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2000 12

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가

가

가

가

가

63

32 ,

30

(Nicorderm) 5mg

9

quantitative

electroencephalography (qEEG)

, 9 30

3

qEEG

Short Blessed Test (SBT), Rey Kim

Memory test

Korean Wechsler Intelligence Scale (K-WAIS)

digit span

5mg

5

6.7 ± 3.6 ng/ml

SBT

가 . Rey Kim Memory Test

가 가

가 . digit span

.

alpha, beta

가 . delta

delta

. Theta

. 가 theta 가

. theta 가

beta 가 theta

가 .

가 ,

가 .

: , , , , .

< >

I

1997

70.6

78.1

1

.

가 가

(muscarine)

가

2-4

(neocortex)

(hippocampus)

가

5-7

가

8

9

.

10-13

.

가

14-15

.

가

가

16-18

19-21

22,23

가

가 가

가

가

가

(PET),

(SPECT),

(fMRI)

qEEG

qEEG

(cortical

arousal)

24-31

32-34

EEG

delta, theta

24-27

alpha, beta

가

24,29-31

delta, theta

가 가

alpha

가가

35-37

가

가

가 10 ng/ml (alpha,
beta) 가 ,³⁸ 15 ng/ml delta

³⁹

가

가

가가

가

가

가

가

⁴⁰

(qEEG)

⁴¹

EEG

가

가

가

가

가

가

qEEG,

가

, qEEG

qEEG

가

qEEG

가

,

가

, 가

II

1.

63

33

30

가

60-69

1

32

30

Table 1

64.7 ± 3.4 , 65.9 ± 1.9

가

2

2.

(Nicoderm) 5mg (ALZA, Kansas, MO, USA)

5

3

7mg

Table 1. Comparison of demographic characteristics between placebo group and Nicotine group

| | Placebo Group | Nicotine Group | p value |
|--------------------------------|---------------|----------------|---------|
| Age (mean ± SD) | 65.9 ± 1.9 | 64.7 ± 3.4 | NS |
| Sex (Male:Female) | 6:24 | 11:21 | NS |
| Degree of education (M:H:U) | 23:5:2 | 26:5:1 | NS |

M, middle school; H, high school; U, university; NS, not significant.

5mg

5mg

·
·
가 42
·
2-4
3-6 43
9 30 qEEG
, 3 qEEG
·
3.
가 가 .

가. Short Blessed Test (SBT)

(OMCT) - - (orientation - memory - concentration)
가 Blessed (Blessed dementia)

scale) ⁴⁴ 가 27 information - memory
concentration test (IMCT) Katzman ⁴⁵ 6 .
SBT

가 ⁴⁵ SBT , , , 20
1 , 6
가 가 가

. Rey Kim Memory Test

Rey Kim Memory Test Andre Rey가 auditory verbal learning test
(RAVLT) 가 ⁴⁶

가 Rey auditory verbal learning test
digit span, verbal fluency test가 가 ,
RAVLT , 가

⁴⁷ Rey Kim Memory Test 1, 2, 3, 4, 5, ,
가

. K- WAIS

K- WAIS ()

가 ⁴⁸

(digit span) backward, forward .

가 가 .

4.

10

2

32

(Electrocap , Eaton,

Ohio, USA) . Neuronics MN 32 ()
 , QEEG software version 421 .

가

가

가

1

256

가

20-30

5 K

(epoch)

(Fast Fourier transformation)

(digital)

power spectra

4

delta (1-4Hz), theta

(4-8Hz), alpha (8-12Hz), beta (12-20Hz)

EEG microvolt

(square root)

⁴⁹

qEEG

5.

가.

5ml heparin

-70°C

Sigma () ethyl ether, methanol J.T.
 Baker () LC Yakuri ()
 300 12 graphitized carbon black
 (40 60mesh) Acros Organic()

2mL
 1mL 가
 가 0, 5, 10, 25, 50, 250, 500, 1000
 가
 diphenylamine 10mg/L 25 μ l
 3000 ng/mL가
 diethylether 6mL
 sodium sulfate 2g 10 1500rpm
 methanol 0.5mL가
 0.5 mL가 sodium sulfate 0.5g
 GC-NPD
 diphenylamine

Hewlett Packard 5890 series gas chromatograph (GC)
 nitrogen-phosphorus detector (NPD) column
 HP-5MS (5% phenyl methyl siloxane)

GC
 (Fig 1). blank 가

GC-NPD chromatogram

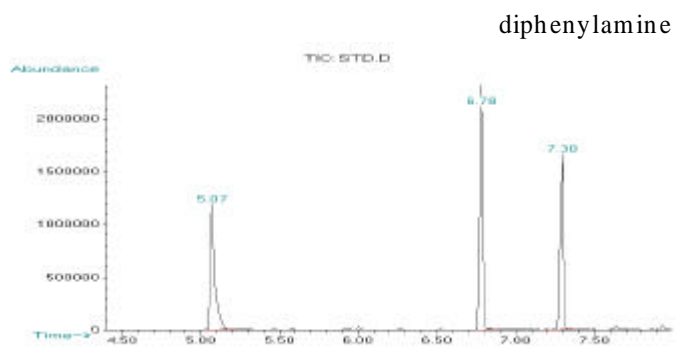


Fig 1. Chromatogram of nicotine and diphenylamine. Nicotine and internal standard material (diphenylamine) was mixed with whole blood in a concentration of 50 ng/ml. Nicotine effluxed at 5.07 minutes after infusion and diphenylamine at 6.78 minutes.

5 가

90%

blank

가

GC-NPD

(Fig. 2)

± 3.6 (0- 21.1) ng/ml , 0 ng/ml .

6.

Student's T-test .

General Linear Model repeated measure .

ANOVA

test General Linear Model repeated measure .

Pearson correlation .

SPSS version 9.0 .

III.

1.

