Original Article

Role of Pain-Related Evoked Potential in the Diagnosis of Meralgia Paresthetica

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Abstract

Introduction: Entrapment of the lateral femoral cutaneous nerve (LFCN) of thigh results in meralgia paresthetica (MP). Standard electrophysiological tests for MP are technically demanding and unreliable. We aimed to study the role of pain-related evoked potentials (PREP) in the diagnosis of MP. **Methods:** Patients with MP and normal volunteers were included. PREP was recorded by stimulating the skin over the lateral thigh 20 cm below the anterior-superior iliac spine and recording from the cortex at Cz. **Results:** A total of 28 subjects and 56 LFCNs were studied. 36 nerves had MP and 20 were normal. The mean PREP latency was 118 (8) ms among normal controls and 164 (10.8) ms in MP. The optimal cut-off point for the diagnosis of MP was 134 ms. Area under receiver operator characteristic curve was 0.97; sensitivity was 91.7% and specificity was 100%. **Conclusion:** PREP is reliable and easy to use electrophysiological test in establishing the diagnosis of MP.

Keywords: Diagnosis, evoked potential, lateral femoral cutaneous nerve of thigh, meralgia paresthetica, pain-related evoked potential

Introduction

Meralgia paresthetica (MP) is a common neurological condition that presents with pain, tingling, and numbness along the lateral aspect of the thigh due to entrapment of the lateral femoral cutaneous nerve (LFCN) of the thigh.[1] The nerve arises from the dorsal branches of L2 and L3 nerve roots as a part of lumbar plexus and leaves the lateral edge of the psoas major muscle, crosses anterior superior iliac spine and fascia of iliacus muscle then passes below the inguinal ligament and then divides into anterior and posterior division. Anterior division gives cutaneous innervation to the anterior part of the thigh and the posterior division to the lateral aspect of the thigh.[2] The site where the LFCN crossed the inguinal ligament is most pronounced site of entrapment.[3] As LFCN is a pure sensory nerve, its entrapment results in pain, numbness, and tingling of the lateral thigh. Different etiologies like obesity, pregnancy, diabetes mellitus, prolonged stretching or use, surgery of lower abdomen can result in MP.[1,4] MP still remains a diagnostic challenge since it can mimic other common diagnoses and electrophysiological testing of the LFCN using nerve conduction studies and somatosensory evoked potentials can be technically difficult.[1] Pain-related evoked potentials (PREP) is an established electrophysiological method to evaluate the signal transmission of electrically stimulated A-delta fibers and is currently underutilized.[5] In this study, we aimed to study the utility of PREP in making a diagnosis of MP.

Methods

The study was approved by the Institutional review board and Ethics committee of Christian Medical College Vellore. Patients with a clinical diagnosis of MP and normal volunteers were recruited from the Neuro electrophysiology lab after obtaining informed consent. All the subjects underwent routine nerve conduction studies to exclude other peripheral neuropathies and also the femoral motor nerve conduction and saphenous sensory nerve conduction to exclude other etiology for similar symptoms such as lumbar radiculopathy and lumbosacral plexopathy. Patients with a peripheral neuropathy were excluded from the study.

Patients with a diagnosis of MP which was confirmed by an experienced neurologist after investigations, including electrophysiological testing and neuroimaging studies, were included as cases. Normal volunteers willing to undergo nerve conduction studies were included as controls after informed consent. For all electrophysiological testing, the participant was asked to lie supine comfortably on a bed. Prior to the placement of electrodes, the application sites were thoroughly cleaned with rubbing alcohol. The laboratory temperature was maintained at 22°C ± 2°C. Femoral nerve studies were performed with concentric surface electrodes. Supramaximal stimulation was done at the inguinal ligament and recording

