Assessment of heart rate variability in patients with chronic stable angina

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Mohammed Hassan Alwan*

Abstract

Background and objectives: A prospective study performed in Ibn-Albitar hospital a tertiary center to assess the effect of ischemic heart disease on heart rate variability.
Methods: Thirty nine consecutive patients all with history of chronic stable angina &with positive treadmill test underwent 24 hours holter test to assess heart rate variability. compared it with 25 age & sex matched control volunteer group.
Results: Thirty one (79.48%) male of patients group& 20 (80%) male of control group . heart rate variability expressed as (SDNN) standard deviation of normal to normal interval, (RMSSD) square root of the mean squared differences of successive normal to normal intervals& (*pNN50)* the proportion derived by dividing (NN50) the number of interval differences of successive normal to normal intervals greater than 50 milliseconds (ms.) by the total number of normal to normal intervals all were significantly lower in patients group.
Conclusion: This study showed that heart rate variability significantly lower in patients with chronic stable angina .
Key words: Heart rate, stable angina

Introduction

The last two decades have witnessed the recognition of a significant relationship between autonomic nervous system and cardiovascular mortality, including sudden cardiac death [1,2]. Experimental evidence for an association between a propensity for lethal arrhythmias and signs of either increased sympathetic or reduced vagal activity has encouraged the development of quantitative markers of autonomic activity. Heart rate variability (HRV) represents one of the most promising such markers [3]. This phenomenon concerned with the oscillation in the interval between consecutive heart beats as well as the oscillations between consecutive instantaneous heart rates. HRV has become the conventionally accepted term to describe variations of both instantaneous heart rate and RR intervals in the ECG [4].The clinical relevance of HRV was first appreciated in 1965 when Hon and Lee noted that fetal distress was preceded by alterations in interbeat intervals before any appreciable change occurred in the heart rate itself [5]. Twenty years ago, Sayers and others focused attention on the existence of physiological rhythms imbedded in the beat-to-beat heart rate signal [6, 7].The association of higher risk of post-infarction mortality with reduced HRV was first shown by Wolf et al [8]. The clinical importance of HRV became apparent in the late 1980s when it was confirmed that HRV was a strong and independent predictor of mortality following an acute myocardial infarction [9]. Variations in heart rate may be evaluated by a number of methods. Perhaps the simplest to perform are the time domain measures. With these methods either the heart rate at any point in time or the intervals between successive normal complexes are determined. In a continuous ECG record, each QRS complex is detected, and the so-called

*Department of Internal Medicine, College of Medicine, Hawler Medical University, Erbil, Iraq.

(NN) intervals (that is all intervals between adjacent QRS complexes resulting from sinus node depolarizations). The simplest variable to calculate is the standard deviation of the NN interval (SDNN), i.e. the square root of variance. The most commonly used measures derived from interval differences include *RMSSD*, *NN50* and *pNN50* All these measurements of short-term variation estimate high frequency variations in heart rate and thus are highly correlated [4]. Various spectral methods for the analysis of the tachogram had been provided the basic information of how power (i.e. variance) distributes as a function of frequency [10], however time–domain analysis is easier to perform [4].Heart rate variability in a general population sample shows expected associations with all known cardiovascular risk factors [11, 12]. Vagal modulation as assessed by HRV analysis was enhanced in association with exercise induced inferoposterior ischemia [13]. Several studies showed that HRV has an independent value in predicting total survival of patients with chronic heart failure. Recently the predictive power of HRV in patients with congestive heart failure has also been reported [14].

Methods

The present study involved patients who attend outpatient clinic in Ibn-Albitar hospital with chest pain where they underwent thorough history, medical examination, ECG at rest, ECG exercise test, Echo study &blood examination. Among all patients, 39 complete the above work and included in the study workup from first of March 2006 to twenty of September 2006 after full filling the following criteria: 1-have classical ischemic chest pain with at least two risk factors for IHD and positive exercise ECG test. 2-Having chronic stable angina (15) on anti-ischemic treatment according to preference of treating cardiologist. 3-Patients with acute myocardial infarction (AMI), unstable angina, valvular heart disease, decompensated heart failure& patients not in sinus rhythm were excluded from the study. The control group involved healthy volunteers who were age & sex matched to the patients group. Severity of chronic stable angina was assessed clinically and by using ECG exercise test (EET). Clinically patients classified according to Canadian cardiovascular society (CCS) with class I mean normal ordinary physical activity, class II slight limitation of ordinary physical activity, class III marked limitation of ordinary physical activity class VI pain at rest [16]. EET were performed for all patients in the study group, treadmill test was used according to bruce protocol. Positive EET was defined as horizontal or down sloping of ST segment depression or elevation in non-Q wave lead of 1mm for at least 60-80millisecond after J point in any of the 12 leads [17, 18]. 24 hour holter study was done for all patients & controls, all of them given appointment between (8 to 9 A.M.) and removed on the following day at (8 to 9 A.M.). HRV measured as SDNN, RMSSD, and PNN50. NN50, number of interval differences of successive NN intervals greater than 50 milliseconds [8].Left ventricular (L.V.) dysfunction was defined as ejection fraction (EF) below 50. Mild L.V. dysfunction defined as EF between (45%-50%). Moderate L.V. dysfunction defined as EF below (45%). Severe L.V. dysfunction defined as EF below (35%) [18]. Statistical analysis all data were presented as mean ± SD. Comparison among data were done using Z test, P value < 0.05 accepted as minimal value for significance.