가. SBT

SBT 3.77 ± 5.04 , 2.72 ± 4.34
 3.50 ± 3.03 1.78 ± 3.10
Student T-test (Table 2) General
Linear Model repeated measure (Table 3)
(5.3-7.2 ng/ml), (7.2 ng/ml)
SBT Table 3, 4
(0-5.3 ng/ml),

. Rey Kim Memory Test

5 12.4 ± 2.6
 11.0 ± 2.4
($p=0.035$) (Table 2, 3).

가 .

(0-5.3 ng/ml), (5.3-7.2
ng/ml), (7.2 ng/ml)
가 7.2 ng/ml
(Table 4, 5) ($p<0.024$).

. K- WAIS

K- WAIS digit span
(Table 2, 3),

(Table 4, 5).

2.

beta, alpha, theta, delta

(Fig. 3).

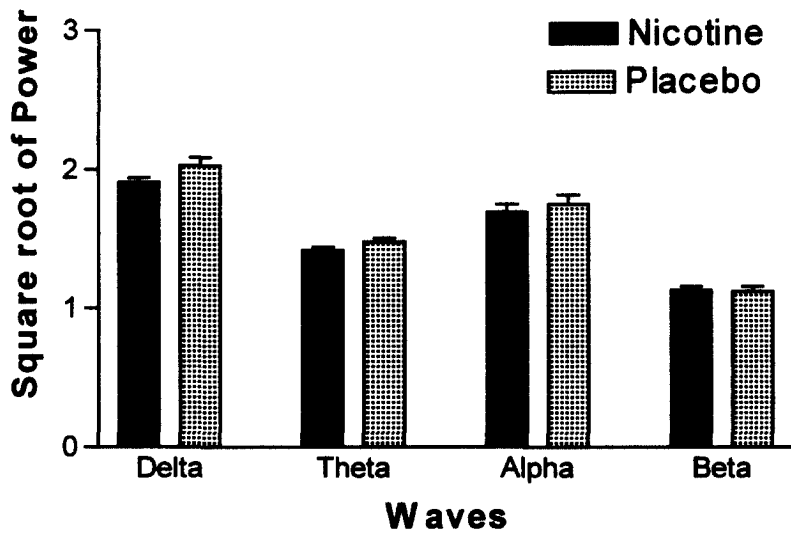


Fig 3. Comparison of the power of each band in the nicotine group and placebo group after patch application

EEG

T - test

t

delta, theta, alpha, beta

Fig. 4, 5, 6, 7 . Delta

t - statistic significance probability map (t-SPM) delta 가

(Fig. 4).

가

FP1, CZ, T6, PO2

(Table 6) C3, TT2
 delta 가 (p=0.053, 0.054).
 Theta
 F7, Cz, T6, OZ (p=0.084,
 0.054, 0.058, 0.061) (Fig. 5). Alpha, beta
 가
 (Fig. 6, 7).

3.

. 가
 , (5 - 1) 가
 가 (p=0.014) (Table 7).
 F3, C3,
 C4, TT1 가 theta 가
 (p=0.004, 0.008, 0.007, 0.005) (Table 8).

4.

,
 5
 (Table 9) C3, CP2 theta 5
 가 (p=0.017, 0.038) (Table 9). FTC1, T5 beta
 가 5 가 (p=0.008, 0.019).

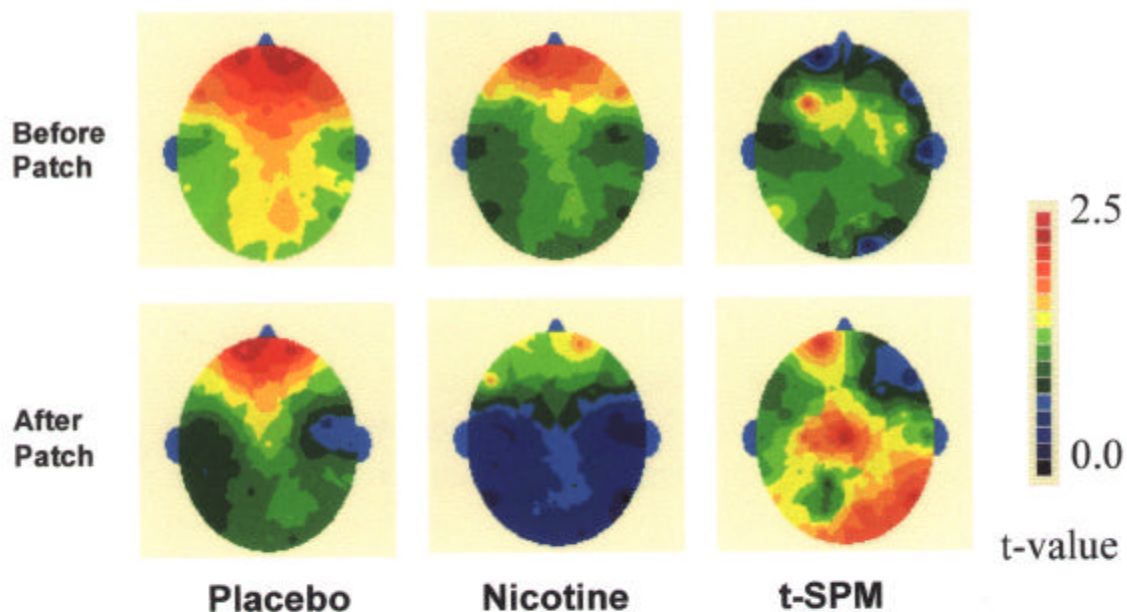


Fig 4. T-statistic significance probability maps (t-SPM) for delta band before and after administration of nicotine. Red area in t-SPM means that the difference in absolute power of qEEG in this area is statistically significant between the nicotine group and the placebo group.

