일반인구의 심박동수 변이의 결정인자들

전형준[1] · 김상섭[1] · 성지동[2] · 백도명[1]

Determinants of Heart Rate Variability in General Korean Population

Hyungjoon Chun, MD[1], Sangsup Kim, MD[1], Jidong Sung, MD[2] and Domyung Paek, MD[1]

[1]*Department of Occupational and Environmental Medicine, School of Public Health, Seoul National University, Seoul, [2]Department of Internal Medicine, Seoul National University Hospital, Seoul, Korea*

ABSTRACT

Background and Objectives   Heart rate variability has been known to be a prognostic factor of heart disease. However, determinants of heart rate variability in general korean population without clinical heart disease have not been studied. Objectives of this study were to measure heart rate variability in general population and to investigate clinical determinants of heart rate variability. **Methods**   Heart rate variability measures were obtained by LRR-03[TM] and MemCalc[TM] software (GMS, Tokyo, Japan) from public officials in a district of Seoul and their families (n 569). Predictors of heart rate variability included age, gender, heart rate, smoking status, systolic blood pressure, diastolic blood pressure, serum total cholesterol, HDL-cholesterol. Univariate analysis and analysis of variance of low frequency power (0.04- 0.15 Hz), high frequency power (0.15- 0.30 Hz), and total power spectrum in relation to explanatory variables were done. In order to select determinants of heart rate variability, multiple linear regression model of each heart rate variability measure was created and stepwise selection method was applied. **Results**   Analysis of variance showed that older age, higher heart rate, body mass index 27, systolic blood pressure 140 mmHg, diastolic blood pressure 90 mmHg, and serum total cholesterol 240 mg/dl were negatively associated with one or more heart rate vari-ability measures. Serum HDL-cholesterol 35 mg/dl was positively associated with low and high frequency power. Multiple linear regression analyses showed that age and heart rate were the major determinants, gender and cardiovascular risk factors such as diastolic blood pressure, HDL-cholesterol, and smoking contributed to one or more heart rate variability measures. **Conclustions**   Age, heart rate, gender, and cardiovascular risk factors must be considered when evaluating heart rate variability. **(Korean Circulation J 2001;31(1):107-113)**

KEY WORDS   Heart rate variability · Power spectral analysis · General population.

서 론

[1)]

1965 Hon Lee

[2)]

65   569   .

5- 8)
.   방 법

9- 11)
.   ,   ,   ,

.

.

12) 13)
.

30

.

.   ,

GMS   LRR- 03   3
LRR- 03

.   .

LRR- 03
MemCalc/BP Analyzer

.   . LRR- 03
,   ,
14)

2
15)   .
,

MemCalc/BP Analyzer
16)   RR signal   , RR
signal   90%   .
.   QRS complex   normal-
to- normal(NN) interval   power spectral density
curve   . power spectral density curve

대상 및 방법

0.04~ 0.15 Hz   (low frequency
power), 0.15- 0.30 Hz   (high
frequency power)   spectral power
Total power spectrum   .

대 상
1999   6   8
698

통계분석
.   ,   , Total power spectrum
,

,   abnormal q wave, WPW   .
syndrome   ,
RR signal   90%
655   .   15

Table 1. Mean and standard deviation (SD) of natural log transformed heart rate variability measures in relation to explanatory variables. Differences between categories were tested by analysis of variance

	Number	ln LF	ln HF	ln TPS
Age (yr)				
15- 24	79	5.68± 0.85	5.09± 1.33	7.00± 0.76
25- 34	112	5.78± 0.92	5.25± 1.20	7.07± 0.78
35- 44	203	5.36± 0.85	4.74± 1.36	6.74± 0.80
45- 54	113	4.99± 1.10	4.26± 1.43	6.36± 0.92
55- 64	62	4.47± 1.09**	3.76± 1.36**	6.19± 0.92**
Gender				
Male	298	5.38± 1.05	4.70± 1.42	6.71± 0.94
Female	271	5.25± 1.00	4.67± 1.42	6.70± 0.81
HR (beats/min)				
< 70	142	5.52± 0.95	5.15± 1.26	7.03± 0.75
70- 79	230	5.43± 0.98	4.73± 1.38	6.78± 0.78
80- 89	135	5.23± 1.02	4.47± 1.39	6.57± 0.87
> 90	62	4.63± 1.08**	3.97± 1.53**	5.98± 1.04**
BMI				
27	58	5.01± 1.25	4.35± 1.61	6.49± 1.14
< 27	511	5.35± 0.99*	4.73± 1.39	6.73± 0.84
SBP (mmHg)				
140	51	4.92± 098	4.46± 1.35	6.39± 0.76
< 140	518	5.36± 1.02**	4.71± 1.42	6.74± 0.88**
DBP (mmHg)				
90	126	4.97± 0.98	4.22± 1.40	6.34± 0.83
< 90	443	5.41± 1.00**	4.82± 1.39**	6.81± 0.86**
Cholesterol (mg/dl)				
240	36	4.82± 1.39	4.04± 1.64	6.34± 0.83
< 240	533	5.35± 0.99*	4.73± 1.39**	6.73± 0.84
HDL-cholesterol (mg/dl)				
35	533	5.35± 0.98	4.74± 1.37	6.73± 0.84
< 35	36	4.77± 1.48*	3.90± 1.84*	6.32± 1.26
Smoking				
Smoker	156	5.30± 1.08	4.81± 1.43	6.71± 0.94
Non-smoker	413	5.32± 1.00	4.64± 1.41	6.70± 0.86

