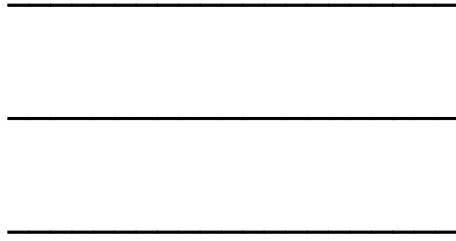


2002 12



가

가

가

가

가

가

10

가

2002 12

.....

I.	.....	1
1.	.....	1
2.	.....	5
II.	.....	6
1.	.....	6
2.	.....	7
3.	.....	9
3.1	.....	10
3.2	.....	12
4.	.....	13
4.1	.....	14
4.2	.....	16
5. 가	.....	17
5.1 가	.....	19
6.	.....	19
7.	.....	22

III.	.....	24
1.	.....	24
2.	.....	25
3.	.....	25
IV.	.....	27
1.	.....	27
2.	.....	28
3.	.....	29
4.	.....	32
5.	.....	34
6.	.....	35
V.	.....	37
1.	.....	37
2.	.....	38
VI.	.....	40
	.....	42
	.....	45

1.	.....	27
2.	.....	28
3.	.....	31
4.	.....	32
5.	.....	33
6.	.....	34
7.	.....	35
8.	.....	36

1.	.....	8
2.	Plethysmogram/BP/ECG (ECG)		
	.....	9
3.	.....	10
4.	.....	11
5.	.....	11
6.	.....	11
7.	.....	12
8.	.....	12
9.	.....	13
10.	.....	15
11.	.....	16
12.	가	18
13.	가	19
14.	.....	22

2002 5 2002 10
52.6±9.7)

55 (33 , 22 ,

27±42 . 14

, 29

156±11.9mmHg

131.8±14.1mmHg ,

101.1±4.1mmHg

87.5±

8.5mmHg

(p<0.001).

EI 0.77±

0.16 0.86±0.16 (p<0.001),

EEI 0.33±0.17

0.40

±0.21(p=0.0039)

b/a,

d/a

가 가

가 EI

가 .

b/a

가 EEI

1 가 b/a 1.845

b/a 1.287

EI

가

가

가

가

(risk factor)

, , ,

1 ,

가

(, 2002).

(10 72.9

) (10 39.1) (, 2001).

, 1999 2

227,000

(AHA, 2002).

, X-Ray

가

가가

가

가

(, 2002).

가

(InfraRed)

(Plethysmograph)

가 ,

- -

가 . - -
가

(, 2002).

2 가 가
(Takazawa et al, 1998).

가

(, 2002).

가

. 1934 Kramer가 Lambert-Beer

barrier layer photocell

, 1940 Millikan Kramer O₂

2

가

가 가

가 가

가 가

가

(, 2002).

1980

, 1988

가

가

가

2,500

가

가

30

가

가

(Cohn, 1995).

(SpO₂)

(Shelley, 2001).

가

가

2.

(elasticity)

(distensibility)

HbO₂

, ,
가 가

II.

1.

가
가
가
가 (:指尖)
0.16 , 가 () 1~2 가 10 가
가
가

2.

(contour)

