Research paper

Normative values of semitendinosus tendon reflex latencies

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ABSTRACT

Objectives: The semitendinosus tendon reflex (STR), also known as the medial hamstring reflex, is rarely described in literature and is believed to provide information mainly concerning the fifth lumbar spinal nerve (L5). Latencies can be obtained with clinical neurophysiological tests. Normative data for STR latencies are not available. The aim of this study was to provide normative values of STR latencies. Also we will describe the technique used for performing the tendon reflex measurements in a clinical neurophysiological setting.

Methods: To determine STR latencies, we measured the stimulus (tap with reflex hammer) – response (EMG activity associated with muscle contraction) relation. The stimulus was administered with a manually operated reflex hammer, tipped with electrically conductive rubber, triggering the EMG recording sweep on impact. The EMG response was recorded with surface electrodes placed on the skin overlying the semitendinosus muscle.

Results: Forty healthy subjects participated in the study. The group consisted of 18 women and 22 men with a median age of 30 years. The mean subject body height was 181 cm (SD 8.1). Latencies showed a significant correlation with body height ($r = 0.70, R^2 = 0.48, P < 0.0001$). The mean latency of the STR was 24.73 ms (SD 1.96). The rounded upper limit of normal of individual absolute right–left differences was 2 ms.

Conclusion: We present, as far as we know, the first report on normative values of STR latencies. The STR could be elicited in 100% of our population. The left–right difference seems to be the most promising clinical parameter for diagnostic purposes.

Significance: We think our results can be of practical use for all clinical neurophysiologists/neurologists and may provide the basis for further research on test characteristics of STR latencies in patients with L5 radiculopathy.

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1. Introduction

The patient-friendly technique of the patellar and ankle tendon reflex (PTR, ATR, respectively) is frequently used in clinical and clinical neurophysiological setting. These reflexes give information about peripheral nerve conduction and central excitability mainly at the level of the fourth lumbar spinal nerve (PTR) and level of the first sacral spinal nerve (ATR). The semitendinosus tendon reflex (STR), also known as medial hamstring reflex, is rarely described in literature and is believed to provide information mainly about the level of the fifth lumbar spinal nerve (L5) (Felsenthal and Reischer 1982; Jensen 1987; Perloff et al. 2010; Ngene et al. 2012).

Like the PTR and ATR, the STR consists of a largely monosynaptic reflex arc. Generally, excitation of muscle spindles due to stretch of a muscle will generate an action potential volley. This is conducted along Ia afferent fibres to the dorsal root and subsequently causes depolarization of homonymous alpha motor neurons. The efferent alpha motor fibres conduct the efferent volley through the ventral root back to the muscle. This produces a reflex muscle contraction counteracting the initial stretch.

Tendon reflex responses can be obtained with simple clinical neurophysiological tests. Normative data for our laboratory regarding the PTR and ATR have been published in 1997 (Frijns et al., 1997). Normative data for STR latencies are not available.

In the present study we present normative values for latencies, amplitudes and inter-side differences of the STR in forty healthy volunteers. Also we will describe the technique used for performing the tendon reflex measurements in a clinical neurophysiological setting.

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2. Methods

2.1. Characteristics of subjects

After informed consent, volunteers were included if they were older than 18 years and did not suffer from any disorder interfering with normal tendon reflexes (for example lumbosacral radiculopathy, polyneuropathy or an upper motor neuron disease).

To ensure there were no disorders interfering with normal tendon reflexes, a standardized medical history was taken. Also we performed a neurological examination including muscle strength of the legs, sensation of vibration and tendon reflexes in the legs (PTR and ATR). The local ethic committee reviewed and approved the study.

2.2. Recording technique

Volunteers were asked to lie in a prone position; both legs passively slightly bent in the knees (angle of 150 degrees), supported by a bedroll underneath the ankles. To obtain STR tendon reflex responses, the stimulus was administered with a custom made manually operated reflex hammer, tipped with electrically conductive rubber. Through a conductive wire, the hammer was connected to the trigger input of the EMG machine (Synergy Nicolet EDX EMG system). On contact with the (electrically grounded) patient, the impact of the hammer triggered the EMG recording sweep. The characteristics of this hammer have been described earlier (Frijns et al., 1997). The EMG response was recorded with surface electrodes placed on the skin overlying the semitendinosus muscle. The active electrode was placed in the middle of the belly of the semitendinosus muscle halfway between the gluteal fold and the popliteal fold. The reference electrode was placed 5 cm distally. A tap with the reflex hammer on the semitendinosus tendon near the popliteal fold evoked the reflex. This muscle tendon is sometimes difficult to access, comparable with the biceps brachii tendon. Therefore, we used a metal bar between the tendon and the reflex hammer (see Fig. 1A). For each leg a total of four measurements were done with varying force of the tap in which we strived for maximum response amplitude without creating a mechanical artefact.