Results

This study involved 39 patients with CSA & 25 person were taken as control. Table (1) showed no significant difference in age or sex distribution between the two groups. Hypertension, diabetes mellitus & positive family history of coronary artery disease (CAD) were more prevalent in the study group as in (Table 1). Patient in functional class 1 according to CCS classification

were 11 (28%), CCS class II were 18 (46%) &10 patients were in class III (25.64%) as in (Table 2). The resting ECG in patients with CSA showed that 27 patient (69.23%) had normal ECG,4 patients (10.25%) with significant Q wave,7 patients (17.94%) with T wave inversion &one patient (2.65%) with ST depression as in (Table 3). Echocardiography in patients with CSA showed that 35 patients (89.74%) were having good L.V function, 2 patients (5.12%)had mild L.V dysfunction & 2 patients (5.12%) had moderate L.V dysfunction as in (Table 4). In all patients with CSA& positive ECG exercise test, SDNN, RMSSD& PNN50 were significantly lower in patients with CSA than control as in (Table 5).

Table 1: Base line characteristics of study and control groups.

Variable	Patients	Control	P value
Number	39	25	
Age (year)	57.816 ± 7.707	56.70± 6.50	0.30
Male No.(%)	31 (79.4)	18 (72)	0.510
Female No.(%)	8 (20.5)	7 (28)	0.490
Hypertension No. (%)	20 (51.3)	6 (24)	0.03
Diabetes mellitus No. (%)	9 (23)	2 (8)	0.119
Smoker No. (%)	20 (51.3)	12 (48)	0.790
Positive family history of CAD No.(%)	10 (25.6)	2 (8)	0.078

Table 2: Classification of angina in patients with CSA

CCSC class	Value
Class I No. (%)	11 (28)
Class II No. (%)	18 (46.64)
Class III No. (%)	10 (25)
Class IV No. (%)	0 (0)

Table 3: Resting ECG findings in patients with CSA

Variable	Value
Number	39
Q wave No. (%)	4(10.25)
T inversion No. (%)	7(17.94)
Resting ST depression No. (%)	1(2.65)
Normal No. (%)	27(69.23)

Table 4: Echocardigraphic finding in study group.

Number	39
Good L.V.F No. (%)	35 (89.74)
Mild L.V. dysfunction No. (%)	2 (5.12)
Moderate L.V. dysfunction No. (%)	2 (5.12)
Severe L.V. dysfunction No. (%)	Zero (0)

Table 5: Heart rate variability in study and control groups

HRV	Patients with CSA	Controls	P value
SDNN	113.8 ± 25.2	142.54± 34.15	0.0001
RMSSD	33.7 ± 18.73	45.95 ± 28.23	0.0014
PNN50	8.28 ± 6.98	14.5 ± 10.63	0.0001

Discussion

This study involved patients with chest pain suggestive of chronic stable angina, who were referred to a tertiary center for farther evaluation. Among all patients during the study period 39 patients fulfiled the inclusion criteria. Hypertension diabetes mellitus & family history were more prevalent in CSA group than control. This is expected as these risk factors increase the tendency to develop angina [19]. We chose patients with positive EET as patients group. Most of patients had normal resting ECG &Echo. These were due to type of patients selected as more than 70% of our patients are in CCS I & II. Most of the studies concerned with HRV and CSA involved post-myocardial infarction patients [20, 21, 22, 23] however studies involving HRV in patients with CSA are lacking making comparison of results of this study with other studies difficult. HRV significantly lower in patients with CSA than control group. Vagal modulation as assessed by HRV analysis was enhanced in association with exercise induced inferoposterior ischemia[13]. The RR interval variations present during resting conditions represent a fine-tuning of the beat-to-beat control mechanisms [24, 25]. Vagal afferent stimulation leads to reflex excitation of vagal efferent activity and inhibition of sympathetic efferent activity. The opposite reflex effects are mediated by the stimulation of sympathetic afferent activity [26]. Efferent vagal activity also appears to be under 'tonic' restraint by cardiac afferent sympathetic activity [27]. Efferent sympathetic and vagal activities directed to the sinus node are characterized by discharge largely synchronous with each cardiac cycle. Ischemic heart disease seems to affect these efferent afferent interaction pathways and as a result HRV is affected, however the exact mechanism of interaction between HRV& IHD is not known [4].

Conclusion

Heart rate variability as measured by time domain method assessed by NNSD, RMSSD, PNN50 was significantly reduced in patients with CSA.

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