가

가

1 A

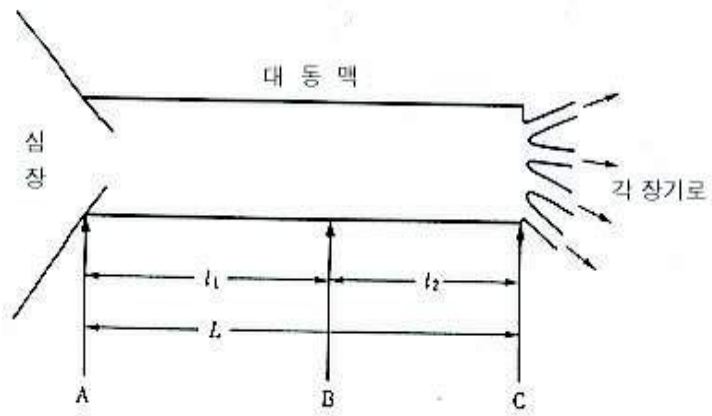
(compliance) C

가

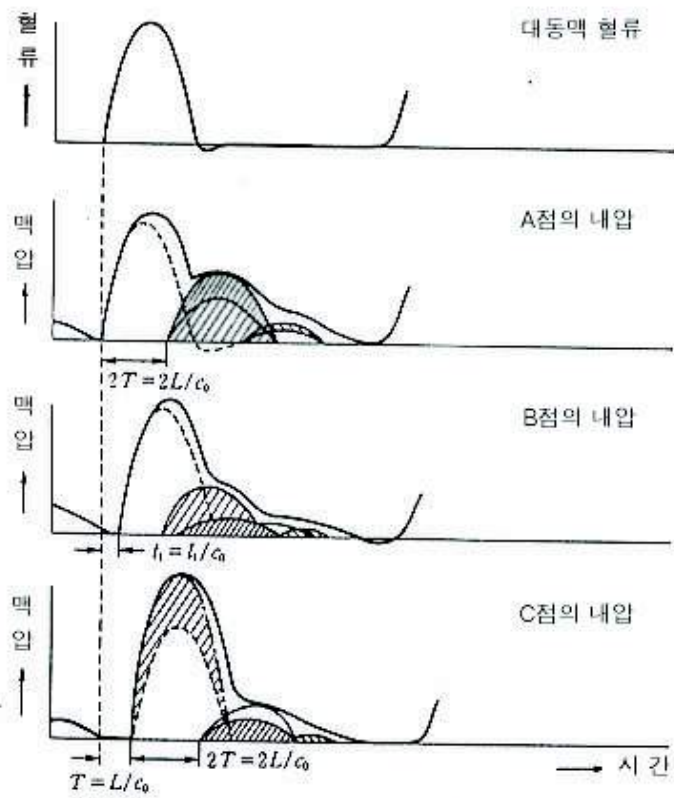
가 (가) 가

가

(HbO₂) (三上正俊, 1999).



(a)



(b)

1.

3.

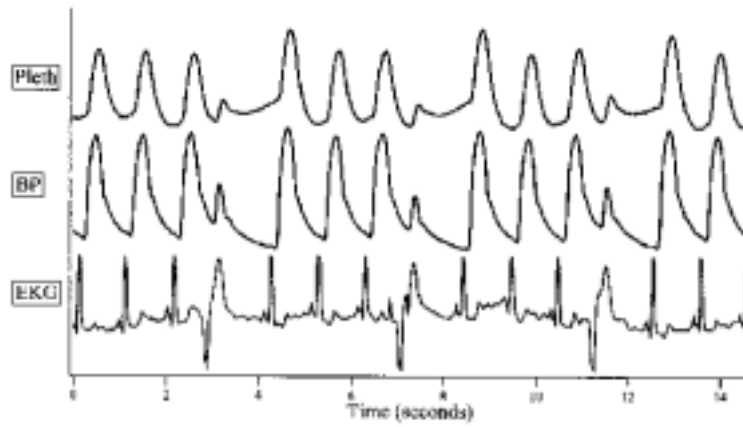
()

, 2

McPulse

가

(2).



2. Plethysmogram/BP/ECG

(ECG)

3.1

3

(plethysmogram)

가

()

1/250

4

가

500~1,000

가

(5).

가

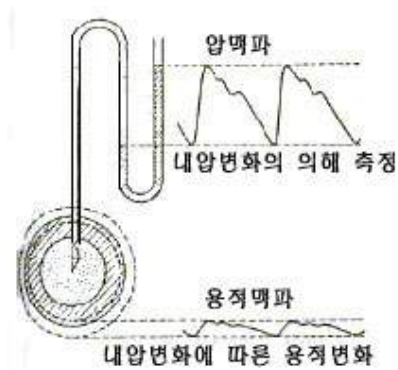
(6).

(波高)

가

가

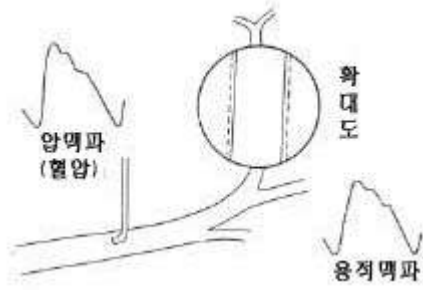
가



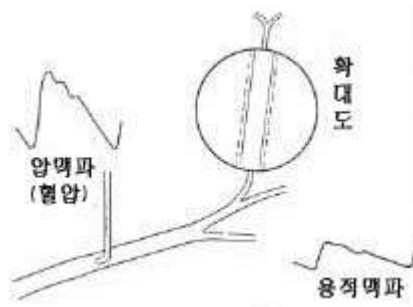
3.



4.



5.



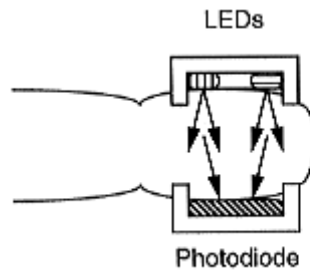
6.