* p< 0.05 by analysis of variance (ANOVA)
** p< 0.01 by analysis of variance (ANOVA), ln LF natural log transformed low frequency power ln HF natural log transformed high frequency power ln TPS natural log transformed total power spectrum HR heart rate BMI body mass index SBP systolic blood pressure DBP diastolic blood pressure HDL high density lipoprotein

결   과

Table 1   Table 2

.   569   0.10

38.9   298   ,   271   .

.   413   148

,   265   .   156   ,

150   6   .   ,   ,

25~34   ,   , Total   ,

power spectrum   .   ,   ,

,   , Total power spectrum   ,

(p< 0.01).   . Total power spectrum   ,   ,

,   , Total power spectrum   ,

,   , Total power spectrum   ,

(p< 0.01).   .

고   찰

(p< 0.05).   Akselrod   power

Total power   spectral analysis

spectrum   (p< 0.01).   (tachogram)

,   .[17]

, Total power spectrum   .

(p< 0.01).

(p< 0.05)   .

(p< 0.01)   .   .

Table 2. Regression coefficient and partial R^2 values related to heart rate variability measures

Variable	ln LF		ln HF		ln TPS	
	Coeff	Partial R^2	Coeff	Partial R^2	Coeff	Partial R^2
Age (10 yr)	- 0.33	0.133	- 0.40	0.094	- 0.26	0.152
Gender (male vs female)	0.23	0.007	NS		0.11	0.004
HR (10 beats/min)	- 0.33	0.093	- 0.44	0.095	- 0.37	0.108
BMI	NS		NS		NS	
SBP (mmHg)	NS		NS		NS	
DBP (mmHg)	- 0.26	0.010	- 0.51	0.008	- 0.33	0.016
Cholesterol (mg/dl)	NS		NS		NS	
HDL-cholesterol (mg/dl)	0.41	0.007	0.65	0.010	0.26	0.005
Smoking (smoker vs non-smoker)	NS		0.33	0.009	NS	

NS   variable which was not significant (p   0.10) in the stepwise model

[18)19)]
.

,

.

.

power spectral density curve   0.04
~0.15 Hz   , 0.15~0.30 Hz   .

spec-
tral power   . Task Force of the European   [26)]
Society of Cardiology and the North American   [27)]
Society of Pacing and Electrophysiology   5
                                power spectral analysis   R- R interval
    0.04~0.15 Hz   , 0.15~0.40 Hz   [28)]
                        [20)]

Martinez- Lavin   0.04~0.15 Hz   ,   .   ,
0.15~0.50 Hz   ,[21)] Rossy   , Total power spectrum
    Thayer   0.03~0.15 Hz   , 0.18
~0.40 Hz   [22)]
                                                                                          .

                                power
spectral analysis   .

                    .   .
    Jensen- Urstad

                        ,   ,   .
            ,   ,   /   .
        [23)] Tsuji
                    ,   , NN interval   ## 요약 및 결론
    (SDNN)   [24)]

                                                                (n 569)
                    ,   .
        .   ,   ,   ,

                            Hayano   ,   ,
    [25)]   .   156   .
    150   6   GMS   LRR- 03   MemCalc/BP Analyzer
                                                                    .
        ,   ,   ,
                                            Total power spectrum

27 , 140 mmHg ,

90 mmHg , 240 mg/dl

35 mg/dl

중심 단어 · Power spectral analysis·

감사문 —————————————

power spectrum
analysis
MemCalc/BP analyzer

REFERENCES

1) Jalife J, Michaels DC. *Neural control of sinoatrial pacemaker activity. In: Levy MN, Schwartz PJ, eds. Vagal Control of the Heart: Experimental Basis and Clinical Implications. Armonk, NY: Futura;1994.*

2) Hon EH, Lee ST. *Electronic evaluations of the fetal heart rate patterns preceding fetal death: further observations. Am J Obstet Gynecol 1965;87:814-26.*

3) Reinhardt L, Makijarvi M, Fetsch T, Martinez-Rubio A, Bocker D, Block M, et al. *Reduced beat-to-beat changes of heart rate: An important risk factor after acute myocardial infarction. Cardiology 1996;87:104-11.*

4) Quintana M, Storck N, Lindblad LE, Lindvall K, Ericson M. *Heart rate variability as a means of assessing prognosis after acute myocardial infarction: A 3-year follow-*

5) Kleiger RE, Miller JP, Bigger JT, Moss AJ, and the Multicenter Post-Infarction Research Group. *Decreased heart rate variability and its association with increased mortality after acute myocardial infarction. Am J Cardiol 1987;59:256-62.*