Latencies were measured from stimulus to the first negative deflection from baseline. Amplitudes were measured from peak to peak (see Fig. 1B). In order to ensure that there were no confounding artefacts (e.g. sinusoidal wave artefacts), we displayed a pre-stimulus time-interval of one division (5 ms). Filter settings were 20 Hz–2 kHz. Sweep duration was 50 ms and sensitivity 500 μV per division. All the test sessions were performed by the same investigator (JW). Room temperature was kept at a constant temperature of 22 degrees Celsius; the body temperature was not measured.

2.3. Statistics

For the statistical calculations and graphics we used IBM SPSS Statistics version 21 with Pearson correlation coefficient and linear regression tests. Firstly, we ascertained that the group mean results of the left and right leg were not significantly different. Variables given, unless otherwise stated, are values of the left leg. For calculations we used latencies of responses with maximum artefact free amplitude. The normal distribution of latencies and amplitudes was ascertained with use of the Shapiro-Wilk test.

3. Results

Of a total of 40 healthy volunteers, all enrolled in the study. On routine neurological examination there were no volunteers with decreased strength, absence of vibration sense or abnormal PTR or ATR. The group consisted of 18 women and 22 men with a median age of 30 years (range 23–64; first quartile = 28.0 and third quartile = 31.8). The mean subject body height was 181 cm (range 166–200 cm; SD 8.1).

Results of mean values of latencies, amplitudes and mean of the individual differences between right and left are shown in Table 1.

Pearson correlation coefficients of tendon reflex latencies with body height are presented in Table 2 and Fig. 2. Correlation coefficients for left and right were 0.17 and 0.16, respectively (all P values < 0.0001). R² was 0.48 and 0.46 respectively. After correction for outliers (>2.5 SD) correlation coefficients were not significantly different.

One sample T test revealed no significant left–right latency difference:

\[ T(39) = -0.144, p = 0.886 \]

Differences between left and right latencies were normally distributed (mean 0.02; SD = 0.75). The 2.5 SD upper limit of normal absolute right–left difference was 1.88 ms. These results are presented Fig. 3.

Table 1

|               | N  | STR left | STR difference right–left |
|---------------|----|----------|---------------------------|
| Latency (ms)  | 40 | 24.73 (1.96) | 0.02 (0.75) |
| Amplitude (mV)| 40 | 2.87 (1.18)  | 0.20 (1.70)  |
4. Discussion

Although latencies showed a significant correlation with body height, the high residual variance, unexplained by body height, makes latency values less useful for diagnostic purposes. The rounded upper limit of normal of absolute right–left differences was 2 ms. This seems to be a helpful cut-off value in daily practice.

One of the advantages of reflex latency measurements is that it may be of diagnostic benefit in the acute stage of a peripheral nerve lesion. This in contrast to nerve conduction- or myography studies, which are normal at this stage and show abnormalities only after the emergence of Wallerian degeneration in days-weeks.

A prolonged absolute right–left difference of STR latency, or absence of the STR on the symptomatic side, could be informative in suspected isolated ischiadic neuropathies or L5 radiculopathies.

Earlier reports on L5 innervated muscle tendon reflexes such as the phasic stretch reflex of the tibialis anterior muscle (TAR) and medial hamstring reflex, support the value of these reflexes in the diagnosis of L5 radiculopathies, especially in the presence of a normal symmetric ATR. The TAR has its limitations, as it can be elicited only in 70–83% of healthy subjects (Felsenthal and Reischer 1982; Jensen 1987; Stam 1988).

In our study, the STR could be elicited in all volunteers. Also the semitendinosus muscle is less vulnerable to interfering peripheral nerve damage (i.e. tibialis anterior weakness in peroneal nerve damage).

5. Conclusion

This is, as far as we could determine, the first published report on normative values of semitendinosus tendon reflex latencies. The STR could be elicited in 100% of our population. The left–right difference seems to be the most promising clinical parameter. We believe the STR may be of practical use for clinical neurophysiologists/neurologists in a clinical setting. Our data may provide a basis for further research on test characteristics of STR latencies in L5 radiculopathies.

Conflict of interest

None for all authors.

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