3.2

7 가

(HbO₂)

(HbO₂) 가 (8).



7.

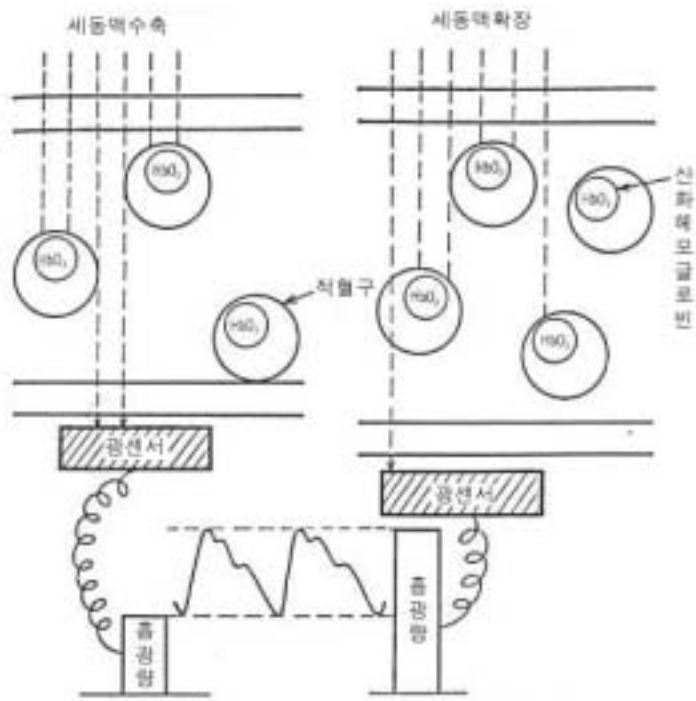


8.

(HbO₂)

가

가 (9).



9.

4.

가

가 .

가 가

4.1

(S), (P), (T), (C),
(D)가 (三上正俊, 1999).

가. (S. Appearance point)

(P, Percussion)

, 1 (P)

P

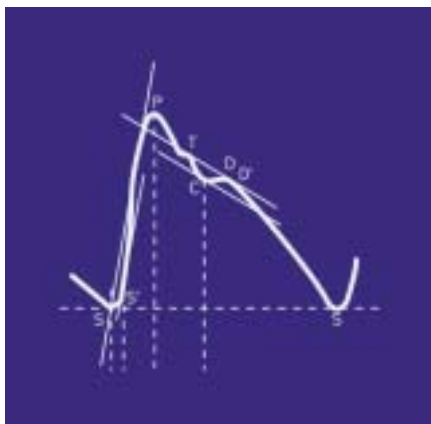
P 가

. (T, Tidal wave)

가

. (C, Incisura)

. (D, Dicrotic)



10.

S :
S-P :
P :
T :
C :
D :

4.2

11

(a)

(b)

(c)

(d)

가

(e)



(a)



(b)



(c)



(d)



(e)

11.

5. 가

가 (Accelerated plethysmogram) (PTG) 2

.

가 ,

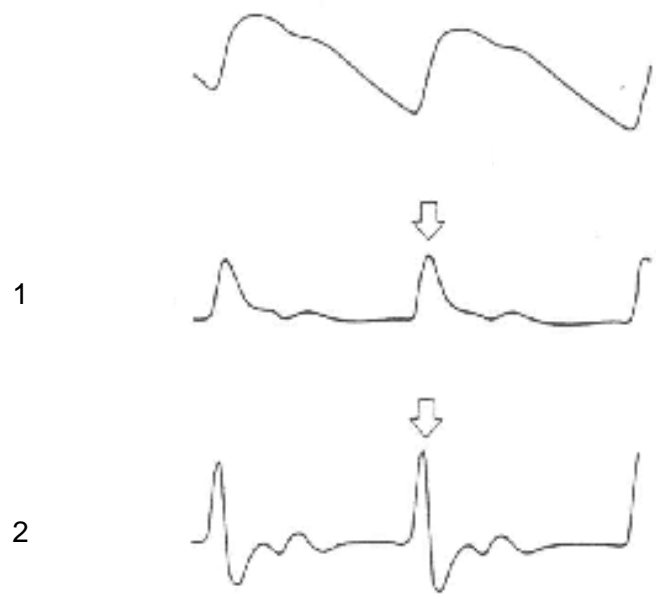
, 2

가 가 .