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was done with G1 being placed over the vastus lateralis muscle and G2 over the tendon of the muscle. Ground was placed near to the recording electrodes.[6] Saphenous nerve conduction studies were performed with the recording electrode (G1) placed just anterior to the anterior border of medial malleolus, G2 being placed located 3.0 cm distal to the recording electrode along the saphenous vein. The stimulation site was 15 cm above the recording electrode along the medial border of the tibia.[7] PREP was recorded using surface electrodes placed at one scalp site, Cz according to the International 10-20 system for electroencephalogram; reference electrode was placed over FPz and ground was placed on the earlobe [Figure 1]. Stimulation was done on the lateral aspect of the thigh 20 cm below the anterior superior iliac spine (ASIS). Four to five trials were performed and averaged using the Nicolet EDX EMG system (Natus Medical Incorporated, San Carlos, CA USA). The signals were filtered at 1 Hz–1 kHz. Eye blinks and ocular movements or any raw signal exceeding 70 μV were excluded.[5] Stimulation was done using a custom-built concentric surface electrode with a central cathode (diameter 0.5 mm) and an external anode ring (diameter 6 mm) as used by Kaube *et al*.[8] This method has previously been used effectively to record PREP signals.[5] Stimulation with the custom made concentric surface electrode produced a pinprick-like painful sensation. In all participants, stimulation was started with the current at 0 and the amplitude of the current was gradually increased till the subject experienced the first painful stimulation. This was taken as the pain threshold for that participant. The average pain threshold for the participants was 0.8 ± 3.2 mA. The stimulation current for the PREP experiment was set at 1.5 times that of the pain threshold. In all the participants, PREPs was obtained by averaging at least 4–5 trials. The N2-P2 complex was studied on Cz, the recording site, at the vertex. Onset latencies and amplitudes (peak to peak) of the N2-P2 complex was measured.[5] Data was entered and analyzed using SPSS version. 15.

Results

A total of 18 subjects and 10 normal controls were included. Twelve subjects were female and sixteen were male. The mean age of the subjects was 41.5 (13) years. The mean body mass index was 31 (5.2). Ten of the patients had unilateral numbness and pain while eight had bilateral symptoms. A total of 56 lateral cutaneous femoral nerves were studied. Twenty-six nerves had an established diagnosis of MP and thirty were normal. Routine nerve conduction studies, femoral compound muscle action potential, and saphenous sensory nerve action potentials were normal in all the subjects. The subjects' characteristics and results of the PREP recordings are given in Table 1. Among the normal nerves, the mean PREP latency was 118 (8) ms and the mean PREP amplitude was 27 (13) μV. In the nerves with MP, the mean PREP latency was 164 (10.8) and the mean PREP amplitude was 16 (10) μV. Receiver operator characteristics (ROC) curve analysis was done using the PREP latency and the area under the curve was 0.97. To make a diagnosis of MP, the optimal cut-off point identified was 134 ms. At this cut-off point, the sensitivity was 91.7% and specificity was 100.0% [Figure 2]. ROC curve analysis using PREP amplitude showed an area 0.75 and at an optimal cut-off point of 20 μV, the sensitivity was 63.9% and specificity was 70%.

Discussion

Though MP is a common neurological problem, clinical tests to evaluate MP including the pelvic compression test and the

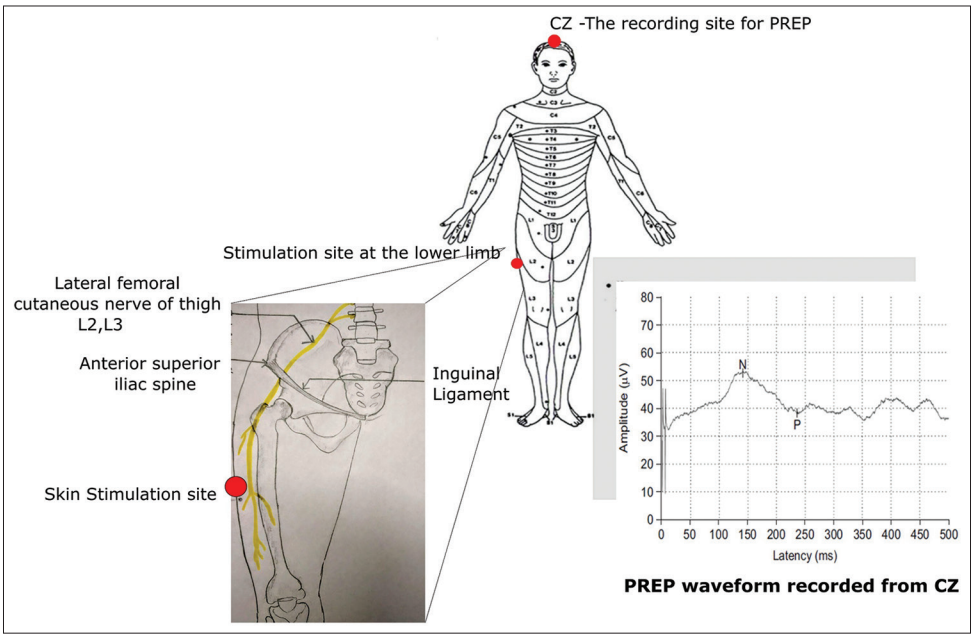

Figure 1: Recording of pain-related evoked potentials in patients with meralgia paresthetica

