

– Abstract –

The Change of Silent Periods Following Transcranial Magnetic Stimulation in Stroke Patients

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Objective: Transcranial magnetic stimulation of the motor cortex during tonic muscle contraction produces a motor evoked potential followed by a silent period (SP) in the electromyogram. The SP reflects the cortical inhibition of the motor pathway. We sought to characterize the SPs in stroke patients and to determine the relationship between the SPs and several clinical findings such as muscle power, the duration of illness and site of lesion.

Method: Subjects were 43 stroke patients who were radiologically proved to have unilateral brain lesion and whose muscle power of abductor pollicis brevis (APB) was greater than fair grade. Stimulation thresholds when SPs first appeared and SPs induced by 30% increased stimulation above the threshold were measured from the APB muscles of both affected and unaffected limbs.

Results: SPs were significantly longer in the affected limbs than in the unaffected limbs. There was no significant interside difference (ISD) in the stimulation threshold. We could demonstrate a negative correlation between the muscle power and ISD of the SPs. There was no significant correlation between ISD and duration of illness, pyramidal tract and cortical involvement.

Conclusion: The SP prolongation is correlated to the decreased muscle strength in stroke patients. The SP study probably contributes to a better quantification of the central motor function in stroke patients.

Key Words: Transcranial magnetic stimulation, Silent period, Stimulation threshold, Interside difference, Stroke

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. 1985 Barker ²

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가 , , (excitatory response)
 가 (inhibitory response)
 (SP: Silent Period)
 3-7 SP 1.
 가 가 1999 4 9
 (Fig. 1).
 SP Renshaw cell inhibition
 spinal motor neuron 8-10 Fair grade 43
 , SP 27 , 16
 , 7,11-13 59.2
 SP 가 19 , 가 24 39 ,
 Uozumi 14 4
 , SP가 , Braune 15 가 6 , 가 37
 4 가 22 , 가 21
 SP가
 SP 가 2.
 가 SP가

Premiere (Medelec,
 UK) Magstim 200 (Magstim, UK)
 13 cm
 2.0 Tesla,
 0.1 msec 10

(%)
 (SP:Silent
 Period)가
 30%
 SP
 SP
 , SP
 SP
 (ISD, Interside Difference)
 SP

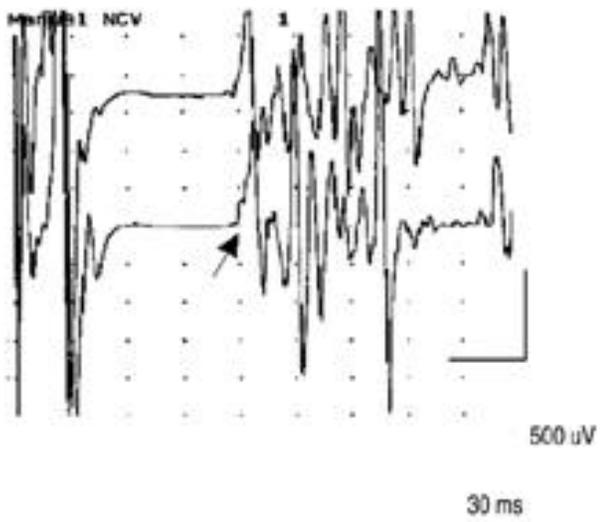


Fig. 1. SP(silent period) in abductor pollicis brevis muscle following motor evoked potential by magnetic cortical stimulation (arrow).

Table 1. Comparison of Stimulation Threshold when SP was appeared, and SP Stimulated by +30% Intensity above Threshold.

	Stimulation threshold (%)	Silent Period (msec)
Affected limb (n=43)	49.0 ± 7.2	117.8 ± 38.4*
Non-affected limb (n=43)	48.2 ± 7.5	97.9 ± 29.2*

The values are mean and standard deviation

*p<0.01

Table 2. Comparison of Interside Difference of Silent Period according to Muscle Power.