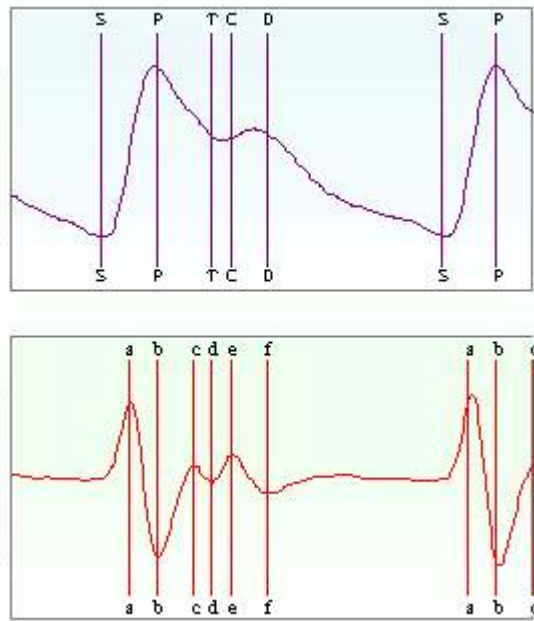
가

가 가 . (a,b,c,d,e,f)

.



가



12. 가

5.1 가

13 가 가 A, B, C, D,
 E, F, G type 7 가 가
 A type G type 가 .



(a) A type



(b) B type



(c) C type



(d) D type



(e) E type



(f) F type



(g) G type

13. 가

6.

가. PH(Pulse Height)

. 가

(1.0)

(16)

EI(Elastic Index)

(T1/T2) , (T) (T2)
(P) (T1)
EEI

Etc(Ejection Time)

,

EEI(Ejection Elastic Index)

T S P
가

a~d

DDI (Dicrotic Dilation Index)

P
가
DDI 가
DDI 가

(T)

가

DEI(Dicrotic Elastic Index)

b/a, d/a

b/a	가 ()
d/a	가 d d/a

APG

APG 7가 A type G type

A,B,C Type

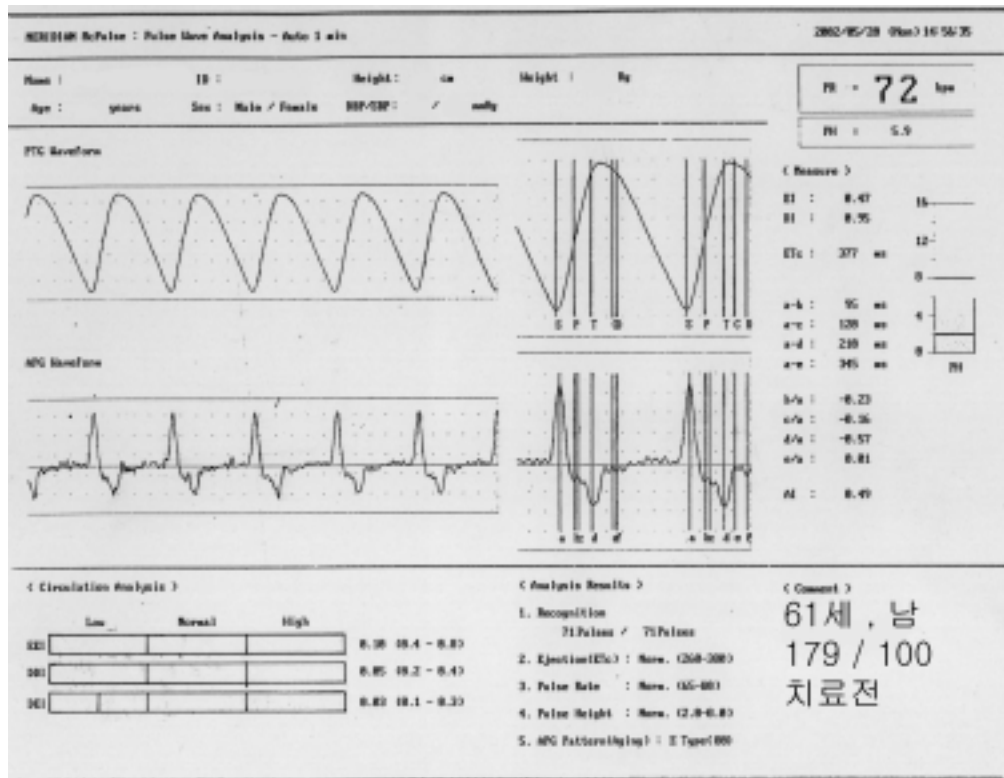
7.

