AARHUS UNIVERSITY

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Perception Threshold Tracking - A Novel Method to Assess Small Fiber Function

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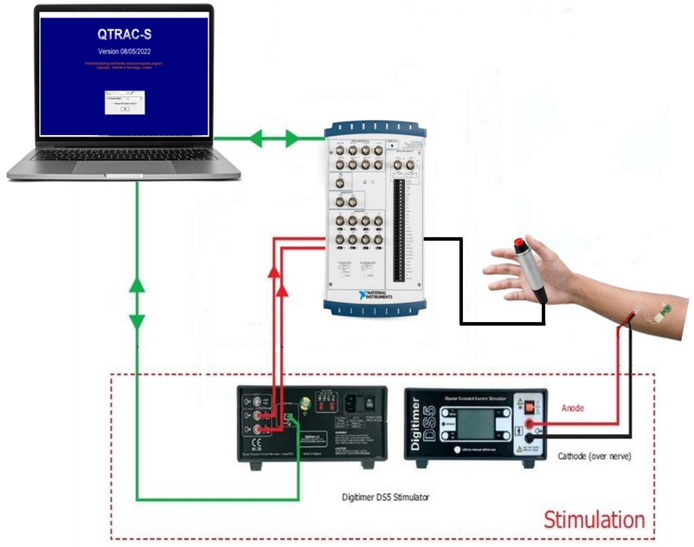
Background and aims

Nerve excitability testing (NET), using threshold-tracking methods, provide complementary information to conventional nerve conduction studies and may be used to investigate ion channel functions, the activity of energy-dependent pumps as well as ion exchange processes, which are important for understanding pain mechanisms. Typical NET predominantly assays Aβ fiber function, but a method examining Aδ and C fibers would be of great interest, particularly from a pain perspective. Here, we utilized perception threshold tracking (PTT), an adapted version of the conventional NET protocol, to test sensory nerve function. This population of fibers is presumed to include a significant proportion of thinly-myelinated Aδ-fibers activated by weak currents delivered using multipin electrodes. In this study, we aimed to examine the reliability of PTT compared to motor and sensory NET.

Methods

Eighteen healthy subjects (18-49 years) were examined three times with motor and sensory NET and PTT - morning and afternoon sessions on the same day (intra-day reliability) and once again after at least a week (inter-day reliability). Motor NET (MNET) and sensory NET (SNET) were performed on the median nerve using Qtrac software. The perception threshold was estimated by increasing the intensity of repeated stimuli through a multipin MRC electrode until the subject felt the stimulus, which was indicated by pressing a button. The intensity of the current was then automatically stepped up/down using Qtrac software allowing changes in the perception threshold to be tracked during strength-duration time constant (SDTC) and threshold electrotonus (TE) protocols.



Results

The coefficient of variation for the SDTC, was excellent for MNET (intra-day: 6%, inter-day: 7%) and SNET (intra-day: 9%, inter-day: 11%) while PTT showed acceptable reliability (intra-day: 22%, inter-day: 25%). For the TE parameters, MNET and SNET showed good to excellent reliability (range: 2-18%), but the reliability for PTT was poor (30%).