	Muscle power of APB ¹		
	Fair (n=8)	Good (n=12)	Normal (n=23)
SP in affected limb (msec)	159.4 ± 51.6	129.5 ± 26.6	97.2 ± 21.5
SP ² in non-affected limb (msec)	120.2 ± 38.6	100.1 ± 38.0	88.9 ± 12.9
ISD ³ (msec)	39.2 ± 32.7*	29.3 ± 40.1*	8.03 ± 21.0*

1. APB : Abductor pollicis brevis

2. SP : Silent period

3. ISD : Interside difference of SP between affected limb and non-affected limb

The values are mean and standard deviation

*P<0.05

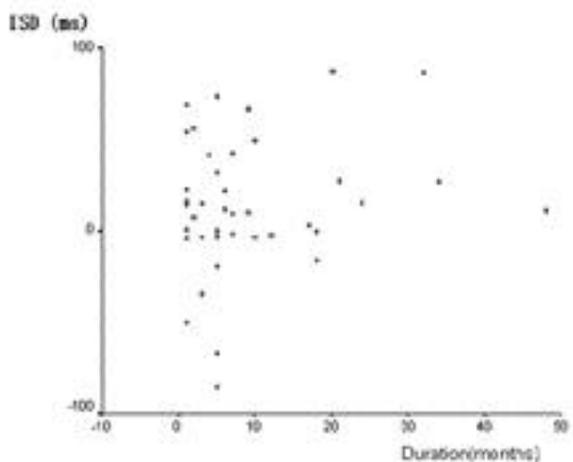


Fig. 2. ISD(interside difference) by duration.

ISD(interside difference) = SP of affected threshold - SP of unaffected threshold.

3.

SPSS for windows version 10.0 program

SP

ISD

ANOVA

regression

. ISD

test

1.

7.5%

Table 1).

2.

가

Fair grade
43

(SP:

Silent Period)

1.

가

49 ± 7.2%,

SP가

48.2 ±
(p>0.05,

SP

SP

97.9 ± 29.2 msec
Table 1).

30%

SP

117.8 ± 38.4 msec

(p<0.01,

Table 3. Comparison of Interside Difference of Silent Period according to Lesion Site.

	Pyramidal tract involvement		Cortical involvement	
	Yes (n=22)	No (n=21)	Yes (n=6)	No (n=37)
SP ¹ in affected limb (ms)	126.1 ± 47.8	109.0 ± 23.2	101.6 ± 31.6	120.4 ± 39.1
SP in non-affected limb (ms)	106.0 ± 37.0	89.3 ± 14.4	90.6 ± 17.7	99.0 ± 30.7
ISD ² (ms)	19.8 ± 36.9	19.6 ± 26.0	11.0 ± 34.3	21.3 ± 31.4

1. SP : Silent period

2. ISD : Interside difference of SP between affected limb and non-affected limb

The values are mean and standard deviation

3. SP (ISD: Interside difference)

가 12 , Normal 가 23 , Fair 가 8 , Good 가 21 , Robinson²² 가 Cz 7 cm ISD 39.2±32.7 msec, 29.3±40.1 msec, 8.03 ±21.0 msec ISD 가 (p<0.05, Table 2).

4. ISD

ISD 가 (p>0.05, Fig. 2). (SP: Silent Period)

5. ISD

ISD 6 ISD 37 11.0±34.3 msec, 21.3±31.4 msec ISD가 SP (Inhibitory activity) 80 ~ 100 msec (IPSPs) excitatory postsynaptic potential 7,11-13 (p>0.05, Table 3).

21 ISD (p>0.05, Table 3).

ear plug SP가 SP가 Uozumi¹⁴ SP가 SP가 , Braune¹⁵ SP가 가 , Haug²⁴ SP가 SP가 4 가 SP가 SP가 16-19

가 가 Fair

SP (ISD: Interside Difference)

SP

가 43

(SP: Silent Period)

SP가

25

SP가

26,27

SP가

가 85%

6 (15%)

ISD

ISD가

가

30%

5%

40%

SP

가 SP

SP

가

22

SP

Cantello 6

가가

SP가

, Holmgren 28

Uozumi 12

Haug 24

가

가

ISD가

4

가

ISD가

SP

, SP

ISD

SP가

SP가

가

1. SP가

가

2. SP

3.

SP (ISD: Interside Difference)가

4. ISD

5.

ISD

SP

SP

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