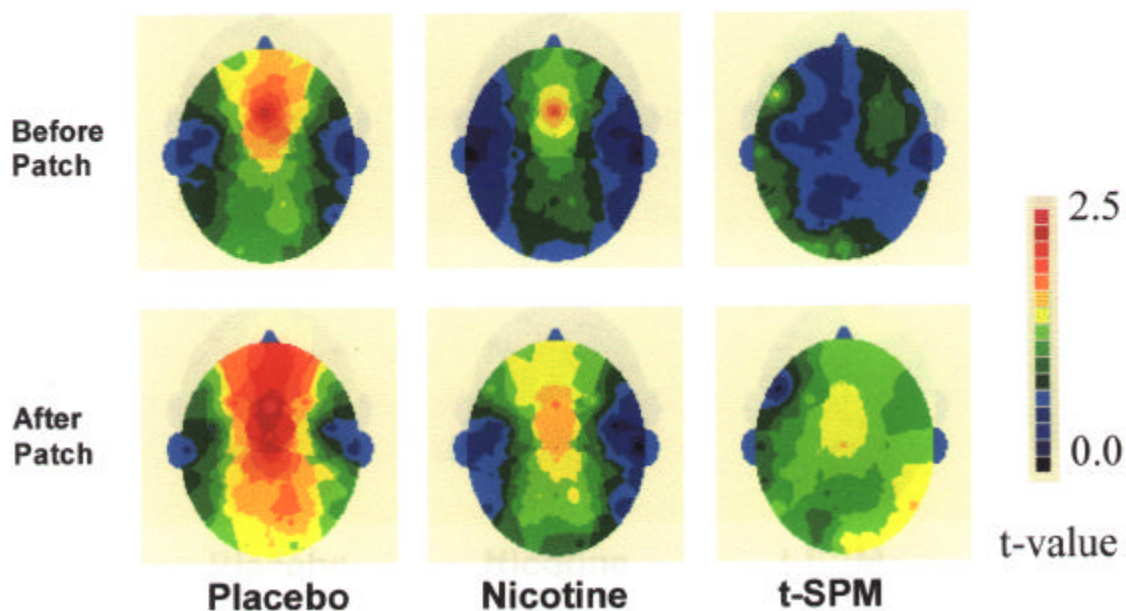


Fig 5. T-statistic significance probability maps (t-SPM) for theta band before and after administration of nicotine

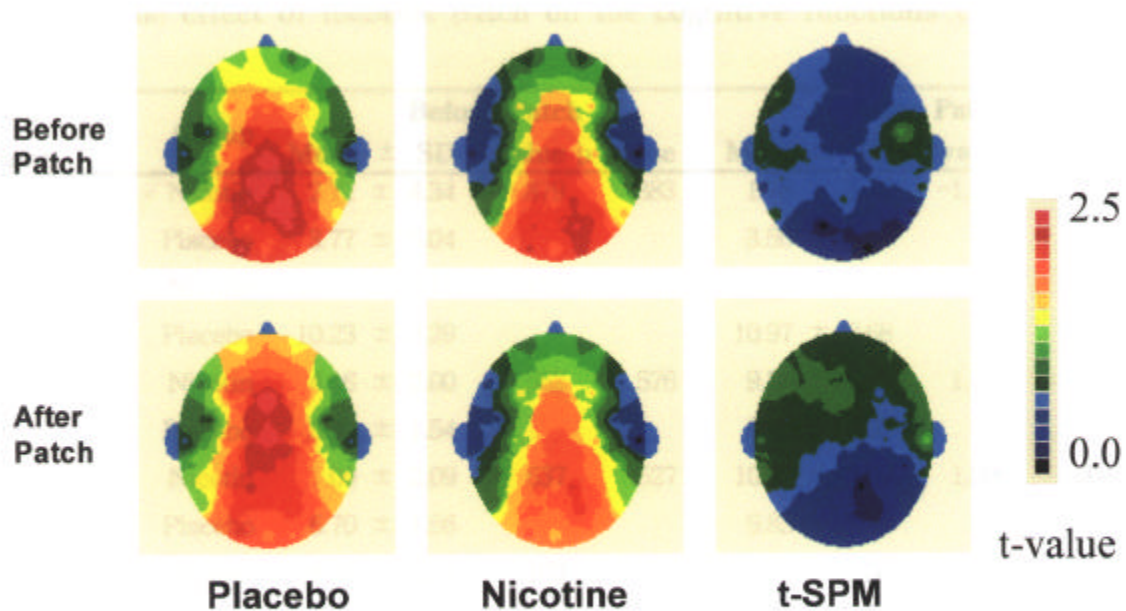


Fig 6. T-statistic significance probability maps (t-SPM) for alpha band before and after administration of nicotine