6) Malik M, Farrell T, Cripps T, Camm AJ. *Heart rate variability in relation to prognosis after myocardial infarction: selection of optimal processing techniques. Eur Heart J 1989;10:1060-74.*

7) Bigger JT, Fleiss JL, Steinman RC, Rolnitzky LM, Kleiger RE, Rottman JN. *Frequency domain measures of heart period variability and mortality after myocardial infarction. Circulation 1992;85:164-71.*

8) Katz A, Liberty IF, Porath A, Ovsyshcher I, Prystowsky EN. *A simple bedside test of 1-minute heart rate variability during deep breathing as a prognostic index after myocardial infarction. Am Heart J 1999;138:32-8.*

9) Lee DH, Hwang HK, Shin DK, Lee HW, Kim YJ, Shim BS, et al. *Assessment of diabetic autonomic neuropathy by power spectrum analysis. Kor J Int Medicine 1991; 41(5):628-41.*

10) Park JW, Youn HJ, Chung WS, Park JC, Kim CM, Park IS, et al. *Changes of responses of autonomic nervous system in patients after myocardial infarction. Kor Circulation J 1994;24(2):272-9.*

11) Jang DW, Lee CW, Baik IS, Bae SC, Kim CW, Kwon JG, et al. *Comparison between Myocardial Infarction and Congestive Heart Failure Using by Heart Rate Variability Analysis of 24 hours Holter Monitoring. Kor Circulation J 1996;26(3):674-80.*

12) Tsuji H, Venditti FJ Jr, Manders ES, Evans JC, Larson MG, Feldman CL, et al. *Reduced heart rate variability and mortality risk in an elderly cohort. The Framingham Heart Study. Circulation 1994;90:878-83.*

13) May O, Arildsen H, Moller M. *Parasympathetic function during deep breathing in the general population: relation to coronary risk factors and normal range. J Intern Med 1999;245:287-94.*

14) Liao D, Barnes RW, Chambless LE, Simpson RJ Jr, Sorlie P, Heiss G. *Age, race, and sex differences in autonomic cardiac function measured by spectral analysis of heart rate variability-the ARIC study. Am J Cardiol 1995; 76:906-12.*

15) Jensen-Urstad M, Jensen-Urstad K, Ericson M, Johansson J. *Heart rate variability is related to leucocyte count in men and to blood lipoproteins in women in a healthy population of 35-year-old subjects. J Intern Med 1998; 243:33-40.*

16) Grundy SM, Pasternak R, Greenland P, Smith S Jr, Fuster V. *Assessment of cardiovascular risk by use of multiple-risk-factor assessment equations: A statement for healthcare professionals from the American Heart Association and the American College of Cardiology. Circulation 1999; 100:1481-92.*

17) Akselrod S, Gordon D, Ubel FA, Shannon DC, Berger AC, Cohen RJ. *Power spectrum analysis of heart rate fluctuation: A quantitative probe of beat-to-beat cardiovascular control. Science 1981;213:220-2.*

18) Malliani A, Pagani M, Lombardi F, Cerutti S. *Cardiovascular neural regulation explored in the frequency domain.*

up study. Eur Heart J 1997;18:789-97.

Circulation 1991;84:1482-92.

19) Pieper SJ, Hammill SC. *Heart rate variability: technique and investigational applications in cardiovascular medicine. Mayo Clin Proc 1995;70:955-64.*

20) Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. *Heart rate variability: standards of measurement, physiological interpretation and clinical use. Circulation 1996;93:1043-65.*

21) Martinez-Lavin M, Hermosillo AG, Rosas M, Soto ME. *Circadian studies of autonomic nervous balance in patients with fibromyalgia: A heart rate variability analysis. Arthritis Rheum 1998;41:1966-71.*

22) Rossy LA, Thayer JF. *Fitness and gender-related differences in heart period variability. Psychosom Med 1998; 60:773-81.*

23) Jensen-Urstad K, Storck N, Bouvier F, Ericson M, Lindblad LE, Jensen-Urstad M. *Heart rate variability in healthy subjects is related to age and gender. Acta Physiol Scand 1997;160:235-41.*

24) Tsuji H, Venditti FJ Jr, Manders ES, Evans JC, Larson MG, Feldman CL, Levy D. *Determinants of heart rate variability. J Am Coll Cardiol 1996;28:1539-46.*

25) Hayano J, Yamada M, Sakakibara Y, Fujinami T, Yokoyama K, Watanabe Y, *et al. Short- and long-term effects of cigarette smoking on heart rate variability. Am J Cardiol 1990;65:84-8.*

26) van Ravenswaaij-Arts CM, Kollee LA, Hopman JC, Stoelinga GB, van Geijn HP. *Heart rate variability. Ann Intern Med 1993;118:436-47.*

27) Finley JP, Nugent ST, Hellenbrand W. *Heart-rate variability in children. Spectral analysis of developmental changes between 5 and 24 years. Can J Physiol Pharmacol 1987; 65:2048-52.*

28) van Geijn HP, Jongsma HW, de Haan J, Eskes TK. *Analysis of heart rate and beat-to-beat variability: Interval difference index. Am J Obstet Gynecol 1980;138:246-52.*