**FEMORAL MOTOR NERVE CONDUCTION STUDY - A NOVEL TECHNIQUE FOR EALRY DETECTION OF DIABETIC PERIPHERAL NEUROPATHY**

**Andrew John Silvester .S, School of Allied Health Sciences, Aarupadai Veedu Medical College & Hospital Campus, Puducherry, Vinayaka Mission’s Research Foundation –DU, Salem,**

**ABSTRACT**

Femoral Motor Nerve Conduction study is the most sensitive test for detecting both clinical and subclinical neuropathies in persons with diabetes. In this chapter, the conduction of the femoral motor nerve conduction method and its abnormalities is compared in type 2 diabetic patients. In diabetic individuals femoral nerve conduction abnormalities has been identified. This chapter unveils use of femoral nerve conduction study in diabetes mellitus can be included as a routine study along with electrophysiological testing and thereby increase the sensitivity of the diagnosis of Diabetic peripheral neuropathy.

**INTRODUCTION**

**DIABETIC PERPIHERAL NEUROPATHY**

A disorder that affects the peripheral nervous system in a wide range is peripheral neuropathies. It is one of the most common forms of neurological disorders and the incidence of neuropathies is widely increasing because of the increasing prevalence of diabetes and obesity [1]. The signs and symptoms of peripheral neuropathies can vary from one individual to another. Some of the common symptoms include burning and tingling [2]. The diagnosis involves a variety of assessment some of which includes monitoring the response of the nerves and the use of nerve conduction studies and electromyography. The treatment and management focuses mainly on managing the symptomatic issues of neuropathy [3].

Diabetic neuropathy most often involves the autonomic system and since it is dependent on length, it generally affects the feet first [4]. The assessment of whether neuropathic pain is associated with diabetes mellitus is of importance for the treatment and management options [5]. Sometimes a number of events can lead to mild to moderate weakness in the distal upper and lower limbs thus, a syndrome known as symmetric sensory-motor diabetic peripheral neuropathy [6].

Another form of neuropathy that is related to diabetes mellitus is femoral neuropathy. The femoral nerve, it courses through the psoas muscle and lies beneath the iliacus muscle. The femoral nerve travels into the leg under the inguinal ligament approximately halfway between the anterior superior iliac spine and the pubic tubercle [7]. The anterior division innervates the skin over the anterolateral thigh and also supplies the pectineus and sartorius muscles. The posterior division innervates the hip and knee joints, supplies the quadriceps muscle and terminates as the saphenous nerve [18]. Along the course of the nerve it can be compressed anywhere, but within the body of the psoas muscle, at the iliopsoas groove, and at the inguinal ligament it is particularly susceptible [8].

Femoral neuropathy is characterized by weight loss, abrupt onset of pain, wasting of the legs, asymmetric proximal weakness and atrophy. The progression of it commonly involves the more distal lower-limb segments and the other lower limb [9]. In the diagnosis of femoral neuropathy, the femoral nerve conduction anomaly is distinct. It is usually necessary to perform a thorough examination of nerves and muscles in upper and lower limbs, in the related paraspinal muscles. Depending on the abnormalities noted additional extremities may need to be examined to appreciate fully the extent of both clinical and subclinical neural insults. The changes in the conduction of the femoral nerves in diabetic patients in India have to be determined. In the present study the conduction time in the femoral nerve in patients with diabetes mellitus with and without neuropathy compared with normal subjects. The femoral nerve conduction in diabetic patients may help us to establish the site of changes in the nervous system suffering with or without neuropathy.

**NERVE CONDUCTION STUDIES**

Nerve Conduction Study (NCS) is commonly used noninvasive procedure to asses the functions of motor and sensory nerves. Skin will be cleaned; electrodes will be placed to the skin along the nerves selected for the procedure. Small electrical stimulus is applied (electric current) that activates the nerves. The electrodes will measure the current that travels down the nerve pathway. If the nerves are damaged, the current will be slower (delayed) and weaker (reduced). This value called latency and measured in milliseconds (ms).The size of the response called the amplitude and measured in millivolts (mV). The procedure takes about 30-90 minutes approximately. No reported complication from the procedure except feeling discomfort from electrical current, but slightly painful. It is a non-invasive procedure.

**FEMORAL MOTOR NERVE CONDUCTION**

**RECORDING ELECTRODES**

Femoral Motor Nerve Conduction study recording are performed with surface electrodes. The majority of motor evoked responses are of sufficient amplitude to be easily detected with surface electrodes. Of course, in pathologic situations, should a response not be observed with surface electrodes.