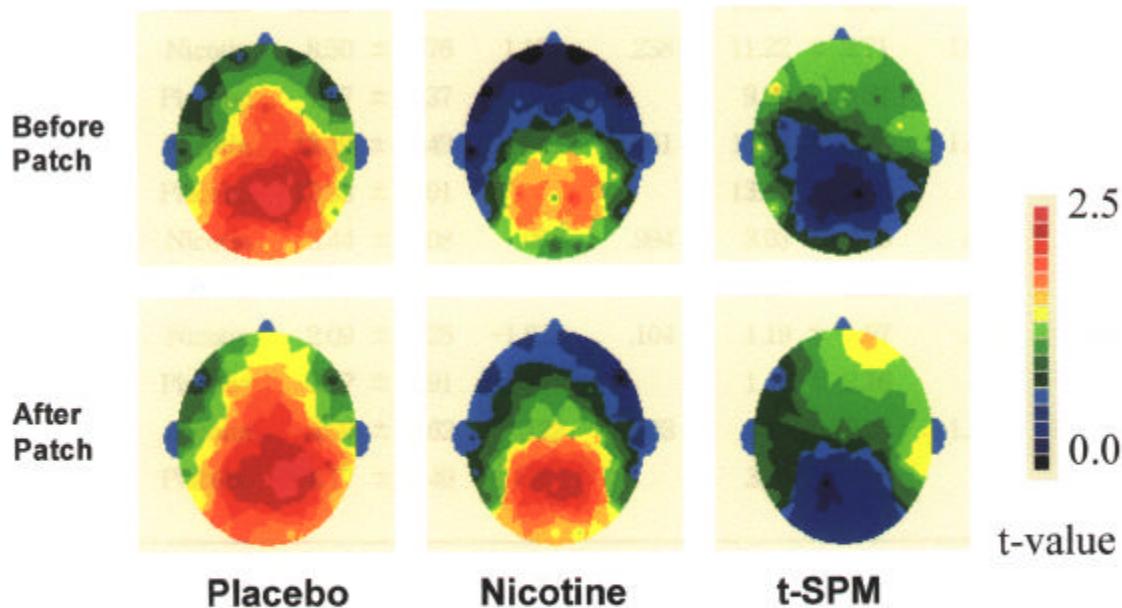


Fig 7. T-statistic significance probability maps (t-SPM) for beta band before and after administration of nicotine

Table 2. The effect of nicotine patch on the cognitive functions (T - test)

| Test Name | Group | Before Patch | | | | After Patch | | | |
|----------------------|---------|--------------|--------|---------|---------|-------------|--------|---------|--------------|
| | | Mean | ± SD | t value | p value | Mean | ± SD | t value | p value |
| SBT | Nicotin | 2.72 | ± 4.34 | -.879 | .383 | 1.78 | ± 3.10 | -1.292 | .201 |
| | Placebo | 3.77 | ± 5.04 | | | 3.50 | ± 3.03 | | |
| Digit Span | Nicotin | 10.09 | ± 3.17 | -.170 | .865 | 10.00 | ± 2.68 | -1.210 | .231 |
| | Placebo | 10.23 | ± 3.29 | | | 10.97 | ± 3.68 | | |
| Trial1 | Nicotin | 4.16 | ± 2.00 | .562 | .576 | 9.38 | ± 3.10 | 1.167 | .248 |
| | Placebo | 3.90 | ± 1.54 | | | 8.47 | ± 3.03 | | |
| Trial2 | Nicotin | 7.00 | ± 2.09 | .637 | .527 | 10.50 | ± 2.58 | 1.006 | .319 |
| | Placebo | 6.70 | ± 1.56 | | | 9.83 | ± 2.64 | | |
| Trial3 | Nicotin | 8.09 | ± 2.33 | .103 | .918 | 11.47 | ± 2.36 | .721 | .474 |
| | Placebo | 8.03 | ± 2.28 | | | 11.03 | ± 2.40 | | |
| Trial4 | Nicotin | 9.44 | ± 2.17 | .622 | .536 | 11.63 | ± 2.24 | .578 | .565 |
| | Placebo | 9.07 | ± 2.52 | | | 11.30 | ± 2.18 | | |
| Trial5 | Nicotin | 10.59 | ± 2.20 | .472 | .638 | 12.41 | ± 2.56 | 2.162 | .035* |
| | Placebo | 10.33 | ± 2.14 | | | 11.03 | ± 2.43 | | |
| Delayed recall | Nicotin | 8.50 | ± 2.76 | 1.192 | .238 | 11.22 | ± 2.71 | 1.630 | .108 |
| | Placebo | 7.57 | ± 3.37 | | | 9.90 | ± 3.62 | | |
| Delayed recogniton | Nicotin | 13.19 | ± 1.49 | 1.911 | .061 | 14.06 | ± 1.05 | 1.487 | .142 |
| | Placebo | 12.33 | ± 2.01 | | | 13.57 | ± 1.56 | | |
| Learning slope | Nicotin | 6.44 | ± 2.08 | .008 | .994 | 3.03 | ± 2.15 | .806 | .423 |
| | Placebo | 6.43 | ± 2.06 | | | 2.57 | ± 2.39 | | |
| Memory retention | Nicotin | 2.09 | ± 1.25 | -1.652 | .104 | 1.19 | ± .97 | .129 | .898 |
| | Placebo | 2.77 | ± 1.91 | | | 1.13 | ± 2.16 | | |
| Retrieval efficiency | Nicotin | 4.69 | ± 2.62 | -.122 | .903 | 2.84 | ± 2.14 | -1.158 | .251 |
| | Placebo | 4.77 | ± 2.49 | | | 3.67 | ± 3.36 | | |

* There was significant difference between nicotine group and placebo group (p< .05).

Table 3. The effect of nicotine on cognitive functions in the nicotine group and placebo group by general linear model repeated measure method

| Test Name | Wilk's Lamda | df | F value | p value |
|-------------------------------|--------------|----|---------|--------------|
| SBT | .956 | 1 | 2.751 | .102 |
| SBT vs group | .986 | 1 | .854 | .359 |
| Digit Span | .972 | 1 | 716.323 | .000 |
| Digit Span vs group | .955 | 1 | .514 | .476 |
| Trial 1 | .269 | 1 | 162.679 | .000 |
| Trial 1 vs group | .988 | 1 | .722 | .399 |
| Trial 2 | .331 | 1 | 121.133 | .000 |
| Trial 2 vs group | .994 | 1 | .370 | .545 |
| Trial 3 | .338 | 1 | 117.438 | .000 |
| Trial 3 vs group | .993 | 1 | .406 | .526 |
| Trial 4 | .498 | 1 | .007 | .000 |
| Trial 4 vs group | 1.000 | 1 | .013 | .936 |
| Trial 5 | .677 | 1 | 28.584 | .000 |
| Trial 5 vs group | .915 | 1 | 5.604 | .021* |
| Delayed recall | .454 | 1 | 72.044 | .000 |
| Delayed recall vs group | .993 | 1 | .419 | .520 |
| Delayed recognition | .625 | 1 | 35.951 | .000 |
| Delayed recognition vs group | .983 | 1 | 1.039 | .312 |
| Learning slope | .369 | 1 | 102.552 | .000 |
| Learning slope vs group | .993 | 1 | .411 | .524 |
| Memory retention | .662 | 1 | 30.619 | .000 |
| Memory retention vs group | .960 | 1 | 2.510 | .118 |
| Retrieval efficiency | .747 | 1 | 20.283 | .000 |
| Retrieval efficiency vs group | .979 | 1 | 1.295 | .260 |

* There was significant difference between nicotine group and placebo group (p < .05).

