Subcortical P30 potential following tibial nerve stimulation: detection and normative data

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Stimulation of the tibial nerve evokes a P30 far-field potential over the scalp which, like the median nerve P14, probably originates in the vicinity of the cervico-medullary junction. Unlike the P14 potential, P30 recording has not been systematically performed in clinical practice, probably because of doubts about the generator of the potential and the possibility of consistently recording it on the scalp after the unilateral stimulation of the tibial nerve.
In this study, we tested the reliability of the tibial nerve scalp far-field P30 potential in 34 normal subjects using different montages, of which the Fpz-Cv6 derivation gave the highest signal to noise ratio, making it possible to obtain a P30 potential peaking at 29.2 ± 1.6 msec in all normal subjects. This suggests that this component should be included in the routine recording of tibial nerve SEPs in order to evaluate the spinal and intracranial conduction of the somatosensory pathway separately.

Key Words: Tibial nerve SEPs — Spinal conduction — Intracranial conduction.

Introduction

Posterior tibial nerve somatosensory evoked potentials (SEPs) are usually performed in a standard manner in order to identify and evaluate two principal components a segmental spinal potential (N22) and a cortical potential (P39), the central conduction time being evaluated by measuring the interval between them [2, 14, 15]. However, this doesn’t allow separate study of central conduction in the intramedullary and intracranial segments of the somatosensory pathways.
Using a non-cephalic reference montage, some authors [4, 16, 17, 22] have identified a scalp far-field “P31” potential after tibial nerve stimulation at the ankle, which was presumed to originate in the brainstem. Other investigators have confirmed this finding and labeled the potential P28 [1, 10] or P30 [6, 8, 11, 20, 21]. This potential has a wide distribution over the scalp with a predominance in the frontal region [6, 8], and is therefore abolished in scalp-reference recordings [17]. Using direct brain-stem recordings during surgery [20], have recently documented that the P30 potential shows the same intracranial spatio-temporal distribution as the P14 component of median nerve SEPs, concluding that the P30 and P14 potentials originate in the proximity of the lower brainstem close to the dorsal column nuclei. Unlike the P14 potential, the P30 recording has not been not systematically performed in clinical practice.
This is the more surprising because study of the P30 potential would make it possible to differentiate spinal cord from intracranial conduction, but difficulties in recording the P30 potential on the scalp following unilateral stimulation of the tibial nerve probably account for this underuse.
The aim of this study was to evaluate whether the
P30 potential could be consistently obtained on the scalp of normal subjects and be reliably used in clinical practice.

**Subjects and methods**

Tibial nerve SEPs were recorded in 34 healthy subjects (mean age 39.1 years; range 20-58) while they were lying on a couch in a warm and semi-darkened room. All samples with an excess of interference were automatically rejected from the average (impedance below 5 Kohm). Two averages of 1500 trials each were obtained and drawn out on an X-Y plotter by a computer. The stimuli at motor threshold (0.3-msec square pulses at a rate of 3 Hz) were delivered by skin electrodes (cathode proximal) at the ankle. The bandpass was 1-3000 Hz (−3 dB at cut-off point, 6 dB per octave) with an analysis time of 100 ms and a bin width of 103 μsec. In eleven of the subjects, tibial nerve SEPs were obtained using Fpz, Cv2 (spinous process of the second cervical vertebra) and Cv6 (spinous process of the sixth cervical vertebra) electrode positions referred to the shoulder contralateral to the stimulation. In the others 23 subjects (mean age 38.3 years; range 20-58), a 4-channel montage was used to record the activity of tibial SEPs 1) in the popliteal fossa on the stimulated side (bipolar recording); 2) over the spinous process of the first lumbar vertebra (L1) referred to an electrode placed 2 cm above the umbilicus; 3) at Fpz referred to the Cv6 electrode; 4) on the vertex at Cz' (4 cm behind the international Cz position) referred to the earlobe contralateral to the stimulation.

**Results**

The SEP traces obtained from the eleven normal subjects in whom Fpz activity was recorded using Cv2, Cv6 and shoulder reference electrodes (see Figure 1) showed no significant differences in P30 latencies (Anova p<0.0001) (Table 1). Moreover, no potential peaking in the latency range of P30 was identifiable in the Cv6 or Cv2 traces recorded with a shoulder reference in any of these subjects. There was thus no evidence that cervical activity may contribute towards building the Fpz-Cv6 or Fpz-Cv2 montages, and the recorded P30 potential can be considered as a scalp far-field component picked up by the Fpz electrode.

Since the best signal to noise ratio was obtained using the Fpz-Cv6 recordings, this montage was adopted to assess the P30 potential for normative data. An example of the normal SEPs obtained in the other 23 normal subjects by stimulating the posterior tibial nerve is given in Figure 2.

![Fig. 1. Normal tibial nerve P30 potential.](image1)

**Table 1. P30 latencies (mean and SD) measured at Fpz using Cv2, Cv6 and the shoulder as references (11 control subjects).**

<table>
<thead>
<tr>
<th>Electrode</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fpz-Cv2</td>
<td>28.47</td>
<td>2.41</td>
</tr>
<tr>
<td>Fpz-Cv6</td>
<td>28.67</td>
<td>2.4</td>
</tr>
<tr>
<td>Fpz-Sh</td>
<td>28.72</td>
<td>2.41</td>
</tr>
</tbody>
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Anova = p<0.0001