

Study on Normal Nerve Conduction Parameters

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- Abstract -

Background and Aims : Nerve conduction study is invaluable in clinical neurology, especially for assessing peripheral neuropathies. Abnormal nerve conduction studies may result not only from peripheral nerve dysfunction itself, but also from other various mechanical, technical, and physiological factors such as age, sex, height and temperature. So we conducted this study to establish the our own normal values.

Methods : In this study, from March. 1997 to July. 1998, 40 Korean adults among person came to Health Promotion Center over the age of 20 without any suspicion of neurological deficits were analysed to determine the effect of compound effects of several physiological factors.

Results : The nerve conduction velocities of the upper extremity and proximal segments were faster than those of the lower extremity and distal segments. Physiological factors such as age, height and temperature affect the results of nerve conduction studies in multiple regression analysis. The sex difference is recognized over peroneal motor nerve. There are no sex differences in amplitude transformed into normal distribution. The significant physiological factor affecting the amplitude of nerve conduction is age, whereas height and temperature play no role.

Conclusions : In multiple regression analysis, height is widespread variable for the nerve conduction velocities and temperature is important variable for lower extremities. The parametric statistical analysis cannot be applied to the amplitude of the compound muscle or nerve action potentials because of marked left shift in distribution. Sqareroot transformation of the CMAP and CNAP may be useful in normalizing the distribution. The most significant physiological factor affection the amplitude is age. Sex differences are not seen in nerve conduction study.

Key Words : Nerve conduction study, Sex, Age, Height, Temperature

(nerve conduction study, NCS)
1). NCS (quantitative data)
() (qualitative concept)
NCS 가 ,

:

가 . 가 20) 39.3 , 39.8
 가 170.4cm 157.0cm
 13cm가 .

2)

3,4) . NCS
 가

2.

가
 가 20 NCS

가 NCS (median nerve) (ulnar nerve)
 , (peroneal nerve),
 4 (posterior tibial nerve) (sural nerve)

가 (TECA) . NCS

가 , 가
 가 (finger-wrist, F-W) (ortho-
 dromic method) ,

NCS (antidromic method)
 가가 (mixed nerve) NCS
 (wrist-elbow, W-E)

5)

가
 NCS
 (abductor pollicis brevis, APB)
 (antecubital fossa) (abductor
 digiti quinti, ADQ)

(supramaximal stimula-
 tion) ,

1.

NCS가 (compound muscle action poten-
 tial, CMAP) (compound nerve
 action potential, CNAP)
 NCS CMAP
 CNAP

(radiculopathy)

$$= \frac{\text{(mm)}}{\text{(msec)}}$$

20

$$= \frac{\text{(mm)}}{\text{(msec)}}$$

1997 5 1998 7

40 (20, tive peak) (positive peak) (nega-
 CNAP

microvolt , CMAP millivolt (Table 3).
Cantata(Dantec)

Table 1

SPSS 8.0 package
p 0.05

2.

(parametric test)
(transformation)
CNAP CMAP
(Table 4, Fig 1,2).

1.

Table 2

(Table 5).
(multiple regression analysis)

(multiple regression analysis)
가

(Table 6).

가

NCS

Table 1. Conditions of nerve conduction study

	Motor nerve	Sensory and Mixed nerve
Filter(Hz)	2-10,000	20-2,000
Sweep time(msec/div.)	5	2
Sensitivity	2-5 mV/div.	10-50 μ V/div.

^{1,6)} NCS

가

Table 2. Nerve Conduction Velocity in Man and Female (Mean \pm SD m/sec)