**Ra (Active Electrode):**

An **Ra** recording is located over the mid-portion or most prominent aspects of the vastus medialis muscle. If an initial positive deflection is observed with neural excitation, E-1 may need to be repositioned slightly in order to generate a negative deflection from the baseline.

**Rr (Reference Electrode):**

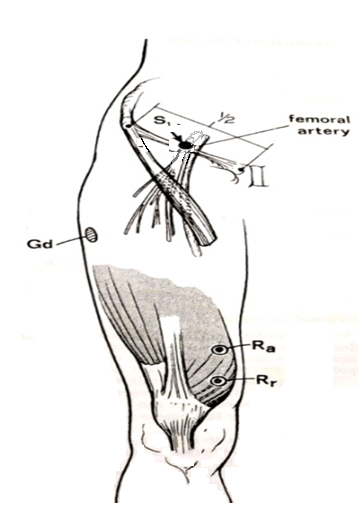
**Rr** is most conveniently secured to the patella or 2-3cm proximal to the active Ra electrode, as this is a relatively electrically silent region.

**Ground (Gd):**

Surface ground electrode placed between simulation and Recording active electrode.

**STIMULATION**

Surface stimulation **(S)** is used for femoral nerve conduction (Fig.1). Although a surface cathode/anode is convenient for the practitioner, the deep location of the nerve may require high current intensities and pulse durations. These possibilities can result in a rather uncomfortable examination for the patient. Should the patient have difficulty tolerating the stimulation, a needle cathode should be considered, as less current intensities are necessary because the cathode is positioned next to the femoral nerve. In this instance, a surface anode located several centimeters more proximal is used.



**Fig 1: Femoral Motor Nerve Conduction Study**

The femoral artery is located in the inguinal, and a site 1 to 2 cm lateral to the artery is used for the stimulation site. The separation between the two proximal cathodal stimulation points should approximate 5 to 6 cm. The total length of the femoral nerve between the proximal stimulation site and E-1 was noted to be 35.4± 1.9 cm [10] [11]. The instrumental parameter comprised of HFF - 2 Hz, LFF - 10 kHz, Sweep - 5 ms, Duration - 1 ms, Intensity - 60 – 100 µV, Gain- 2000- 5000 µV /cm and Sensitivity - 5 mV [18].

**FEMORAL MOTOR NERVE CONDUCTION CHANGES IN DIABETIC PERIPHERAL NEUROPATHY**

In a study by O’Hare JA, Abuaisha F, Geoghegan M diabetic patients, femoral neuropathy is not common, femoral neuropathy was seen at a level of 0.3% in type 1 diabetes and 1.1% in type 2 diabetes [12] [19]. Bastron JA, Thomas JE study suggested in a large series of 105 patients with femoral neuropathy, the age of onset ranged from 36 to 83 years, and symptoms progressed over an average of 6.2 months, with 9.5% of patients having painless muscle weakness [13]. Focal endoneural infarctions were reported in major proximal nerve trunks and lumbosacral plexus, indicating an ischemic pathogenesis of these neuropathies given by Said G, Lacroix C, Lozeron P, Ropert A, Planté V, Adams D [14] [19]. In a morphological study by, it was found that the pathology of proximal nerves varied with the clinical aspects of the neuropathy. The study of Said G et al and Coppack SW, Watkins PJ consisted of biopsy specimens of the intermediate cutaneous nerve of the thigh (a sensory branch of the femoral nerve) [15] [16] [19].

The femoral nerve conduction abnormalities become more evident. In other words, when the polyneuropathy of the patients becomes severe these abnormalities become prominent. This leads to the possibility that as the polyneuropathy becomes more severe there might be the involvement of the proximal nerves. Without diabetic distal symmetric polyneuropathy, clinical diabetic femoral neuropathy may even be seen. This leads to controversies in the diagnosis of clinical diabetic femoral neuropathy regarding the importance of abnormalities in femoral nerve conduction. In their study where they diagnosed polyneuropathy according to clinical findings, determined that femoral latencies of the patients with and without polyneuropathy as longer than those of the control group [17] [19].

**CONCLUSION**

The evidence proves that the neuropathy develops as an integral part of the metabolic disturbance rather than as a consequence of the vascular complications of diabetes. Femoral motor nerve conduction abnormalities have been determined in diabetics who clinically did not have femoral nerve involvement. Femoral nerve abnormalities are seen in diabetic patients without diabetic neuropathy. Femoral motor nerve conduction study in diabetes mellitus can be included as routine study along with other nerve conduction studies and thereby increase the sensitivity of the diagnosis of Diabetic peripheral neuropathy.

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