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RESEARCH ARTICLE

CAN ANXIETY AMONG TRAFFIC POLICEMEN AFFECT THEIR HEART RATE VARIABILITY?

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ABSTRACT

Heart Rate Variability (HRV) provides non invasive, unobtrusive information about modulation of heart rate by Autonomic Nervous System (ANS). HRV is commonly described by standard deviation of intervals between successive R waves (SDNN) of cardiac cycle. Reduced HRV is indicated by reduced SDNN. Work stress is a common entity in the present day world and a job involving the manning of a traffic signal is one such stressful jobs. ANS is involved in the physiological expression of anxiety and stress. HRV analysis can be used as a tool to analyze the sympathovagal imbalance that might be precipitated due to anxiety. The aim of the study was to estimate HRV in traffic policemen and to study the association between their anxiety scores and HRV. HRV of all participants was recorded for 5 min in supine position in a quiet room. Speilberger's State Trait Anxiety Inventory questionnaire with scores ranging from 20 to 80 was given to subjects. Anxiety scores were correlated with SDNN using Pearson's correlation coefficient. There was a negative correlation between SDNN and anxiety level in traffic policemen ($r = -0.729$, $p < 0.01$). Reduced HRV was seen in subjects with high anxiety score indicating sympathetic dominance.

INTRODUCTION

Heart rate variability is a noninvasive electrocardiographic marker reflecting the activity of the sympathetic and vagal components of the ANS on the sinus node of the heart. It expresses the total amount of variations of both instantaneous heart rate and R-R intervals (intervals between QRS complexes of normal sinus depolarization) (Camm *et al.*, 1996). Analysis of the variability in R-R intervals in the ECG also known as HRV can indicate any imbalances between sympathetic and vagal influences on the heart. Newer method of autonomic function testing is based on the signal processing applied on Heart Rate Variability (HRV) signal. The information available from the time-frequency representation of HRV signals is useful in classifying the subject population into 4 classes namely normal, sympathetic loss, parasympathetic loss and combined losses. The results of earlier studies suggest that the presence of autonomic neuropathy can be clearly detected by short time HRV signal analysis possible in the clinical environment (Camm *et al.*, 1996). Although automaticity is intrinsic to different cardiac tissues with pacemaker properties, the electrical and contractile activity of the myocardium is largely modulated by the Autonomic Nervous System (ANS). Both branches of the ANS influence ion channel activity implicated in the regulation of depolarisation of the cardiac pacemaker cells. In a healthy volunteer, the Parasympathetic Nervous System (PNS) fibres and the Sympathetic Nervous System (SNS) fibres richly innervate the sinoatrial node. Parasympathetic innervations of the heart are mediated by the vagus nerve which causes a decreased firing of the SA node thereby decreasing the heat rate whereas stimulation by the sympathetic fibers causes an increase in the heart rate. Thus the variability in the heart rate is due to the action of balance and synergy between the two branches of the autonomic system, which is mainly enforced through neural, mechanical, humoral and other physiological mechanisms. It maintains cardiovascular parameters in their most favorable ranges and permits suitable reactions to change in external or internal stimuli (McCraty *et al.*, 1995). This balance between the effect of the SNS and the PNS is known as the sympathovagal balance and is believed to be

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echoed in the beat-to-beat changes of the cardiac cycle (Malik and Camm, 1993). Heart Rate Variability (HRV) helps provide a non invasive and unobtrusive information regarding modulation of heart rate by Autonomic Nervous System (ANS) in a variety of dynamic circumstances including evoked emotions. Cardiovascular autonomic functioning of the heart can be tested by standard tests devised by Ewings *et al*. power spectral analysis of HRV (Camm *et al*., 1996), time domain measures of HRV (Camm *et al*., 1996) etc. One of the important time domain measures of HRV is commonly described by standard deviation of intervals between successive R waves (SDNN) of cardiac cycle. Reduced HRV is indicated by reduced SDNN. Altered HRV is seen in conditions like diabetes mellitus, hypertension and in patients with acute myocardial infarction, renal failure and in psychiatric disorders (Acharya *et al*., 2006). Clinical studies involving HRV remains one of the most promising methods of investigating general health. ANS is involved in physiological expression of anxiety and stress. Hence HRV can be used as a useful tool in analyzing the sympathovagal balance during anxiety. Anxiety was defined by Freud as “something felt,” an emotional state that included feelings of apprehension, tension, nervousness and worry accompanied by physiological arousal. Consistent with Darwin's theory of evolution, Freud defined that anxiety was adaptive in motivating behavior that helped individuals cope with threatening situations and that intense anxiety was prevalent in most psychiatric disorders.