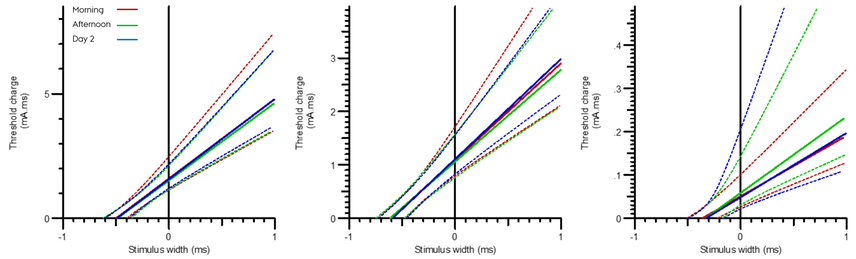


Figure 1. Strength duration relationship, mean ± SD

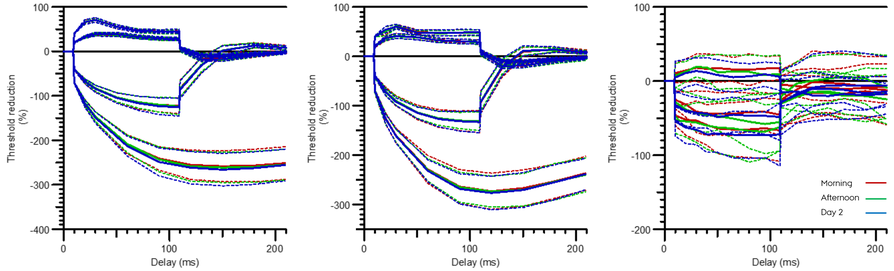


Figure 2. Threshold Electrotonus, mean ± SD

Variable Name	COV	
	Intra-day *Value±SE*	Inter-day *Value±SE*
Strength-duration\time constant (ms)	6.7 ± 1.9	7.1 ± 1.3
Rheobase (mA)	15.1 ± 5.4	18.6 ± 5.0
TEh(90-100ms)	3.7 ± 0.8	4.6 ± 0.8
TEd(10-20ms)	1.3 ± 0.3	2.3 ± 0.4
TEd(40-60ms)	1.9 ± 0.5	4. ± 0.6
TEd(90-100ms)	2.0 ± 0.6	4.4 ± 0.9
TEh(10-20ms)	2.0 ± 0.5	2.5 ± 0.4
TEd(undershoot)	11.8 ± 3.0	11.0 ± 1.8
TEh(overshoot)	11.4 ± 2.6	18.1 ± 4.2
TEd(peak)	1.3 ± 0.3	2.5 ± 0.4
S2 accommodation	3.7 ± 0.9	6.0 ± 0.9
Accommodation half-time (ms)	3.6 ± 1.0	4.8 ± 1.0
TEh(20-40ms)	2.3 ± 0.5	2.7 ± 0.6
TEh(slope 101-140ms)	6.2 ± 1.4	5.2 ± 1.3
TEd20(peak)	2.6 ± 0.7	3.5 ± 0.6
TEd40(Accom)	3.6 ± 0.8	5.8 ± 0.8
TEh(peak,-70%)	3.5 ± 0.7	3.9 ± 0.7
S3(-70%)	62.7 ± 15.3	74.9 ± 11.0
TEd20(10-20ms)	2.8 ± 0.7	2.9 ± 0.6

Motor NET

Variable Name	COV	
	Intra-day *Value±SE*	Inter-day *Value±SE*
Strength-duration\time constant (ms)	9.4 ± 1.9	11.4 ± 2.1
Rheobase (mA)	13.5 ± 4.7	19.7 ± 4.8
TEh(90-100ms)	4.7 ± 0.8	4.8 ± 0.8
TEd(10-20ms)	4.1 ± 1.3	4.7 ± 1.2
TEd(40-60ms)	3.3 ± 0.5	2.9 ± 0.4
TEd(90-100ms)	3.6 ± 0.9	3.3 ± 0.7
TEh(10-20ms)	3.8 ± 0.7	3.2 ± 0.5
TEd(undershoot)	8.5 ± 1.8	10.3 ± 2.3
TEh(overshoot)	14.6 ± 2.9	12.0 ± 2.3
TEd(peak)	2.5 ± 0.6	2.5 ± 0.5
S2 accommodation	29.2 ± 06.6	22.4 ± 6.2
Accommodation half-time (ms)	20.5 ± 5.2	21.6 ± 5.4
TEh(20-40ms)	3.2 ± 0.5	3.6 ± 0.7
TEh(slope 101-140ms)	6.1 ± 1.1	6.1 ± 1.1
TEd20(peak)	5.1 ± 1.3	3.9 ± 0.7
TEd40(Accom)	17.8 ± 2.9	15.5 ± 3.6
TEh(peak,-70%)	4.1 ± 0.8	4.3 ± 0.8
S3(-70%)	22.8 ± 4.3	18.9 ± 3.4
TEd20(10-20ms)	5.2 ± 1.5	4.3 ± 0.8

Sensory NET

Variable Name	COV	
	Intra-day *Value±SE*	Inter-day *Value±SE*
Strength-duration\time constant (ms)	22.8 ± 5.6	25.8 ± 4.5
Rheobase (mA)	25.6 ± 5.8	25.9 ± 4.7
TEh(90-100ms)	97.7 ± 45.7	97.1 ± 64.6
TEh(10-20ms)	30.9 ± 10.7	31.5 ± 8.8
TEh(overshoot)	60.3 ± 10.5	64.7 ± 15.1
TEh(20-40ms)	57.0 ± 29.9	58.1 ± 27.7
TEh(slope 101-140ms)	36.3 ± 30.3	40.6 ± 24.0
TEd20(peak)	32.2 ± 7.2	31.0 ± 7.6
TEd20(10-20ms)	132.6 ± 211.8	49.8 ± 60.1
TEh20(10-20ms)	33.5 ± 7.7	28.4 ± 6.6

PTT

IMI-PainCare
BIOPAIN Functional pain biomarkers in healthy subjects and animals
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Conclusions

PTT is a novel method for the assessment of impairment of small sensory fibers, as seen in pain. However, the reliability is poorer than sensory and motor NET, which are known to have excellent reliability. Further studies are needed for technical improvement particularly TE parameters.

We have no conflict of interest.