Table 4. Comparison of cognitive functions in the three groups divided by the blood nicotine level after nicotine patch application (one-way anova)

| Test Name | Group** | N | Before Patch | | | After Patch | | | | |
|----------------------|---------|----|--------------|---------|---------|-------------|--------------|---------|-------------|----------------|
| | | | Mean ± SD | F value | p value | Post hoc. | Mean ± SD | F value | p value | Post hoc. |
| SBT | 1 | 11 | 4.00 ± 5.29 | | | | 2.73 ± 5.24 | | | |
| | 2 | 10 | .90 ± 1.66 | 1.436 | .254 | | .20 ± .63 | 1.198 | .316 | |
| | 3 | 11 | 3.09 ± 4.76 | | | | 2.27 ± 4.20 | | | |
| Digit Span | 1 | 11 | 9.00 ± 3.38 | | | | 9.45 ± 2.91 | | | |
| | 2 | 10 | 11.20 ± 3.05 | 1.295 | .289 | | 11.30 ± 2.75 | 1.809 | .182 | |
| | 3 | 11 | 10.18 ± 2.96 | | | | 9.36 ± 2.11 | | | |
| Trial 1 | 1 | 11 | 5.09 ± 2.66 | | | | 10.00 ± 3.38 | | | |
| | 2 | 10 | 3.90 ± 1.66 | 2.095 | .141 | | 10.20 ± 2.44 | 1.742 | .193 | |
| | 3 | 11 | 3.45 ± 1.13 | | | | 8.00 ± 3.13 | | | |
| Trial 2 | 1 | 11 | 8.18 ± 2.68 | | | | 10.55 ± 3.24 | | | |
| | 2 | 10 | 6.80 ± 1.55 | 3.553 | .042 | | 11.00 ± 1.94 | .381 | .687 | |
| | 3 | 11 | 6.00 ± 1.26 | | | | 10.00 ± 2.49 | | | |
| Trial 3 | 1 | 11 | 9.36 ± 3.14 | | | | 11.55 ± 2.94 | | | |
| | 2 | 10 | 7.70 ± 1.57 | 2.939 | .069 | | 11.30 ± 2.26 | .035 | .966 | |
| | 3 | 11 | 7.18 ± 1.40 | | | | 11.55 ± 1.97 | | | |
| Trial 4 | 1 | 11 | 10.36 ± 2.50 | | | | 11.91 ± 2.88 | | | |
| | 2 | 10 | 9.20 ± 2.44 | 1.730 | .195 | | 11.90 ± 1.66 | .460 | .636 | |
| | 3 | 11 | 8.73 ± 1.19 | | | | 11.09 ± 2.07 | | | |
| Trial 5 | 1 | 11 | 11.27 ± 2.10 | | | | 12.00 ± 3.16 | | | |
| | 2 | 10 | 10.20 ± 2.57 | .792 | .462 | | 12.90 ± 2.02 | .311 | .735 | |
| | 3 | 11 | 10.27 ± 1.95 | | | | 12.36 ± 2.50 | | | |
| Delayed recall | 1 | 11 | 9.18 ± 3.25 | | | | 11.09 ± 3.51 | | | |
| | 2 | 10 | 8.30 ± 3.06 | .517 | .602 | | 11.60 ± 2.37 | .139 | .871 | |
| | 3 | 11 | 8.00 ± 2.05 | | | | 11.00 ± 2.28 | | | |
| Delayed recognition | 1 | 11 | 13.55 ± 1.51 | | | | 14.09 ± 1.38 | | | |
| | 2 | 10 | 12.90 ± 1.66 | .510 | .606 | | 14.00 ± 1.05 | .024 | .976 | |
| | 3 | 11 | 13.09 ± 1.38 | | | | 14.09 ± .70 | | | |
| Learning slope | 1 | 11 | 6.18 ± 2.04 | | | | 2.00 ± 1.41 | | | |
| | 2 | 10 | 6.30 ± 1.95 | .276 | .761 | | 2.70 ± 1.25 | 4.236 | .024 | 1<3* |
| | 3 | 11 | 6.82 ± 2.36 | | | | 4.36 ± 2.77 | | | |
| Memory retention | 1 | 11 | 2.09 ± 1.38 | | | | .91 ± 1.04 | | | |
| | 2 | 10 | 1.90 ± 1.45 | .220 | .804 | | 1.30 ± 1.06 | .695 | .507 | |
| | 3 | 11 | 2.27 ± 1.01 | | | | 1.36 ± .81 | | | |
| Retrieval efficiency | 1 | 11 | 4.36 ± 3.23 | | | | 3.00 ± 2.79 | | | |
| | 2 | 10 | 4.60 ± 2.63 | .209 | .813 | | 2.40 ± 1.84 | .303 | .741 | |
| | 3 | 11 | 5.09 ± 2.07 | | | | 3.09 ± 1.76 | | | |