14

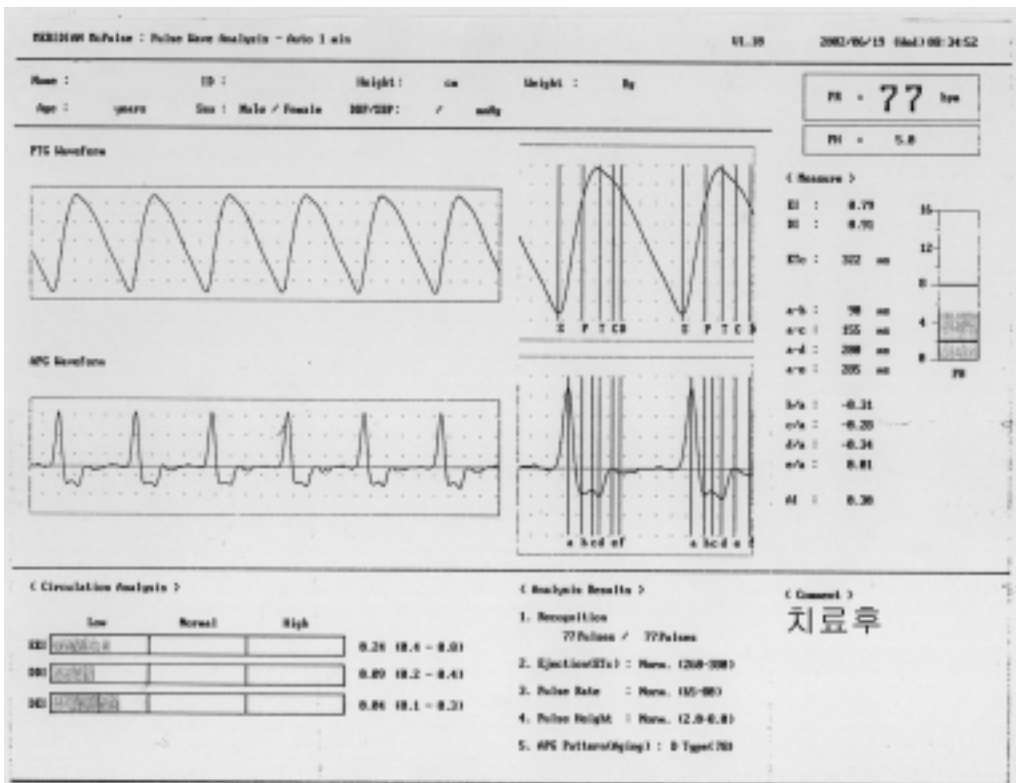
McPulse

(a)

, (b)



(a)



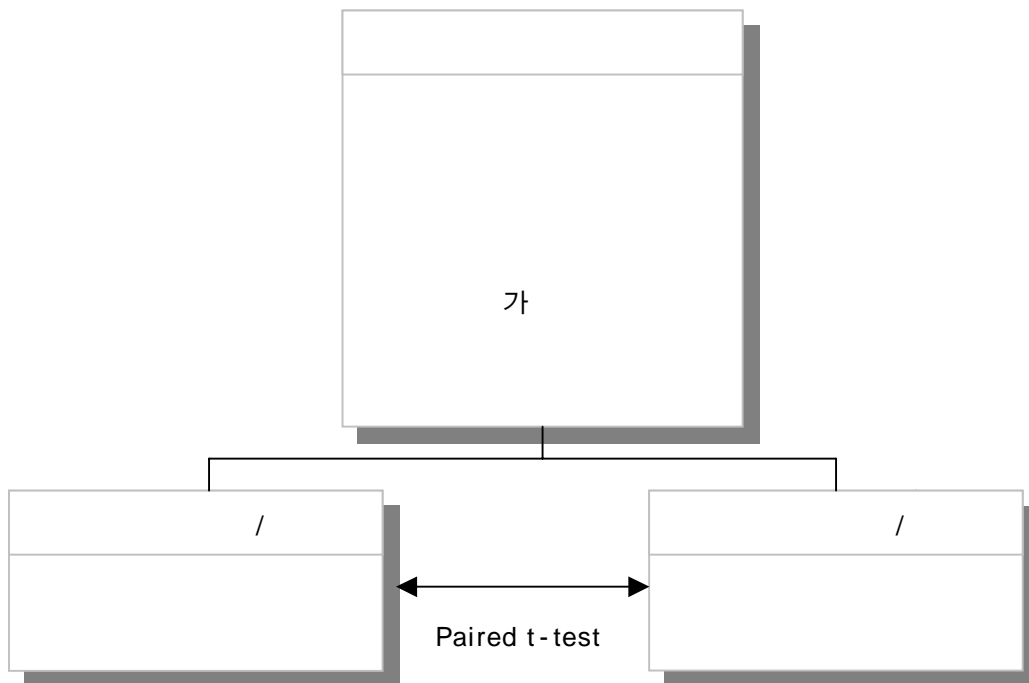
(b)

14.