In measuring anxiety, the importance of distinguishing between anxiety as an emotional state and individual differences in anxiety as a personality trait was emphasized (Spielberger *et al.,* 1985). HRV has been shown to be a valuable indicator and predictor of "burnout" states that result in the inability of the body to respond to external and internal stress.HRV can be used to characterize many psychological disorders including major depression and panic disorders which gives a very important link between HRV and emotional states (McCraty *et al*., 1995). HRV analysis done after mental stress and in situations of hostility have shown sympathetic dominance and reduced parasympathetic activity. Reduced parasympathetic tone has also been strongly reported in heart failure and following myocardial infarction and in hypertension (McCraty *et al*., 1995). Spielberger (1983) developed the State–Trait Anxiety Inventory (STAI). The STAI consists of two 20-item self-report measures. The STAI State assesses how respondents feel “right now, at this moment” (e.g., “I feel at ease”; “I feel upset”), and the STAI Trait targets how respondents “generally feel” (e.g., “I am a steady person”; “I lack selfconfidence”). In addition, the STAI State and Trait each have been found to contain two factors, which Spielberger labeled anxiety-present and anxiety-absent (Spielberger *et al*., 1983). Respondents are asked to rate themselves on each item on the basis of a 4-point Likert scale, ranging from not at all to very much so for the STAI State and from almost never to almost always for the STAI Trait (Gro *et al*., 2007).

Aims and Objectives

The present study was designed to

- Estimate HRV in traffic policemen of a town in Karnataka.
- Study the association between anxiety levels and HRV in traffic policemen.

MATERIALS AND METHODS

The study included 35 traffic policemen of a town in Karnataka aged 25 – 60 yrs. Ethical clearance was obtained from ethics committee of the institute. Written informed consent was obtained from all the participants. The subjects were selected based on inclusion and exclusion criteria.

Inclusion criteria

Study group

1. Male subjects between 25-60yrs of age.

Exclusion criteria

1. Subjects with history of diabetes mellitus, hypertension, myocardial infarction, anxiety disorders and demyelinating diseases (Anderson *et al*., 1989; Flachenecker *et al*., 1997).
2. Subjects on medication with antiarrhythmics and atropine (Kleiger *et al*., 2005).

The subjects were given questionnaire to collect information about their smoking history, history of ischemic heart disease, diabetes mellitus, hypertension and drug history. A general physical and systemic examination was conducted. HRV was recorded for 5 min in supine position in a quiet room.

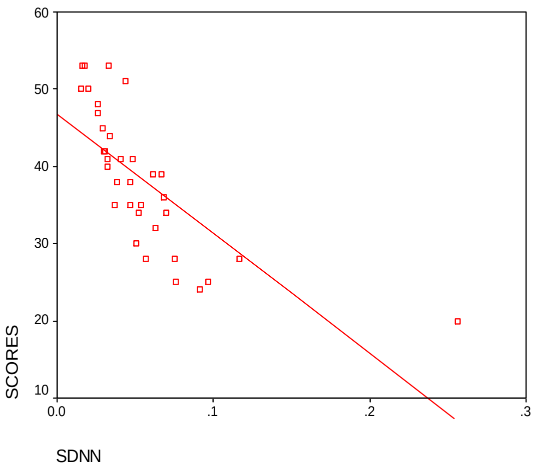
HRV recording

A portable ECG system BPL CARDIART 8408 VIEW was used in this study. High quality ECG recording was taken under standardized conditions to minimize artifacts. Analysis of this was done using time domain method. Recording was done in the morning hours between 9:00a.m and 11:00a.m. The subjects were instructed to avoid food two hours prior to testing, avoid coffee or alcohol 24 hours prior to testing and to wear loose and comfortable clothing during the test. Subjects were instructed to close the eyes and to avoid talking, moving of hands, legs and body, coughing and sleeping during the test. The electrocardiogram was recorded in the supine position for 5 minutes after 10 minutes of supine rest. The analog ECG signal was obtained using lead two. The ECG signal was continuously amplified, digitized and analysis was obtained. The R-R peak detector was adjusted appropriately. Data obtained was analyzed and the following parameter was recorded:

Time domain measure: SDNN(s)

STAI questionnaire

Speilberger’s State Trait Anxiety Inventory questionnaire was given to subjects. Anxiety level scores ranged from 20 (low) to 80 (high). Subjects rated themselves on every item based on a 4-point Likert scale, which included ‘not at all’ to ‘very much so’ for the STAI State and ‘almost never’ to ‘almost always’ for the STAI Trait. Anxiety scores were correlated with SDNN using Pearson’s correlation coefficient.