* p < .05

** group 1: 0-5.3 ng/ml of nicotine blood level, group 2: 5.4-7.2 ng/ml, group 3: 7.3-10.7 ng/ml.

Table 5. Comparison of the effect of nicotine on cognitive function in the three subgroups with different blood nicotine level by general linear model repeated measure method**

| Test Name | Wilk 's Lamda | df | F value | p value | Post hoc. |
|-------------------------------|---------------|----|---------|---------|----------------|
| SBT | .879 | 1 | 4.009 | .055 | |
| SBT vs group | .990 | 2 | .142 | .868 | |
| Digit Span | .998 | 1 | .061 | .807 | |
| Digit Span vs group | .925 | 2 | 1.169 | .325 | |
| Trial 1 | .244* | 1 | 90.017 | .000 | |
| Trial 1 vs group | .941 | 2 | .906 | .415 | |
| Trial 2 | .336* | 1 | 57.873 | .000 | |
| Trial 2 vs group | .902 | 2 | 1.583 | .223 | |
| Trial 3 | .308* | 1 | 65.148 | .000 | |
| Trial 3 vs group | .838 | 2 | 2.401 | .108 | |
| Trial 4 | .414* | 1 | 41.096 | .000 | |
| Trial 4 vs group | .936 | 2 | .995 | .382 | |
| Trial 5 | .488* | 1 | 30.365 | .000 | |
| Trial 5 vs group | .826 | 2 | 3.047 | .063 | |
| Delayed recall | .393* | 1 | 44.736 | .000 | |
| Delayed recall vs group | .931 | 2 | 1.072 | .356 | |
| Delayed recognition | .691* | 1 | 12.946 | .001 | |
| Delayed recognition vs group | .967 | 2 | .488 | .619 | |
| Learning slope | .307* | 1 | 65.442 | .000 | |
| Learning slope vs group | .907 | 2 | 1.492 | .242 | 1<3* |
| Memory retention | .729* | 1 | 10.807 | .003 | |
| Memory retention vs group | .975 | 2 | .373 | .692 | |
| Retrieval efficiency | .659* | 1 | 15.015 | .001 | |
| Retrieval efficiency vs group | .981 | 2 | .278 | .759 | |

* p < .05

** group 1: 0 5.3 ng/ml of nicotine blood level, group 2: 5.4 7.2 ng/ml, group 3: 7.3 10.7 ng/ml.

Table 6. The effect of nicotine on delta wave in quantitative EEG

| Area | Group | Before Patch | | | | After Patch | | | |
|-------|---------|--------------|---------|---------|------------|-------------|---------|--|--|
| | | Mean ± SD | t value | p value | Mean ± SD | t value | p value | | |
| HEOG | Nicotin | 2.36 ± .41 | -1.271 | .209 | 2.44 ± .51 | .237 | .814 | | |
| | Placebo | 2.53 ± .54 | | | 2.41 ± .50 | | | | |
| FP1 | Nicotin | 2.25 ± .39 | .473 | .640 | 2.08 ± .28 | -2.328 | .026* | | |
| | Placebo | 2.19 ± .38 | | | 2.35 ± .43 | | | | |
| FP2 | Nicotin | 2.13 ± .34 | -.827 | .420 | 2.19 ± .29 | -.837 | .407 | | |
| | Placebo | 2.24 ± .44 | | | 2.32 ± .60 | | | | |
| F7 | Nicotin | 2.02 ± .37 | -.796 | .430 | 2.17 ± .33 | -.977 | .333 | | |
| | Placebo | 2.11 ± .36 | | | 2.08 ± .35 | | | | |
| F3 | Nicotin | 1.90 ± .31 | -2.118 | .039 | 2.00 ± .25 | -1.251 | .216 | | |
| | Placebo | 2.07 ± .29 | | | 2.11 ± .45 | | | | |
| FZ | Nicotin | 1.58 ± .73 | -1.436 | .189 | 2.00 ± .26 | -1.508 | .142 | | |
| | Placebo | 2.10 ± .33 | | | 2.16 ± .35 | | | | |
| F4 | Nicotin | 1.98 ± .34 | -1.297 | .200 | 1.98 ± .23 | -.725 | .471 | | |
| | Placebo | 2.10 ± .33 | | | 2.03 ± .33 | | | | |
| F8 | Nicotin | 2.09 ± .33 | -.366 | .716 | 2.04 ± .28 | -.475 | .637 | | |
| | Placebo | 2.13 ± .33 | | | 2.08 ± .32 | | | | |
| FT C2 | Nicotin | 1.83 ± .33 | -.713 | .479 | 1.80 ± .26 | -.978 | .332 | | |
| | Placebo | 1.89 ± .34 | | | 1.93 ± .40 | | | | |
| FT C1 | Nicotin | 1.78 ± .33 | -1.64 | .107 | 1.77 ± .27 | -1.52 | .135 | | |
| | Placebo | 1.95 ± .44 | | | 1.86 ± .40 | | | | |
| T3 | Nicotin | 1.82 ± .36 | -.942 | .351 | 1.86 ± .24 | -1.14 | .259 | | |
| | Placebo | 1.91 ± .36 | | | 1.95 ± .37 | | | | |
| C3 | Nicotin | 1.87 ± .33 | -1.034 | .305 | 1.81 ± .20 | -1.978 | .053 | | |
| | Placebo | 1.95 ± .31 | | | 1.96 ± .35 | | | | |
| CZ | Nicotin | 1.94 ± .31 | -1.084 | .284 | 1.93 ± .20 | -2.415 | .019* | | |
| | Placebo | 2.03 ± .25 | | | 2.10 ± .32 | | | | |
| C4 | Nicotin | 1.86 ± .32 | -1.477 | .145 | 1.83 ± .23 | -1.47 | .147 | | |
| | Placebo | 1.98 ± .28 | | | 1.95 ± .36 | | | | |
| T4 | Nicotin | 1.84 ± .35 | -.063 | .950 | 1.78 ± .28 | -1.061 | .293 | | |
| | Placebo | 1.85 ± .33 | | | 1.88 ± .39 | | | | |
| TT 1 | Nicotin | 1.89 ± .33 | -1.062 | .293 | 1.87 ± .23 | -1.177 | .245 | | |
| | Placebo | 1.98 ± .31 | | | 1.97 ± .40 | | | | |
| TCP1 | Nicotin | 1.83 ± .36 | -1.084 | .285 | 1.80 ± .22 | -1.441 | .157 | | |
| | Placebo | 1.93 ± .26 | | | 1.92 ± .40 | | | | |
| CP1 | Nicotin | 1.90 ± .31 | -1.044 | .301 | 1.89 ± .19 | -.782 | .440 | | |
| | Placebo | 1.98 ± .28 | | | 1.95 ± .35 | | | | |
| CP2 | Nicotin | 1.97 ± .27 | -1.273 | .208 | 1.94 ± .18 | -1.52 | .136 | | |
| | Placebo | 2.06 ± .29 | | | 2.05 ± .36 | | | | |
| TCP2 | Nicotin | 1.89 ± .33 | -1.071 | .289 | 1.86 ± .22 | -1.753 | .087 | | |
| | Placebo | 1.98 ± .31 | | | 2.02 ± .41 | | | | |
| TT 2 | Nicotin | 1.90 ± .33 | -1.188 | .240 | 1.86 ± .26 | -1.973 | .054 | | |
| | Placebo | 2.00 ± .27 | | | 2.03 ± .39 | | | | |
| T5 | Nicotin | 1.78 ± .35 | -1.606 | .114 | 1.78 ± .20 | -1.687 | .099 | | |
| | Placebo | 1.92 ± .31 | | | 1.93 ± .43 | | | | |
| P3 | Nicotin | 1.87 ± .30 | -1.199 | .235 | 1.87 ± .21 | -1.647 | .106 | | |
| | Placebo | 1.96 ± .28 | | | 1.99 ± .37 | | | | |
| P4 | Nicotin | 1.87 ± .28 | -.952 | .345 | 1.87 ± .22 | -1.558 | .126 | | |
| | Placebo | 1.94 ± .28 | | | 1.99 ± .35 | | | | |
| T6 | Nicotin | 1.79 ± .34 | -.940 | .351 | 1.74 ± .24 | -2.267 | .029* | | |
| | Placebo | 1.88 ± .35 | | | 1.97 ± .45 | | | | |
| PO1 | Nicotin | 1.89 ± .28 | -1.001 | .321 | 1.91 ± .18 | -.958 | .343 | | |
| | Placebo | 1.96 ± .27 | | | 1.98 ± .35 | | | | |
| PO2 | Nicotin | 1.93 ± .29 | -1.417 | .162 | 1.89 ± .21 | -2.081 | .043* | | |
| | Placebo | 2.04 ± .28 | | | 2.05 ± .38 | | | | |
| O1 | Nicotin | 1.89 ± .33 | -.887 | .378 | 1.82 ± .23 | -1.913 | .062 | | |
| | Placebo | 1.96 ± .29 | | | 1.97 ± .37 | | | | |
| OZ | Nicotin | 1.86 ± .31 | -1.324 | .191 | 1.87 ± .23 | -1.918 | .061 | | |
| | Placebo | 1.96 ± .26 | | | 2.01 ± .35 | | | | |
| O2 | Nicotin | 1.81 ± .28 | 1.374 | .175 | 1.79 ± .20 | -1.979 | .054 | | |
| | Placebo | 1.91 ± .29 | | | 1.94 ± .35 | | | | |