III.

1.

paired t-test



2.

2002 5 2002 10
55 (33 , 22 ,
52.6±9.7)
1
(Norvasc)
McPulse (Meridian, co., R.O.K)

3.

SAS 6.12
paired t-test
160

가

IV.

1.

55 (33 , 22) 52.6±9.7
 14 , 29
 156.4±11.9mmHg
 101.1±4.1mmHg 27±42
 1 (1.8%)
 199.4±30.1mg/dL , 192.4±102mg/dL

(1).

1.	(n=55)
()	52.7 ± 9.7
()	33
(%)	29(52.7)
(%)	14(25.5)
가 (%)	34(61.8)
()	27.6 ± 42.5
(%)	1(1.8)
(mmHg)	156.4 ± 11.9
(mmHg)	101.1 ± 4.1
(mg/dL)	192.4 ± 102
(mg/dL)	199.4 ± 30.1

2.

				156±
11.9mmHg	131.8±14.1mmHg			
	101.1±4.1mmHg		87.5±8.5mmHg	
	(p<0.001).		EI	
	0.77±0.16		0.86±0.16 (p<0.001),	
		EEI	0.33±0.17	0.40±0.21
(p=0.0039)		b/a	-0.41±0.15	-
0.45±0.17	(p=0.0500),	d/a	-0.41±0.14	-
0.37±0.14	(p<0.001) (2).			

2.

			p - value
	156.4±11.9	131.8±14.1	0.000
	101.1±4.1	87.5±8.5	0.000
EI	0.77±0.16	0.86±0.16	0.000
EEI	0.33±0.170	0.40±0.21	0.004
b/a	-0.41±0.15	-0.45±0.17	0.050
d/a	-0.41±0.14	-0.37±0.14	0.000
LDH	390.9±68.7	370.0±52.7	0.003

EI ; Elastic Index

EEI ; Ejection Elastic Index

b/a ; a

b

d/a ; a

d

3.

160 , 159.9±11.1mmHg
 133.0±13.4mmHg , 102.6±3.7mmHg
 89.0±8.7mmHg (p<0.001). EI
 0.75±0.15 0.87±0.16 (p<0.001), EEI 0.31±
 0.17 0.40±0.22 (p=0.002). d/a 0.45±0.14
 0.37±0.13 (p<0.001). AI 0.14 ±0.32 0.07±0.32
 (p<0.001). DDI 0.13±0.06 0.17
 ±0.09 (p=0.02).
 b/a .

160 AI, DDI 가
 (3).
 ,
 30 140 , 90

155.2±11.5mmHg 123.2±10.2mmHg ,
 99.6±3.2mmHg 81.9±4.3mmHg
 (p<0.001). EI 0.72±0.12 0.83±0.14 가

(p<0.001), EEI 0.30±0.14 0.40±0.22
 (p=0.01). d/a 0.42±0.14 0.35±0.14
 (p=0.003). b/a
 (3).

140 90
 25 .
 157.8±12.3mmHg 142.1±
 10.7mmHg , 102.8±4.4mmHg 94.2
 ±7.2mmHg (p<0.001). EI 0.82±0.18
 0.90±0.16 (p=0.03), d/a 0.45±0.14 0.39±0.13
 (p=0.01), DDI 0.13±0.09 0.17±0.07
 (p=0.075).

EI 가가 (3).

3.

	p - value		
160			
	159.9 ± 11.1	133.8 ± 13.4	0.000
	102.6 ± 3.7	89.0 ± 8.7	0.000
EI	0.75 ± 0.15	0.87 ± 0.16	0.000
EEI	0.31 ± 0.17	0.40 ± 0.22	0.002
b/a	-0.39 ± 0.15	-0.43 ± 0.17	0.080
d/a	-0.45 ± 0.14	-0.37 ± 0.13	0.000
AI	0.14 ± 0.32	0.07 ± 0.32	0.000
DDI	0.13 ± 0.06	0.17 ± 0.09	0.020
	155.2 ± 11.5	123.2 ± 10.2	0.000
	99.6 ± 3.2	81.9 ± 4.3	0.000
EI	0.72 ± 0.12	0.83 ± 0.14	0.000
EEI	0.30 ± 0.14	0.40 ± 0.22	0.014
b/a	- 0.41 ± 0.14	- 0.46 ± 0.18	0.090
d/a	- 0.42 ± 0.14	- 0.35 ± 0.14	0.003
AI	0.06 ± 0.29	0.40 ± 0.22	0.245
DDI	0.14 ± 0.07	0.16 ± 0.10	0.470
	157.8 ± 12.3	142.1 ± 10.7	0.000
	102.8 ± 4.4	94.2 ± 7.2	0.000
EI	0.82 ± 0.18	0.90 ± 0.16	0.030
EEI	0.36 ± 0.19	0.41 ± 0.20	0.140
b/a	-0.41 ± 0.15	-0.43 ± 0.15	0.416
d/a	-0.45 ± 0.14	-0.39 ± 0.13	0.015
AI	0.13 ± 0.34	0.07 ± 0.30	0.154
DDI	0.13 ± 0.08	0.17 ± 0.07	0.075

