



Brief Communication

Entrapment of medial plantar nerve [tarsal tunnel syndrome] in type 2 diabetes mellitus: An electrophysiological study

Ashraf Husain *, Sultan Ayoub Meo, Syed Aftab Omar, Syed Shahid Habib, Abdulmajeed Al-Drees

Department of Physiology (29), College of Medicine, King Khalid University Hospital, King Saud University, P.O. Box 2925, Riyadh 11461, Saudi Arabia

ARTICLE INFO

Article history:

Received 13 March 2009

Accepted 30 March 2009

Keywords:

Diabetes mellitus

Tarsal tunnel syndrome

Medial plantar nerve

Distal motor latency

Sensory nerve action potential

ABSTRACT

Background: With increase in type 2 diabetes mellitus patients the complications of diabetes are being seen more frequently. Patients with diabetic neuropathy often present with distressing symptoms such as pain and burning sensation in the feet. Tarsal tunnel syndrome with electrophysiological changes may be a causative or contributing factor. The present study was designed to assess the presence and features of tarsal tunnel syndrome in diabetes mellitus patients.

Method: In this study a group of 10 normal volunteers were selected who had no neurological complaints or foot trauma. Another group of 33 patients having longstanding diabetes mellitus with complaints of pain, burning sensation and paraesthesia in the feet were selected for electrophysiological tests and median plantar nerve was studied.

Results: In the present study we observed that 15 (45%) of diabetic cases showed abnormal findings e.g., prolonged distal motor latency, decreased amplitude of M-response, low or absent sensory response suggesting tarsal tunnel syndrome.

Conclusion: This study shows that the tarsal tunnel syndrome may be present in a significant number of diabetic patients with subjective neuropathic symptoms in the feet. The tarsal tunnel syndrome should be kept in mind during the diagnostic workup and management of diabetes mellitus.

© 2009 International Journal of Diabetes Mellitus. Published by Elsevier Ltd.

Open access under [CC BY-NC-ND license](http://creativecommons.org/licenses/by-nc-nd/3.0/).

1. Introduction

Patients with longstanding history of diabetes mellitus often complain of pain, burning sensation, numbness and paraesthesia of feet and heel. These features in fact could be due to compression of medial plantar nerve, a branch of tibial nerve inside the tarsal tunnel. The symptoms are worst with prolonged standing or on long walk. The term was first coined by Keck and Lam in separate articles [1,2]. However, the first description of the clinical feature of tarsal tunnel syndrome (TTS) is attributed to Von Malaise [3] in 1918.

To assess TTS electrophysiologically following tests are required: distal motor latency (DML), sensory conduction velocity (SCV) and study of amplitude of sensory nerve action potential (SNAP) of medial plantar nerve [4]. Considering the applied anatomy of tarsal tunnel and complications of diabetes mellitus, the aim was to diagnose the tarsal tunnel syndrome in patients having pain and burning sensation in the feet.

2. Subjects and methods

The study was conducted in the Department of Clinical Physiology, King Abdulaziz Hospital, King Saud University, Riyadh, Saudi

Arabia. Patients with long history of type 2 diabetes were referred by the Diabetic Center of KAUH. Ten control cases were selected who had no history of feet trauma or any neurologic disease and were fit physically. A verbal informed consent was obtained in each case. A group of 33 patients with history of diabetes up to twenty years duration were selected. All the patients complained of pain, burning, numbness and paraesthesia of heel or feet. In both control and diabetes mellitus patients, the tibial nerve was stimulated 1 cm posterior to the medial malleolus and the recording electrode was placed on the abductor hallucis muscle. The reference electrode was kept on the big toe while the ground was put on the dorsum of the foot. Distance between stimulating and recording electrode was kept 10 cm. The measurements was made with a flexible tape while the ankle was in a neutral position (90°) [5,6]. The recording was made on Nicolet, Spirit nerve conduction recording machine at room temperature [7]. Distal motor and sensory latency, M-response, sensory nerve action potential and sensory and motor conduction studies were performed.