* There was significant difference between nicotine group and placebo group (p < .05).

Table 7. Correlation between cognitive function test and nicotine blood concentration

| Test | Pearson's Correlation | p |
|----------------------|------------------------------|----------|
| SBT | .154 | .417 |
| Digit Span | -.326 | .079 |
| Trial 1 | -.225 | .233 |
| Trial 2 | .306 | .100 |
| Trial 3 | .297 | .110 |
| Trial 4 | .070 | .715 |
| Trial 5 | .244 | .194 |
| Delayed recall | .169 | .373 |
| Delayed recognition | .031 | .873 |
| Learning slope | .445 | .014* |
| Memory retention | .048 | .801 |
| Retrieval efficiency | -.131 | .489 |

* $p < 0.05$

Table 8. The correlations between the changes of absolute power in qEEG and the blood level of nicotine

| Area EEG | Alpha | Beta | Delta | Theta |
|-----------------|-------|-------|-------|---------|
| FP1 | -.311 | -.435 | .178 | -.340 |
| FP2 | -.222 | -.244 | -.297 | -.125 |
| F7 | -.165 | -.295 | .105 | -.324 |
| F3 | -.286 | -.264 | -.346 | -.558** |
| FZ ^a | . | . | . | . |
| F4 | -.345 | -.292 | -.023 | -.579 |
| F8 | -.121 | -.296 | .161 | .077 |
| FTC2 | -.273 | .011 | -.007 | .043 |
| FTC1 | -.206 | .098 | .304 | -.106 |
| T3 | -.362 | -.108 | .054 | -.092 |
| C3 | -.307 | -.267 | -.084 | -.540** |
| CZ | -.337 | -.177 | -.244 | -.369 |
| C4 | -.331 | -.198 | -.099 | -.536** |
| T4 | -.338 | -.179 | -.043 | -.045 |
| TT1 | -.253 | -.391 | -.036 | -.550** |
| TCP1 | -.359 | -.197 | .040 | -.220 |
| CP1 | -.322 | -.219 | -.018 | -.522** |
| CP2 | -.147 | -.275 | .159 | -.406 |
| TCP2 | -.174 | .038 | .244 | -.500 |
| TT2 | -.274 | -.270 | -.093 | -.322 |
| T5 | -.195 | .070 | .106 | -.182 |
| P3 | -.263 | -.161 | -.040 | -.539** |
| P4 | -.297 | -.030 | .149 | -.479** |
| T6 | -.505 | -.263 | -.123 | -.358 |
| PO1 | -.256 | -.025 | .214 | -.217 |
| PO2 | -.306 | -.122 | -.036 | -.425 |
| O1 | -.077 | .057 | .172 | -.172 |
| OZ | -.087 | -.095 | -.096 | -.120 |
| O2 | -.226 | -.205 | -.092 | -.340 |

** Correlation is significant at the 0.01 level (2-tailed).

a Cannot be computed because at least one of the variables is constant.