EI ; Elastic Index

EEI ; Ejection Elastic Index

b/a ; a b

d/a ; a d

4.

가.

가 EI -0.42
EI
0.0016 가

(4).

4.

	EI	E EI	DDI	DEI	b/a	d/a	SBP	DBP
EI								
E EI	0.86***							
DDI	0.68***	0.61***						
DEI	0.45***	0.46***	-0.04					
b/a	-0.67***	-0.94***	-0.47***	-0.37***				
d/a	0.47***	0.72***	0.29*	0.27*	-0.81***			
SBP	-0.42**	-0.37**	-0.37**	-0.10	0.34*	0.24		
DBP	0.14	0.12	-0.16	0.25	-0.07	-0.05	0.21	

* ; p < 0.05

** ; p < 0.01

*** ; p < 0.001

가
 0.0043
 (5).
 DEI
 0.38
 DEI
 가

5.

	EI	E EI	DDI	DEI	b/a	d/a	SBP	DBP
EI								
E EI	0.87***							
DDI	0.65***	0.58***						
DEI	0.22	0.14	-0.25					
b/a	-0.68***	-0.95***	-0.44***	-0.08				
d/a	0.51***	0.71***	0.15	0.34	-0.77***			
SBP	-0.01	-0.21	-0.01	0.25	0.3**	-0.22		
DBP	0.15	0.03	-0.08	0.38**	0.02	0.02	0.68***	

* ; p < 0.05

** ; p < 0.01

*** ; p < 0.001

.

.

가
 DEI
 0.33
 가
 p<0.05
 가
 b/a

가 . 1 가 b/a 0.723
67.8%

7.

	EI	E EI	DDI	DEI	b/a	d/a
EI	0.377					
E EI		0.606**				
DDI			0.580**			
DEI				0.509*		
b/a					0.688***	
d/a						0.435**
	-0.003	-0.003	0.000	-0.001	0.002	-0.002
	0.000	0.000	0.000	0.000	0.000	0.000
	-0.025	-0.018	-0.021	0.003	0.012	-0.020
	0.055	0.075	0.027	0.028	-0.056	0.071
가	0.044	-0.023	-0.021	0.038*	0.036	0.067
	-0.006	0.063	-0.074	0.030	-0.123	0.091
	0.524	0.975*	0.430	-0.105	-0.723*	0.183
	-0.617	-0.629	-0.393	0.040	0.428	0.036
	0.019	0.020	-0.007	-0.005	-0.013	0.038
	0.668	0.291	0.064	0.021	-0.222	-0.174
R ²	0.483	0.643	0.429	0.660	0.678	0.626
	* ; p < 0.05	** ; p < 0.01		*** ; p < 0.001		

6.

E EI

b/a .

EEI b/a

(multiple regression) . 5%

8 .

5% EEI

1.845 1 가

b/a 1.845 b/a

1.287 (8).

8.

	EI	EEI	DDI	DEI	b/a	d/a
	-0.002	0.002	0.004	-0.018	-0.002	0.000
	0.000	0.000	0.000	0.005	-0.001	-0.001
	0.035	0.152	0.080	-0.767	0.072	-0.121
	0.009	-0.132	-0.018	-0.403	-0.113	0.147
가	-0.128	0.056	0.041	-1.045	0.062	0.196
	-0.030	-1.845 [*]	0.019	-1.161	-1.287 ^{**}	0.319
	-0.850	-2.894	0.452	11.556	-1.845 [*]	-0.005
	1.165	2.167	-0.606	-4.860	1.393	0.126
	0.001	-0.014	0.040	0.232	-0.016	0.086
	0.050	-0.186	-3.295	1.496	0.078	0.007
R ²	0.338	0.422	0.171	0.335	0.049	0.387

* ; p < 0.05

** ; p < 0.01

*** ; p < 0.001

V.

가

McPulse

가

1.

가

가

가

가

가

가

가

가

가

2.

1

McPulse

EI,

EEl,

b/a,

d/a

가
EI
b/a
가
가
가
EI
EI 가
가
가

VI.