3. Results

A cross sectional case control study was conducted in 10 normal control and 33 type 2 diabetic patients [25 males and 8 females]. The age of the patients ranged from 40–61 years and the duration of diabetes mellitus was about twenty years. Out of 33 (66 limbs)

* Corresponding author. Tel.: +9661 4671041, +966 502913963 (Mob.), +9661 4682166 (Res.); fax: +9661 4672567.

E-mail address: ashrafhusain31@hotmail.com (A. Husain).

diabetic cases 18 cases (36 limbs) in spite of symptoms had normal electrophysiological values. 15 cases (30 limbs) had both symptoms and abnormal findings in nerve conduction studies [NCS] in lower limbs and four patients out of 15 had bilateral complaint and abnormal NCS of medial plantar nerve. The remaining eleven had unilateral symptoms and NCS abnormality. Out of 15 (30) limbs of abnormal cases the sensory and motor involvement were present in 9 limbs, and only sensory abnormal findings were observed in 18 limbs. However, in 3 limbs no response was observed. Thus, our results showed that the distal motor latency and amplitude of M-response was abnormal in 15 out of 33 (45%) type 2 diabetic patients. In 3 out of 33 diabetic patients no sensory nerve action potential was obtained bilaterally.

4. Discussion

Type 2 diabetes mellitus patients are increasing in number hence its complications are also increasing. The patients had various types of neuropathic complication and tarsal tunnel syndrome is one of them. Diabetic patients who have to stand for long time complain of burning sensation and pain in feet with history of restless legs. In such cases, tarsal tunnel syndrome should be considered as one of the causes. Electrophysiological studies are required to come to confirmed diagnosis. In the present study, we observed that 50% of the cases having history of burning feet and positive Tinel's sign showed no abnormality in conduction study of medial plantar nerve. However, in the remaining 50% patients, we found (i) prolonged distal motor latency, (ii) decreased amplitude of M-response, (iii) prolonged distal sensory response and (iv) low amplitude sensory nerve ac-

tion potentials. The probable patho-physiological explanation given by some researchers for the observed changes are that there are mainly two mechanisms involved (a) metabolic theory: when blood glucose is high it enters the nerve and gets converted to sorbitol which attracts water leading to nerve swelling and cause damage to the nerve. (b) Transport theory: the reason for nerve swelling is related to the transport system with the diabetic nerve [8]. The swelling causes compression that damages the cell membrane of the nerve leading it to the impairment of rebuilding of protein, tubulin, which is transported inside the cell. The results of the present study facilitate the diagnosis of tarsal tunnel syndrome which may be helpful in the management of diabetes mellitus associated nerve entrapment. As this nerve is analogous to the median nerve in hand, hence it will not be out of place to select the medial plantar nerve for diagnosis of tarsal tunnel entrapment.

References

- [1] Keck C. The tarsal tunnel syndrome. *J Bone Joint Surg* 1962;44:180–4.
- [2] Lam SJS. A tarsal tunnel syndrome. *Lancet* 1962;2:1354–5.
- [3] Von Malaise. Zur Pathologie der Plantar nerven. *Dtsch Z Nervenheilk* 1918;58:89–104.
- [4] Mondelli M, Morana P, Padua L. An electrophysiological severity scale in tarsal tunnel syndrome. *Acta Neuro Scand* 2004;109(4):284.
- [5] Trepman E, Kadel NJ. Effect of foot and ankle position on tarsal tunnel compartment pressure. *Foot Ankle Int* 2000;20(11):721.
- [6] Daniels TR, Lau JT, Hearn TC. The effect of foot position and load on tibial nerve tension. *Ankle Int* 1998;19(2):73–8.
- [7] Antunes AC, Nobrega JA, Manzano GM. Nerve conduction study of the medial and lateral plantar nerves. *Electromyogr Clin Neur* 2000;40:135–8.
- [8] Parker RG. Diabetes and nerve compression. *The Dellon Institute for Peripheral Nerve Surgery*; 2007.