Table 9. Correlation between the changes of qEEG and the changes in scores of trial 5

| Area \ EEG | Alpha | Beta | Delta | Theta |
|-----------------|-------|-------|-------|--------|
| FP1 | .023 | -.175 | .222 | -.348 |
| FP2 | .305 | .056 | .018 | -.106 |
| F7 | .308 | .178 | .325 | .056 |
| F3 | .025 | .125 | .164 | -.300 |
| FZ ^a | . | . | . | . |
| F4 | .036 | .097 | -.093 | -.285 |
| F8 | .287 | .443 | .110 | .131 |
| FTC2 | .192 | .308 | .307 | .029 |
| FTC1 | .148 | .544* | .344 | .311 |
| T3 | -.002 | .170 | .028 | -.019 |
| C3 | -.011 | .038 | .061 | -.438* |
| CZ | -.005 | .229 | .259 | -.310 |
| C4 | .025 | .166 | .105 | -.303 |
| T4 | -.034 | -.021 | .020 | -.188 |
| TT1 | .242 | .217 | .240 | .094 |
| TCP1 | -.011 | .198 | .355 | -.225 |
| CP1 | .044 | .050 | .308 | -.199 |
| CP2 | .037 | -.035 | .230 | -.369* |
| TCP2 | .103 | .178 | .181 | -.303 |
| TT2 | .039 | .122 | .071 | .011 |
| T5 | .089 | .447* | .362 | .089 |
| P3 | .033 | .025 | .239 | -.369 |
| P4 | .074 | .073 | .215 | -.247 |
| T6 | -.103 | -.048 | .084 | -.232 |
| PO1 | .015 | .050 | .293 | -.172 |
| PO2 | -.005 | -.007 | .174 | -.152 |
| O1 | .075 | .305 | .382* | -.116 |
| OZ | .100 | .093 | .349 | .107 |
| O2 | -.044 | -.003 | .403* | -.219 |

* Correlation is significant at the 0.05 level (2-tailed).

a Cannot be computed because at least one of the variables is constant.

IV.

5mg

7mg

14 mg

7mg

5mg

5

6.7 ± 3.6 ng/ml

14mg

가 14.6 ng/ml

50

SBT

가

SBT

SBT

SBT

Rey - Kim

5

가

5

가

51 - 52

가

가

가 7.2 ng/ml

가

가 53,54

50

가

가

가

K-WAIS digit span

가 digit span

54

55-58

digit span 가

가

가

가

delta theta 가 , alpha

35-37

diurnal vigilance가

가 , delta 가 가 59

, FP1, CZ, T6, PO2

delta

, TT2, O2

가

50

61,62

가

. Theta

가 가 theta

가 , theta 5

가

. alpha beta 가
 . delta theta
 24-27 alpha beta 가 24,29-31
 . delta 가 15 ng/ml
 39
 가 6.7 ng/ml 15 ng/ml
 delta 가 가
 delta 가
 가
 ng/ml alpha beta 가 가 10.0
 38
 가 가 6.7 ng/ml alpha beta
 가 가
 가
 EEG 가 EEG
 31
 가 EEG
 EEG 가
 delta 가
 5mg
 가

IV.

가 , 가 , 가

가

가

63

32 , 30 .

(Nicorderm) 5mg

9 quantitative

electroencephalography (qEEG) , 9 30

3 qEEG .

Short Blessed Test (SBT), Rey Kim

Memory test Korean Wechsler Intelligence Scale (K-WAIS) digit span

5mg 5

6.7 ± 3.6 ng/ml . SBT

가 . Rey Kim Memory test

가 가

가 . digit span

alpha,

beta 가 . delta

delta . Theta

1. 12. 1996
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Abstract

Effect of nicotine on the attention, memory and quantitative EEG in normal aged person

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The proportion of aged people has been increased continuously in Korea. Accordingly, psychiatric disorders in old person such as dementia have been focused in general health care. Therefore it is very important to prevent or treat the deterioration of cognitive functions in aged person even before overt manifestation of dementia.

There has been many reports on the effect of nicotine on cognitive function in human. However, the results are controversial. Moreover, most of the previous studies has been tested in normal middle aged people or in already dementic patients. However, there has been no report which studied the effect of nicotine exclusively in elderly healthy people who tend to have decreased cognitive function compared with young person.

The aim of this study was to investigate whether nicotine can improve cognitive function in healthy old aged people and to see what areas of brain show the changes in quantitative EEG.

The subject included 63 old persons who had not smoked and did not have psychiatric illness or other physical diseases. They were randomly divided into

two groups, Placebo and Nicotine groups. One subject could not finish the study. So finally Placebo group composed of 30 person and Nicotine group of 32. There were no differences in mean age, sex ratio, degree of education and marital status between the two group. Nicotine was administered using transdermal patch method. Nicorderm (ALZA, Kansas, MO, USA) 5mg was applied on the back on 9:30 in the morning. Quantitative EEG and cognitive function tests such as Short Blessed Test (SBT), Rey Kim Memory Test, and digit span test of K-WAIS were performed before and after nicotine administration. To see the correlation of blood level of nicotine with these test results, blood level of nicotine was checked using gas chromatography. The mean concentration of nicotine in blood was 6.7 ± 3.6 ng/ml 5 hours after nicotine administration.

As a result, memory function tested using Rey Kim Memory Test was significantly improved in Nicotine group and these effect was correlated with the blood level of nicotine. However, there was no significant difference in SBT and digit span scores between two groups. After nicotine administration absolute power of delta wave more decreased significantly in prefrontal and temporal area of the brain in Nicotine group than in Placebo group. Theta wave tend to decrease in several brain areas in Nicotine group but there were no difference in alpha and beta waves between two groups. The decrease of the absolute power of theta wave was correlated with the degree of nicotine blood level and was also correlated with the improvement of memory function.

In conclusion, these results suggest that nicotine administration in normal elderly persons can improve memory capacity with decrease in the power of slow waves of EEG in frontal and temporal areas.

Key Words: nicotine, elderly person, attention, memory, cognitive function, quantitative EEG.