2002 5 2002 10

55

1

McPulse

EI,

EEl,

b/a,

d/a

가

1

가 가

EI

b/a

가

EEl

b/a

, 가 EEI
,
.
가
가
가
가
.
가
가
.
, ,
가

· · · · · 1997 : 283-285

· · · · · 1983; 7(2) :
287-344

· · · · · 2002 :
6(1) ; 109-122

· · · · · 가 2002 : 23(1)

· · · · · 1985 ; 35(2) :
341-344

· · · · · 25
2001 ; 21

· · · · · 1992 : 320-321

· · · · · 2002

. 가

2002 ; 9(1) : 101 - 112

가.

American Heart Association. Heart and stroke statistical update 2002.

Asmar R, Rudnichi A, Blacher J, et al. Pulse pressure and aortic pulse wave are markers of cardiovascular risk in hypertensive population. AJH 2001 ; 14 : 91-97

Bortolotto LA, Blacher J, Kondo T. Assessment of vascular aging and atherosclerosis in hypertensive subjects: Second derivative of photoplethysmogram versus pulse wave velocity. AJH 2000 ; 13 : 165-171

Cohn JN, Finkelstein S, McVeigh G, et al. Noninvasive pulse wave analysis for the early detection of vascular disease. Hypertension 1995 ; 26 : 503-508

Franklin KA, Sandstrom E, Johansson G, et al. Hemodynamics, cerebral circulation, and oxygen saturation in Cheyne-Stokes respiration. J Appl Physiol 1997 ; 83(4) ; 1184-1191

Johns Hopkins White Papers 1998. Coronary Heart Disease

Sakaguchi J. Clinical investigation on finger plethysmography the plethysmographic findings of cardiovascular dynamics in the grade of hypertension. J Tokyo Wom Med Coll 1978 ; 48 : 10-23

Shelley K, Shelley S. Pulse oximeter waveform:Photoelectric Plethysmography. Other Monitoring Applications : 2001 ; 420-428

Sumner Ds, Strandness DE. An abnormal finger associated with cold sensitivity. Ann Surg 1972 ; 175 : 294-298

Tanaka N, Fufita M, Matsuoka O, Saiki T, Aikawa M, et al. Assessment of vasoactive agents and vascular aging by the second derivative of photoplethysmogram waveform. Hypertension 1998 ; 32(2) : 365-370

Wilkinson IB, Cockcroft JR, Webb DJ. Pulse wave analysis and arterial stiffness. JCVF 1998 ; 32(Suppl.3) : S33-S37

Zweifler AJ, Nicholls MG. Diminished flinger volume pulse in borderline hypertension : Evidence for early structural vascular abnormality. Am Heart J 1982 ; 104 : 812-815

三上正俊, 鍵谷 文. 脈波の多彩な魅力-動脈硬化度診断の革命. 日本圖書刊行會近代文藝社 1999

Abstract

A Study of hemodynamic change through non-invasive plethysmogram analysis for hypertension patient treatment

**Seon Mi Lee
Graduate School of
Health Science and Management
Yonsei University**

(Directed by professor Eun-Cheol Park M.D., Ph.D.)

The purpose of is to find the hemodynamic change of hypertension patient before/after the treatment of 'Ca-channel blocker' through the plethysmogram analysis

The subjects of this study were 55 hypertension outpatients of a general hospital from May 2002 to October 2002. Among those 33 were male and 22 were female and the age average was 52.6 ± 9.7 .

'Ca-channel blocker' was given to the all patients for one month. All the objects of the study were diagnosed as essential hypertension patients without other disease.

The analysis results are as follows:

1. After 1 month treatment of Ca-channel blocker, noticeable change was found in systolic blood pressure and diastolic blood pressure($p < 0.001$). Ejection Elastic Index(EEI) showed statistically remarkable change, and pulse height b/a and pulse height d/a showed significant change.

2. After 1 month treatment of Ca-channel blocker, the EI of the group who returned to normal blood pressure has far more increased than that of the group who did not returned to normal blood pressure.

3. Before the treatment of the Ca-channel blocker, as systolic blood pressure increased, the EI decreased.

4. Taking medicine for hypertension treatment reduced the change of Ejection Elastic Index(EEI)

This study shows that systolic blood pressure affects EI. The loss of blood vessel elasticity is the early prediction index for the cardiovascular disease. Reinforcement of the preventive measures for early check up of blood vessel related disease can considerably help to diagnose the cardiovascular disease.

As a result, the study of plethysmogram analysis for blood vessel elasticity and resistance status will be helpful material for early checkup of cardiovascular disease.