Graph 1. Pearson's correlation between SDNN (s) and anxiety scores

RESULTS

Mean age of the subjects was 39.8±9.25 years. Pearson's correlation coefficient r = -0.729 was obtained. Correlation is significant at the 0.01 level (2 tailed) There is a negative correlation between SDNN and anxiety level in traffic policemen (r = -0.729, p<0.01). Reduced HRV was seen in subjects with high anxiety score indicating sympathetic dominance. The age (years), time domain measure of HRV i.e. SDNN (s) and anxiety score of all the participants were tabulated as shown in Table 1.

Table 1. Age (years), SDNN(s) and anxiety scores of the participants

S No	Age	SDNN (s)	Scores
1	42	0.047	35
2	45	0.015	50
3	30	0.067	39
4	38	0.031	42
5	32	0.052	34
6	35	0.044	51
7	40	0.068	36
8	37	0.02	50
9	33	0.076	25
10	40	0.034	44
11	28	0.117	28
12	50	0.026	48
13	24	0.256	20
14	34	0.063	32
15	54	0.016	53
16	34	0.075	28
17	49	0.032	41
18	31	0.054	35
19	49	0.026	47
20	44	0.047	38
21	45	0.041	41
22	33	0.097	25
23	58	0.018	53
24	50	0.037	35
25	55	0.033	53
26	39	0.057	28
27	37	0.029	45
28	32	0.091	24
29	54	0.03	42
30	29	0.051	30
31	46	0.032	40
32	51	0.038	38
33	43	0.048	41
34	25	0.061	39
35	30	0.07	34

DISCUSSION

Work stress has become a common entity in the present day. One such occupation is that of traffic policemen. Police officers are reported to have greater stress due to lack of available manpower and long working hours as reported in earlier studies (Deschamps *et al*., 2003). Stress due to work predicts the first onset of anxiety and depression in subjects who had no prior history of these disorders (Melchior *et al*., 2007). Job in which the demands exceed the person's ability to cope are perceived as stressful and this could influence the risk of psychiatric disorders (Melchior *et al*., 2007). Animal and human studies have suggested that biological mechanisms could involve the dysregulation of stress hormones (De Kloet *et al*., 2005). In stress, there is possibly an increased relative contribution of adrenomedullary secretion to circulating norepinephrine (Goldstein DS *et al*., 1983). An increased sympathetic activity and reduced parasympathetic tone has been reported in altered emotional states including anxiety and stress (McCraty *et al*., 1995). Stress inhibits the baroreflex blunting of sympathetic outflow and thus increases the sympathetic activity (McCraty *et al*., 1995). The increased plasma catecholamine results in increase in heart rate, blood pressure and sympathetic outflow (Goldstein *et al*., 1983).

The increase in the sympathetic outflow of the autonomic nervous system contributes to the resulting sympathovagal imbalance, i.e. sympathetic dominance which is reflected by a diminished HRV. Low HRV is known to be associated with cardiac arrhythmia, cardiac mortality and all cause mortality after myocardial infarction (Kleiger and Miller, 1978; Saul *et al*., 1988). It also runs the risk of precipitating transient myocardial ischemia. Our study showed a significant reduction in HRV in subjects with high anxiety score. There was a significant negative correlation between the time domain measure of HRV and the anxiety scores. This indicated that higher the anxiety score greater the sympathovagal imbalance and hence sympathetic dominance in the study subjects. Not measuring the plasma catecholamine levels being the limitation of the study, further studies need to be done on a larger sample size.

Conclusion

Vagal modulation of heart was sensitive to experience of emotional anxiety with the study showing a significant negative correlation between HRV and anxiety scores. HRV was significantly reduced in subjects with high anxiety score indicating sympathetic dominance. Since health education, cardio respiratory fitness training, yoga training and periodic health checkups minimize anxiety and perceived stress, it will be worthwhile to introduce fitness training programmes among traffic policemen and thus reduce the burden of ill health among this population.

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