean	S D	S E	mean	S D	S E		
1	Duration	4.28	1.88	0.38	5.36	2.20	0.44	1.866	0.0680 NS
2	RBS	239.76	84.06	16.81	210.80	72.82	14.56	1.302	0.1991 NS

NS: Non significant

**Table 2: Comparison of mean, SD & SE in duration and level of RBS (base line) value between the group A and group B.**

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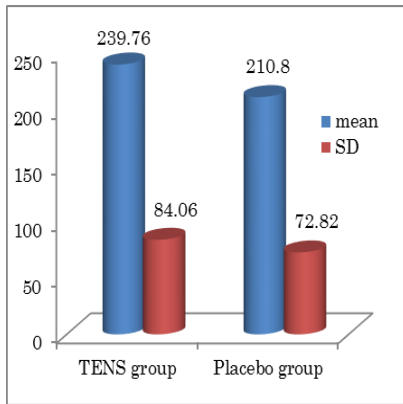


Figure 2a: Base line RBS level of both group

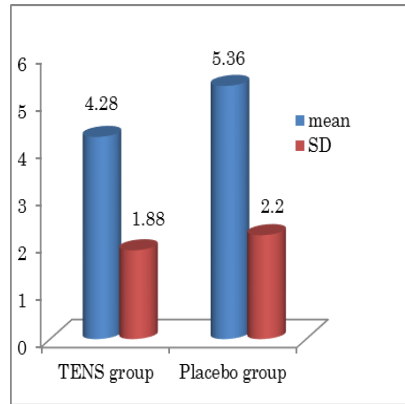


Figure 2b: Duration of diabetes mellitus in both groups

SN	Parameter	Day 1 pre			Day 7 post			't' value	'P' value
		mean	SD	SE	mean	SD	SE		
1	Group A	239.76	84.05	16.81	148.2	48.58	9.71	8.893	0.000 S
2	Group B	210.8	72.82	14.56	230.2	58.11	11.62	-1.322	0.199 NS

S = significant

NS = Non significant

**Table 3: Shows comparison of mean, SD & SE in day1 pre and day 7 post RBS level between the group A and group B.**

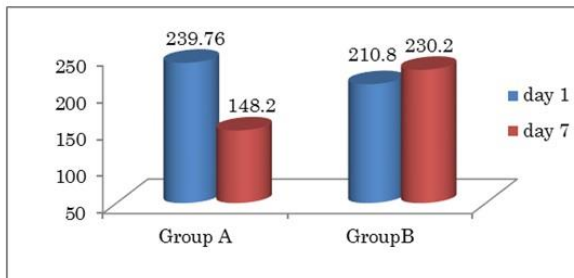
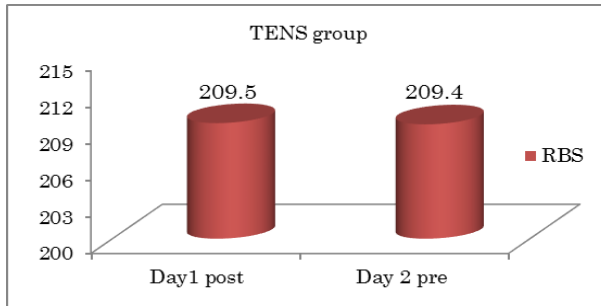


Figure 3: RBS level of day 1 and day 7 in group A and group B

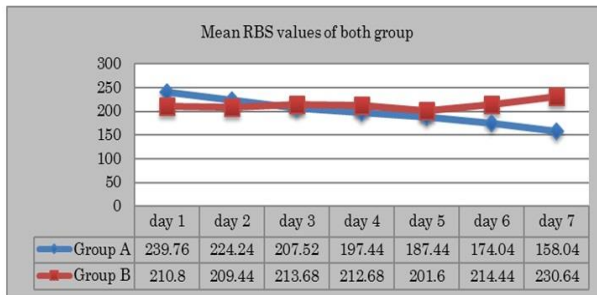
SN	Parameter	Day 1 post			Day 2 pre			't' value	'P' value
		mean	SD	SE	mean	SD	SE		
1	RBS	209.5	72.58	14.51	209.4	63.85	12.77	0.012	0.991 NS

NS = Non significant

**Table 4: Comparison of maintenance of change of RBS between day 1 post stimulation and day 2 pre stimulation in group A**



