

# Is there a role for TENS application in the control of diabetes mellitus in insulin-dependent patients?

Mueen Ullah Khan<sup>1</sup>, MBBS, FCPS

**ABSTRACT** An 80-year-old man with insulin-dependent diabetes mellitus presented to the hospital with low back pain. He was initially managed with non-steroidal anti-inflammatory drugs, tramadol and epidural steroid injection. Transcutaneous electrical nerve stimulation (TENS), applied on the back and buttocks, was subsequently advised. Initially, TENS was applied once every 24 hours. On improvement of pain symptoms, it was increased to thrice every 24 hours. The patient then complained of symptoms of hypoglycaemia (blood sugar level < 4 mmol/L). Discontinuation of TENS resulted in raised blood sugar level. When TENS was restarted, the same hypoglycaemic response was noted. The insulin dosage was adjusted to half of the patient's routine daily requirement with continued application of TENS. This incidental finding has alerted us to hypoglycaemic episodes following TENS application, which may be due to effective pain control, decreased sympathetic stimulation, enhanced insulin sensitivity or altered muscle metabolism due to electrical stimulation.

*Keywords: diabetes, transcutaneous electrical nerve stimulation, low back pain, therapy, control*  
*Singapore Med J 2012; 53(11): e249–e250*

## INTRODUCTION

Diabetes mellitus is an endocrine disorder in which the cells of the body are unable to metabolise sugar properly due to a total or relative lack of insulin. Chronic regional pain and chronic widespread pain in the adult population are usually associated with diabetes mellitus. Diabetic neuropathy is a debilitating complication of diabetes mellitus and results in pain and decreased mobility. Percutaneous electrical nerve stimulation and transcutaneous electrical nerve stimulation (TENS) are useful non-pharmacological therapeutic modalities for treating pain in diabetics. These therapies decrease extremity pain, improve physical activity, sense of well-being and quality of sleep while reducing the need for oral analgesic medication. We report the case of an 80-year-old South Asian man with insulin-dependent diabetes mellitus in whom TENS was advised for his back pain. When TENS therapy was started, the patient reported adequate pain relief, but with episodes of hypoglycaemia. Trends of rising blood sugar were noticed on cessation of TENS therapy. Finally, TENS therapy helped in reducing the patient's daily insulin requirement.

## CASE REPORT

An 80-year-old South Asian man had had type 2 diabetes mellitus for 20 years. He was on insulin (regular 10U, NPH 14U in the morning and evening) for improved control of his hyperglycaemia. His blood sugar level remained within the acceptable range (6–9 mmol/L) with this regimen. The patient was referred from the neurosurgical clinic for pain control without any evidence of ongoing infection or any treatable cause of backache. Initially, he was managed with simple medications like non-steroidal

anti-inflammatory drugs, tramadol and lumbar epidural steroid injection. He was advised to apply TENS to the sites of pain on his back and buttocks. He initially applied TENS (80–150 Hz) once every 24 hours. This showed improvement in pain symptoms, but only for a limited duration. He was then advised to apply TENS three times a day, for a duration of 10 minutes each. After six days of regular TENS application, he started to complain of symptoms of hypoglycaemia after the second application, which was evidenced by low blood sugar levels (< 4 mmol/L) on gluco checks. He was advised to discontinue the TENS application and insulin. He was also advised to keep the gluco check record and monitor the responses.

Interestingly, the patient's blood sugar level started to rise, and he then started on routine insulin therapy. However, when TENS application was resumed, the same hypoglycaemic response was noticed. Insulin dosage was reduced to half of the patient's daily requirement and the application of TENS was reduced to twice daily. He was followed up for one month, and daily blood sugar was checked. The patient's blood sugar level remained within the acceptable range throughout that period (6–9 mmol/L).

## DISCUSSION

Type 2 diabetes mellitus is a metabolic disorder in which the body produces an inadequate quantity of insulin or the body's cells become resistant to insulin. Insulin is necessary for the utilisation of glucose for energy. The main goal of treatment is adequate glycaemic control. It has been proved that better glycaemic control can protect against or delay the complications of diabetes mellitus. Management includes pharmacological treatment with a variety of available medications. Insulin may be added

<sup>1</sup>Department of Anaesthesia and Intensive Care, College of Medicine and King Khalid University Hospital, King Saud University Riyadh, Saudi Arabia

**Correspondence:** Dr Mueen Ullah Khan, Assistant Professor, Department of Anaesthesia, College of Medicine, King Saud University P.O. Box, Riyadh-7805, Saudi Arabia.  
mueenullahpk@hotmail.com

to oral medications, or used alone, for better control of diabetes mellitus. In addition to medication, other non-pharmacological strategies such as aerobic exercise are advised. Exercise involves muscle contractions and is known to decrease elevated blood glucose by the counter release of insulin and improve insulin sensitivity.<sup>(1,2)</sup> Other non-pharmacological methods that are popular in Chinese medicine, such as acupuncture,<sup>(3,4)</sup> acupressure<sup>(5)</sup> and electrical stimulation of specific acupoints, are used to relieve the symptoms of diabetes mellitus-related complications. The mechanism of acupressure/electro-acupressure and its effects on cellular glucose and lactate metabolism are still unclear. However, a short-term hypoglycaemic effect was seen in animal models when electro-acupuncture was applied at specific acupoints, due to various mechanisms.<sup>(6,7)</sup>