Segment	Total	Male	Female	P value	
Sensory and Mixed nerve					
Median nerve	F-W	41.86 \pm 2.63	42.17 \pm 2.95	41.59 \pm 2.30	0.176
	W-E	54.82 \pm 4.69	53.93 \pm 4.97	55.72 \pm 4.33	0.724
Ulnar nerve	F-W	38.63 \pm 2.83	38.88 \pm 3.04	38.38 \pm 2.66	0.608
	W-E	54.34 \pm 4.04	52.80 \pm 3.52	55.88 \pm 4.03	0.551
Sural nerve	Calf	40.34 \pm 4.57	40.07 \pm 4.23	40.62 \pm 4.97	0.530
Motor nerve					
Median nerve	TL	3.27 \pm 0.38	3.37 \pm 0.42	3.17 \pm 0.31	0.404
	W-E	57.97 \pm 5.22	57.16 \pm 5.36	58.78 \pm 5.07	0.664
Ulnar nerve	TL	2.72 \pm 0.20	2.76 \pm 0.19	2.68 \pm 0.21	0.589
	W-E	58.30 \pm 4.70	57.99 \pm 5.14	58.62 \pm 4.32	0.412
	E-E	61.12 \pm 8.75	60.96 \pm 9.19	61.29 \pm 8.53	0.376
Peroneal nerve	TL	4.19 \pm 0.60	4.30 \pm 0.67	4.08 \pm 0.50	0.290
	K-A	53.35 \pm 5.28	53.69 \pm 6.83	53.01 \pm 3.22	0.001
Posterior Tibial nerve	TL	4.15 \pm 0.58	4.34 \pm 0.60	3.95 \pm 0.51	0.600
	K-A	49.20 \pm 5.23	48.86 \pm 5.51	49.54 \pm 5.06	0.323

F-W : finger-wrist, W-E : wrist-elbow, T-L : terminal latency
E-E : across elbow, K-A : knee-ankle

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Table 3. The Effects of Age, Height and Temperature on Nerve Conduction Velocity (Multiple Regression Analysis)

Segment	Age	Height	Temperature	multiple R	
Sensory and Mixed nerve					
Median nerve	F-W	= 0.131	= 0.029	= 0.104	0.177
	W-E	-0.431*	-0.388*	0.088	0.461
Ulnar nerve	F-W	-1.430	0.271	0.223	0.422
	W-E	-0.382*	-0.431*	0.235	0.468
Sural nerve	Calf	-0.236	-0.008	0.503*	0.519*
Motor nerve					
Median nerve	TL	0.050	0.271	-0.490	0.506*
	W-E	-1.840	-0.313	0.831	0.205
Ulnar nerve	TL	0.105	0.236	-2.946*	0.486*
	W-E	-0.284	-0.015	0.137	0.290
	E-E	-0.291	-0.178	0.007	0.285
Peroneal nerve	TL	0.277	0.415*	-0.471*	0.541*
	K-A	-1.730	0.220	-0.129	0.343
Posterior Tibial nerve	TL	-0.198	0.386*	-0.253	0.535*
	K-A	-0.185	0.129	0.035	0.223

F-W : finger-wrist, W-E : wrist-elbow, TL : terminal latency
 E-E : across elbow, K-A : knee-ankle, * : p<0.05

Table 4. Changes of Amplitude Distribution from transformation

Segment	Raw amplitude		Sqrt amplitude		Log amplitude		
	skew	kurt	skew	kurt	skew	kurt	
Sensory and Mixed nerve							
Median nerve	F-W	1.05	1.34	0.51	0.01	0.04	-0.64
	W-E	0.13	-1.12	-0.20	-0.94	-0.60	-0.36
Ulnar nerve	F-W	1.23	2.91	0.51	1.13	-0.21	0.86
	W-E	0.87	1.02	0.26	0.25	-0.38	0.33
Sural nerve	Calf	0.89	0.35	0.47	-0.21	0.03	-0.47
Motor nerve							
Median nerve	APB	0.48	0.87	-0.27	0.53	-0.52	0.67
Ulnar nerve	ADQ	0.49	0.93	0.16	0.49	-1.56	0.36
Peroneal nerve	EDB	0.54	-0.60	0.15	-0.60	-0.42	-0.43
Posterior Tibial nerve	AHB	0.53	-0.14	0.21	-0.40	-0.11	-0.50

F-W : finger-wrist, W-E : wrist-elbow, TL : terminal latency
 E-E : across elbow, K-A : knee-ankle,
 APB : Abductor Pollicis Brevis, ADQ : Abductor Digiti Minimi
 EDB : Extensor Digitorum Brevis, AHB : Abductor Hallucis Brevis
 skew : skewness, kurt : kurtosis

NCS (interlaboratory variability) 가
 7,8). NCS 가 100
 가 2
 NCS 가 1) 가
 , 2) (experimental)
 error, 가 2 . Lueders⁹⁾ 20
 80% 99% 95%
 3.28

