LETTERS TO THE EDITOR

Evaluation of Autonomic Nervous Activity in Patients with Vibration Disease Using Electrocardiographic R-R Interval Variations

Key words: Vibration disease—Autonomic nervous activity—R-R interval variation

Many patients with vibration disease have various general symptoms such as headache, feeling of heaviness in the head, insomnia, irritable moods, forgetfulness and impotence. These symptoms suggest involvement of the central nervous and/or the autonomic nervous system in the causation of the disease. Some reports¹⁻⁴⁾ have stated that various dysfunctions of the autonomic nervous system (ANS) are found in patients with vibration disease.

We, in this study, took electrocardiographic R-R interval variation as an index of autonomic nervous activity, and studied the relationship between this index and various general symptoms in patients with vibration disease.

Fifty five male subjects, aged between 37 and 68 (mean 52.1 years) comprised the patient group. All of them were under application of the Workmen's Accident Compensation Insurance Law, and had been under treatment for vibration disease. Eighteen of them had used mainly chain-saws, 21 had used rock drills, 9 had used chipping hammers and 6 had used other vibrating tools.

As a control group, 16 male subjects aged between 40 and 65 (mean 53.1 years) were examined. Ten of them were under treatment for other diseases such as fracture of the clavicle or hemorrhoids. The other 6 had used vibrating tools, but no abnormalities were found by specific examination for vibration disease. None had received treatment for ischemic heart disease, diabetes mellitus, or neurological disease. As far as possible, medication were restricted for 24 hours prior to the electrocardiographical examination. Recording of each electrocardiogram (ECG) was performed on a morning in December, January or February, in a room of the hospital or the clinic where each patient received treatment. The room temperature was kept constant at approximately 20°C. Before the recording of ECG, each subject was asked, by means of a standardized questionnaire, whether general symptoms were present or not. The symptoms listed were headache, feeling of heaviness in the head, insomnia, irritable mood, forgetfulness, impotence, fatigability, and palmar sweating. On these symptoms, the subjects were required to choose one of three answers: "Not present", "Infrequently present", or "Always present". After the subject lay supine for 15 minutes, ECG waves were fed into the data recorder (TEAC R-71) for

Table 1. Correlation Coefficients among Age (AGE), Mean R-R Interval (R-R), Variance of R-R Interval (VAR), and Coefficient of Variance (CV)

	Patient Group (n=54)			Control Group (n=16)		
	AGE	R-R	VAR	AGE	R-R	VAR
R-R	0.053			-0.288		
VAR	-0.310*	0.536**		-0.728**	0.523*	
CV	-0.429**	0.049	0.859**	-0.748**	0.299	0.965**

* $p < 0.05$; ** $p < 0.01$ in Pearson's correlation coefficient

Table 2. Means and Standard Deviations for AGE, R-R, CV in the Patient Group and in the Control Group

	Patient	Control
n	54	16
AGE (years)	52.1 $\pm$ 7.6	53.0 $\pm$ 6.7
R-R (msec)	899.1 $\pm$ 139.0	892.9 $\pm$ 144.9
CV (%)	2.23 $\pm$ 0.58*	2.91 $\pm$ 1.11

Mean $\pm$ SD

* $P < 0.05$ in t-test between patient and control

approximately two minutes. Recorded ECG waves were replayed and 100 successive R-R intervals were processed with a Signal Processor (SANEI-SOKKI 7T07) to calculate mean R-R interval (R-R) and variance (VAR), and coefficient of variance (CV).

Table 1 shows all possible correlations of the four factors, age, R-R, VAR, and CV in the patient group and in the control group. There was a very high correlation between VAR and CV in both the groups. But comparing the two indexes, VAR and CV, we found that CV had no correlation to R-R, while VAR had significant correlation to R-R. From these results, it can be said that CV is a better index of autonomic nervous activity than VAR, because CV is independent of R-R interval.

Table 2 shows means and standard deviations of age, R-R, and CV in the patient group and in the control group. The two groups were almost identical in the mean ages and R-R. In the patient group, however, the mean CV was significantly smaller than in the control group.

The 54 patients were also divided into two groups of the "symptomatic" and the "asymptomatic" for each symptom, and Table 3 shows the means of age, R-R, and CV in the two groups. The mean ages were almost identical in the two groups. The means of CV were significantly smaller in "symptomatic" groups with feeling of heaviness in the head, and impotence, which is in agreement with other reports.⁵⁻⁷⁾ The means of R-R interval were shorter in the "symptomatic" group for almost all symptoms and the difference was significant for the symptom of impotence (Table 3).