TENS delivers electrical currents through the skin to activate peripheral nerves. This technique is widely used to relieve a wide range of acute and chronic pain conditions.<sup>(8)</sup> TENS was used for chronic pain control in our patient. He experienced a significant reduction in the blood glucose level and decrease in insulin requirement after the initiation of TENS. The exact mechanisms of hypoglycaemia and reduction in insulin requirement upon TENS application are yet unknown. TENS is frequently applied in diabetics and has proved to play an effective role in the treatment of diabetic peripheral neuropathy and pain control.<sup>(9)</sup> Electrical stimulation, improvement in pain control and hypoglycaemia constitute a complex interaction that involves the peripheral and central nervous systems,<sup>(6)</sup> rather than a single mechanism. The effect of TENS on insulin sensitivity is still not fully understood. Some other effects of TENS could have played a part in our patient's glucose control. The lowering of plasma glucose and decrease in insulin requirement might be due to effective pain control<sup>(10)</sup> and altered autonomic nervous system activity. We did not have the opportunity to test out this hypothesis in another patient with respect to the fall in blood sugar level after the application of TENS.

Evidence regarding the efficacy of electrical stimulation in lowering the blood sugar levels of diabetic patients is sparse. However, in a recently published article, it has been shown that when TENS was applied on the ST36 and SP6 acupoints, there were positive effects seen in the prevention of hyperglycaemia and an increase in the sensitivity of plasma insulin in the TENS group, as compared to the placebo group.<sup>(11)</sup> The effect of hypoglycaemia in our patient may be due to a mechanism explained by altered autonomic function and increased anaerobic metabolism of the big muscles of the back and the gluteal region. We believe that in addition to TENS therapy and pain control,<sup>(10)</sup> other effects such as calcitonin gene-related peptide,<sup>(12)</sup> elimination of underlying oxidative stress, tramadol<sup>(13)</sup> on board and neuronal release

of nitric oxide<sup>(14,15)</sup> could have played an important role in the reduction of insulin requirement.

In summary, this case report highlights the possibility of hypoglycaemia occurring in diabetics who are on TENS therapy. It also emphasises the need for a search of the different modes and areas for electrostimulation in diabetic patients for the non-pharmacological management of diabetes mellitus.

## ACKNOWLEDGEMENT

All the resources required for the preparation of this manuscript were provided by the Department of Anaesthesia and Intensive Care, King Saud University Riyadh, Saudi Arabia.

## REFERENCES

- Hawley JA, Lessard SJ. Exercise training-induced improvements in insulin action. *Acta Physiol (Oxf)* 2008; 192:127-35.
- De Angelis K, da Pureza DY, Flores LJ, et al. [Physiological effects of exercise training in patients with type 1 diabetes]. *Arq Bras Endocrinol Metabol* 2006; 50:1005-13. Portuguese.
- Chu Q, Wang L, Liu GZ. [Clinical observation on acupuncture for treatment of diabetic nephropathy.] *Zhongguo Zhen Jiu* 2007; 27:488-90. Chinese.
- Chu Q, Wang L, Liu GZ. [Effect of acupuncture on hemorheology in patients with diabetic nephropathy.] *Zhen Ci Yan Jiu* 2007; 32:335-7. Chinese.
- Jin KK, Chen L, Pan JY, et al. Acupressure therapy inhibits the development of diabetic complications in Chinese patients with type 2 diabetes. *J Altern Complement Med* 2009; 15:1027-32.
- Mei ZG, Zhu B, Li YH, et al. [Responses of glucose-sensitive neurons and insulin-sensitive neurons in nucleus tractus solitarius to electroacupuncture at auricular concha in rats.] *Zhongguo Zhen Jiu* 2007; 27:917-22. Chinese.
- Chang SL, Lin KJ, Lin RT, et al. Enhanced insulin sensitivity using electroacupuncture on bilateral Zusanli acupoints (ST 36) in rats. *Life Sci* 2006; 79:967-71.
- Tashani O, Johnson M. Transcutaneous Electrical Nerve Stimulation (TENS) A Possible Aid for Pain Relief in Developing Countries? *Libyan J Med* 2009; 4:62-5.
- Jin DM, Xu Y, Geng DF, Yan TB. Effect of transcutaneous electrical nerve stimulation on symptomatic diabetic peripheral neuropathy: a meta-analysis of randomized controlled trials. *Diabetes Res Clin Pract* 2010; 89:10-5.
- Binder W, Mousa SA, Sitte N, et al. Sympathetic activation triggers endogenous opioid release and analgesia within peripheral inflamed tissue. *Eur J Neurosci* 2004; 20:92-100.
- Man KM, Man SS, Shen JL, et al. Transcutaneous electrical nerve stimulation on ST36 and SP6 acupoints prevents hyperglycaemic response during anaesthesia: a randomised controlled trial. *Eur J Anaesthesiol* 2011; 28:420-6.
- Tanaka S, Barron KW, Chandler MJ, Linderth B, Foreman RD. Low intensity spinal cord stimulation may induce cutaneous vasodilation via CGRP release. *Brain Res* 2001; 896:183-7.
- Cheng JT, Liu IM, Tzeng TF, et al. Plasma glucose-lowering effect of tramadol in streptozotocin-induced diabetic rats. *Diabetes* 2001; 50:2815-21.
- Croom JE, Foreman RD, Chandler MJ, Barron KW. Cutaneous vasodilation during dorsal column stimulation is mediated by dorsal roots and CGRP. *Am J Physiol* 1997; 272:H950-7.
- Smukler SR, Tang L, Wheeler MB, Salapatek AM. Exogenous nitric oxide and endogenous glucose-stimulated beta-cell nitric oxide augment insulin release. *Diabetes* 2002; 51:3450-60.