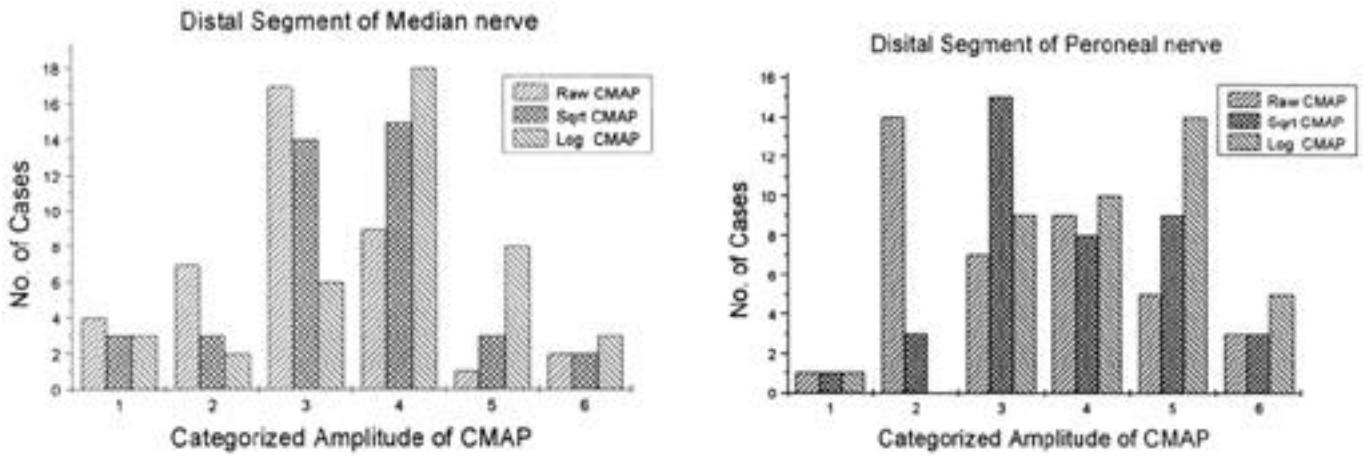


Figure 1. Distribution of CMAP Amplitude

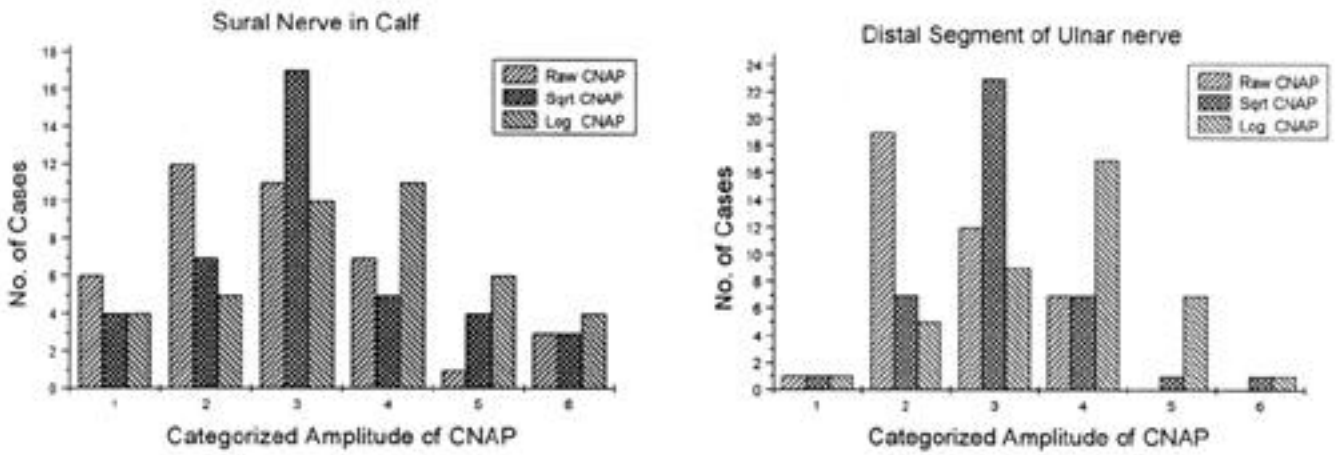


Figure 2. Distribution of CNAP Amplitude

가 15-19) semilogarithmic

가 DeJesus¹⁶⁾ $Y_2 = Y_1 e^{(m^2 - t)}$, DeJong²⁰⁾

$Y_2 = Y_1(Q10)^{T/10}$

가

가 89%¹⁰⁾, 가²⁾

가

가 1.6-4.4m/sec²¹⁾

5-9% coefficients of variation(¹¹⁻¹³⁾)