It has been shown that CV values increased by the stimulation of the

Table 3. Means and Standard Deviations for the AGE, R-R, and CV in the Two Groups, Asymptomatic and Symptomatic

		Asymptomatic	Symptomatic
Headache	n	42	12
	AGE (years)	51.7 $\pm$ 7.3	53.4 $\pm$ 8.8
	R-R (msec)	910.2 $\pm$ 134.9	860.3 $\pm$ 152.4
	CV (%)	2.30 $\pm$ 0.49	1.97 $\pm$ 0.80
Feeling of Heaviness in the Head	n	30	24
	AGE (years)	52.4 $\pm$ 7.4	51.7 $\pm$ 8.0
	R-R (msec)	900.7 $\pm$ 139.8	897.1 $\pm$ 141.1
	CV (%)	2.39 $\pm$ 0.49	2.03 $\pm$ 0.64*
Insomnia	n	23	28
	AGE (years)	52.7 $\pm$ 7.6	50.8 $\pm$ 7.6
	R-R (msec)	937.1 $\pm$ 151.2	866.0 $\pm$ 122.8
	CV (%)	2.40 $\pm$ 0.57	2.09 $\pm$ 0.58
Forgetfulness	n	14	40
	AGE (years)	52.8 $\pm$ 8.3	51.8 $\pm$ 7.4
	R-R (msec)	944.6 $\pm$ 118.6	883.2 $\pm$ 143.5
	CV (%)	2.33 $\pm$ 0.69	2.20 $\pm$ 0.55
Irritable Mood	n	17	37
	AGE (years)	53.8 $\pm$ 6.5	51.2 $\pm$ 8.0
	R-R (msec)	940.9 $\pm$ 155.4	879.9 $\pm$ 128.6
	CV (%)	2.24 $\pm$ 0.65	2.23 $\pm$ 0.56
Impotence	n	34	16
	AGE (years)	50.3 $\pm$ 7.3	54.0 $\pm$ 7.1
	R-R (msec)	928.2 $\pm$ 138.1	838.2 $\pm$ 130.0*
	CV (%)	2.36 $\pm$ 0.51	1.98 $\pm$ 0.69*
Fatigability	n	12	41
	AGE (years)	50.2 $\pm$ 6.3	52.9 $\pm$ 7.8
	R-R (msec)	957.3 $\pm$ 115.4	885.5 $\pm$ 142.3
	CV (%)	2.45 $\pm$ 0.60	2.15 $\pm$ 0.57
Palmar Sweating	n	15	38
	AGE (years)	55.1 $\pm$ 7.8	51.2 $\pm$ 7.1
	R-R (msec)	916.3 $\pm$ 140.9	897.7 $\pm$ 137.6
	CV (%)	2.19 $\pm$ 0.59	2.24 $\pm$ 0.60

Mean $\pm$ SD* $p < 0.05$; in t-test between "asymptomatic" and "symptomatic"

parasympathetic nervous system^{8,9)} (PNS) including deep breathing, swallowing, coughing and breath holding. Furthermore, the R-R interval variation decreases after blocking the vagal activity with atropine, while propranolol does not significantly change this measure.¹⁰⁻¹³⁾ However, some reports¹³⁻¹⁵⁾ have shown that during stimulation of sympathetic nervous system (SNS), such as β -adrenergic stimulation with isoprotelenol, there was also a decrease in R-R variation. From these facts, CV values obtained in supine resting position without possible stimulation of SNS has been regarded as an indicator of PNS activity.^{9,11,15)}

The present results therefore suggest that the PNS activity in patient group or in "symptomatic" group might be reduced. But it can not be concluded that the smaller CV values in these groups reflect only decreased PNS activity alone, since we could not evaluate the SNS activity in this study. In further studies, a method to evaluate SNS activity should be added, or CV should be measured, independently of SNS activities, during β -adrenergic blockade.

ACKNOWLEDGEMENT

We thank the staff of Tsu-Seikyo hospital, Matsumoto-Kyoritsu hospital, Minato-Kyoritsu hospital, and Kamiyahagi hospital, for their technical help.

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(Received June 25, 1986 and in revised form March, 1987)