**Figure 4: Maintenance of change of RBS in group A**



**Figure 5: Group A has shown a continuous reduction of blood glucose level, whereas the group B did not show this type of feature.**



**Figure 6: Electrode placed over the ST36 acupoint**

## V. Discussion

Treatment of diabetes with TENS on acupoint is effective in reducing blood glucose level, especially in individual with non insulin dependent DM [Figure: 5]. In this study, TENS over the ST36 acupoint can help to decrease plasma glucose concentrations in type 2 diabetic mellitus patients [Figure:6]. From the preliminary experiments, TENS stimulation at a frequency of 25 Hz and intensity of 9 mA was found to be effective. A similar TENS stimulation at the non-acupoint location failed to reduce blood glucose level in type 2 diabetic. It can be considered that the hypoglycemic effect is a specific response to the TENS at the ST36 acupoint. Acupuncturists found about 20 acupoints that are effective in reducing blood glucose level. Acupuncture may be effective in both treating, preventing and managing complications the of diabetes (Ingle et al. 2011)

In the theory of traditional Chinese medicine, acupuncture regulates ‘Chi’ which runs through all the meridians of the whole body. Recently, ST36 acupoint is considered as a major acupoint to control plasma glucose. (Chang et al. 2006). In this study only one acupoint (ST36) bilaterally were used for a period of 5 minutes. Whereas other studies used more points and they had also taken longer duration of stimulation. This duration is suitable for patients as well as for Physiotherapist and this was the very short duration ever use in this type of study so far.

Manual needling is the classic method, and electro-acupuncture, that is electrical stimulation is introduced to the body via metallic needles inserted into the acupoints is the most commonly used modality today (Ulett et al. 1998). In this study an alternative method is used to apply electrical stimulation on acupoint via skin electrodes, which called TENS (TENS), which has been used in the physiotherapy field to reduce pain by the stimulating nerve. This was non invasive and easy method to



use. Previous study which stimulate the ST36 and SP6 bilaterally on the non diabetic patient shows the transcutaneous electrical nerve stimulation on that point improve the insulin resistance during the general anesthesia (Man et al. 2010). As the animal and the non diabetic patients experiment has shown different mechanisms, but both are related to decrease the blood glucose level. As this was the very first study done on diabetic patient, so actually what mechanism were happening in the human body who were suffering in a diabetic is still unknown.

The beta cells of the pancreas are responsible for the secretion of insulin, the hormone that facilitates the transport of energy-producing glucose into the body's cells. In type 2 diabetes, dysfunction of these insulin-producing cells combined with a decrease in the insulin response of individual cells, results in increased blood sugar levels. The progression of beta-cell dysfunction associated with increased insulin resistance is the usual indication for the use of oral anti-diabetic medications. With effective oral anti-diabetic medication, hyperglycemia or high blood sugar levels can be corrected. Generally people who suffering from type 2 diabetes takes different type of medicines by the advice of physicians to control their blood glucose level. The medicines that commonly use in diabetes mellitus have property of insulin secretagogues and Insulin sensitizers.

The insulin secretagogues are a group of oral medications that stimulate the beta cells of the pancreas to secrete more insulin. They also decrease glucose production by the liver and enhance the burning of glucose into usable energy forms by individual muscle fibers. (Anthony S et al; 2008). Insulin sensitizers are a group of oral medications that enhance the action of the insulin in the body.

From the previous study which had done on the animals and non diabetic patients with the electropuncture and transcutaneous electrical nerve stimulator have shown the

similar effect of medicine that it helps to improve the insulin resistance, to enhance insulin synthesis, to increase the number of receptors on target cells, and to accelerate the utilization of glucose. (Hu 1995)

The TENS is very common and available instrument which is used in physiotherapy department everywhere. This was cost effective and less time consuming procedure ever used in the blood glucose reduction. Commonly people who suffering from diabetics take medicine or insulin to control the blood glucose level. Both the medicine and the insulin have side effect on the body as it has been use long to control blood glucose level, but the TENS have no such type of side effect on human body. This new approach of reduction blood glucose level gives a new treatment procedure which is free from any side-effect to the diabetic patient. So transcutaneous electrical nerve stimulation can be used as a safe and new method to control the blood glucose level for who suffering from type 2 diabetes mellitus.

## **VI. Conclusion**

In this study, we have found that application of TENS is effective in controlling blood glucose levels and hence we conclude that TENS along with medicine and diet have a significant effect on blood glucose level among type 2 diabetic mellitus.

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