NCS (sensitivity) (specificity)

가

가

가 NCS 가²²⁾

가^{14,24,26)} 가²³⁾ 가^{14,24,25)}

가 Ludin Trakmann¹⁴⁾ 가^{3,27,28)}

가²⁴⁾

:

Table 5. Comparison of Amplitude Transformed into Normal Distribution in Male and Female (Mean±SD)

Segment		Total	Male	Female	P value
Sqrt(CNAP), uV					
Median nerve	F-W	4.62±1.00	4.45±1.09	4.79±0.91	0.446
	W-E	5.17±1.15	5.00±1.33	5.33±0.94	0.056
Ulnar nerve	F-W	3.76±0.70	3.56±0.52	3.96±0.80	0.314
	W-E	5.12±1.04	4.89±0.88	5.34±1.16	0.271
Sural nerve	Calf	4.67±0.92	4.55±0.91	4.78±0.95	0.835
Sqrt(CMAP), mV					
Median nerve	APB	4.05±0.57	4.00±0.62	4.11±0.52	0.293
Ulnar nerve	ADQ	3.93±0.37	4.10±0.38	3.79±0.31	0.853
Peroneal nerve	EDB	2.48±0.53	2.55±0.52	2.40±0.54	0.881
Posterior Tibial nerve	AHB	5.09±0.73	5.23±0.74	4.95±0.72	0.869

CNAP : Compound nerve action potential

CMAP : Compound muscle action potential

F-W : finger-wrist, W-E : wrist-elbow, TL : terminal latency

APB : Abductor Pollicis Brevis, ADQ : Abductor Digiti Minimi

EDB : Extensor Digitorum Brevis, AHB : Abductor Hallucis Brevis

Table 6. The Effects of Age, Height and Temperature on Amplitude (Multiple Regression Analysis)

Segment		Age	Height	Temperature	multiple R
Sqrt(CNAP), uV					
Median nerve	F-W	= -0.458*	= -0.149	= -0.056	0.449
	W-E	-0.351*	-0.126	-0.007	0.333
Ulnar nerve	F-W	-0.529*	-0.279	-0.130	0.558*
	W-E	-0.307	-0.270	-0.100	0.375
Sural nerve	Calf	-0.092	-0.245	-1.300	0.291
Sqrt(CMAP), mV					
Median nerve	APB	-0.214	-0.104	0.049	0.199
Ulnar nerve	ADQ	0.130	0.180	-0.353	0.352
Peroneal nerve	EDB	-0.286	0.028	0.071	0.297
Posterior Tibial nerve	AHB	-0.389	-0.146	-0.063	0.390

F-W : finger-wrist, W-E : wrist-elbow, TL : terminal latency

APB : Abductor Pollicis Brevis, ADQ : Abductor Digiti Quinti

EDB : Extensor Digitorum Brevis, AHB : Abductor Hallucis Brevis

* : p<0.05

29-31) 가
 42) 가
 38,43) 가
 Kato⁴⁴⁾, 가
 Wagman Lesse⁴⁵⁾ 가
 Lang⁴²⁾, Rivner²²⁾ 가
 4-6 가
 32,33) 14 16 34) 가
 20 Campbell²⁹⁾ Soundmand³⁰⁾ 가
 가 가
 3) tapering
 23,25,35-40) 가
 가 26,41) 가 가 NCS

gression analysis) partial re-
(stepwise regression
NCS

가
4,22,30,42)

가 40

NCS

가

가

가

가

CMAP coefficient of variation 60%
15-30%

15)

(parametric

study)

CNAP log

4,46)

가

CNAP CMAP

15,17)

46,47)

NCS

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