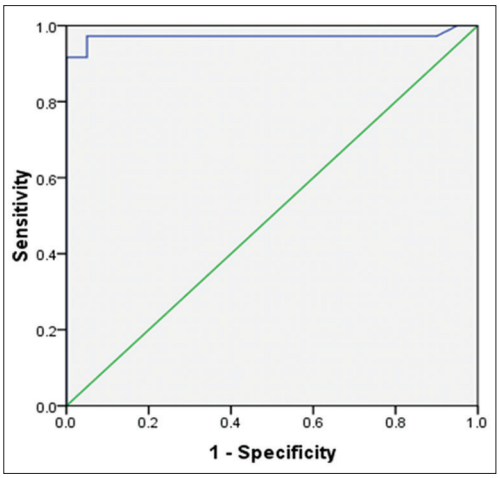

Figure 2: Receiver operator characteristics curve for the diagnosis of meralgia paresthetica based on PREP latency. ROC curve analysis using the PREP latency showed an area under the curve of 0.972. To make a diagnosis of meralgia, the optimal cut-off point identified was 134 ms. At this cut-off point, the sensitivity was 91.7% and specificity was 100%

Table 1: Characteristics of subjects and results of pain-related evoked potentials in normal subjects and patients with meralgia paresthetica

	Total	Normal	Meralgia Paresthetica
Number of subjects	28	10	18
Age Mean (SD)	41.5 (13)	36.7 (6.7)	43.1 (2.4)
Gender Male/female	19/9	7/3	12/6
Diabetic	5 (17.9)%	-	5 (27.8%)
Hypertensive	3 (10.7%)	-	3 (16.6%)
Obesity	20 (71.4%)	3 (30%)	17 (94.4%)
Hypothyroidism	5 (17.9%)	-	5 (27.8%)
Pain score (VAS)			3.2 (1.3)
Number of nerves studied	56	30	26
PREP amplitude Mean (SD)	20.3 (12.7)	27.7(13.5) μV	16.2(10.4) μV *P*=0.001
PREP latency Mean (SD)	163.8 (54.9) ms	118.4 (8) ms	189 (53.5) ms *P*=0.001

PREP=Pain-related evoked potentials, SD=Standard deviation

femoral nerve neurodynamic test are not reliable. Bedside tests using nerve blocks using lidocaine or procaine are effective, but depend on local anatomy which can be variable.[9] Hence, there is a need for further diagnostic testing in cases where these clinical tests do not confirm the diagnosis. Nerve conductions studies, somatosensory evoked potentials, high-resolution ultrasound, and magnetic resonance imaging have been used to make a diagnosis of MP.[1] However, to our knowledge, this is the first study to use PREP in making a diagnosis of MP.

In this study, we are able to record PREP from patients with MP and show that PREP latency can be used to make an electrophysiological diagnosis of MP. Our study shows that this test can be performed easily and reliably in obese patients which could be technically difficult in other electrophysiological methods.[10,11] When compared against the diagnosis made by an experienced neurologist, which was taken as the gold standard for this study, PREP latency was found to have a sensitivity was 91.7% and specificity of 100%. This fares better than the other electrophysiological methods such as somatosensory evoked potentials (81.3% sensitivity) and sensory nerve conduction (65.2% sensitivity).[1,11,12] Magnetic resonance neurography (MRN) has been used previously for the diagnosis of MP, but requires a high-level knowledge of the local anatomy and is placed at a substantially higher cost.[13] In a study by Chhabra *et al.* on MP using MRN, the diagnostic accuracy was around 90% and the sensitivity was only around 71%.[13] As ultrasound examination of the peripheral nerves has become more popular, screening of LFCN could be done to establish MP. Detection of a fusiform nerve swelling and nerve flattening under or within the ligament are used to make a diagnosis of MP.[14] However, there is limited data on its diagnostic utility.[14] The limitations of this study include a small size and absence of a definite gold standard. In addition, the normative values and the cut-off points may vary with each laboratory and we suggest that each lab should establish its own normative data.

In conclusion, in patients with clinical symptoms suggestive of MP, PREP is a reliable electrophysiological test in establishing the diagnosis of MP. In comparison with the other modalities, it is technically easier to perform, less time consuming, and much cheaper in establishing a diagnosis of MP.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Abbreviations

LFCN: Lateral femoral cutaneous nerve of thigh

MP = Meralgia paresthetica

PREP = Pain-related evoked potentials

ASIS = Anterior superior iliac spine

EEG = Electroencephalogram

BMI = Body mass index

CMAP = Compound muscle action potential

SNAP = Sensory nerve action potential

ROC = Receiver operator characteristics

MRN: Magnetic resonance neurography

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