Respiratory Influence on R-R Intervals in Normal and Diabetic Air Force Personnel

P Bandopadhyay, M Akhtar, PK Banerjee

R-R interval ratio has been studied in 55 diabetics and 30 normal controls. Clinical evaluation had not revealed any evidence of peripheral or autonomic neuropathy in any diabetic subject. R-R interval ratio (mean values) in diabetic subjects was found to be 1.16 ± 0.11 as compared to that in normal controls (1.35 ± 0.15). The difference was statistically significant (P < 0.001). This simple bedside technique of R-R interval ratio estimation may be useful to assess latent involvement of autonomic nervous system in diabetic subjects.

Keywords: Respiratory variation in heart rate, diabetes mellitus, autonomic neuropathy.

R-R interval estimation has been employed for detection of autonomic nervous system disorder by several authors all over the world. Its importance in diagnosis of neuropathy in diabetics has also been emphasised by many workers. This technique has been employed in cases of diabetes mellitus with a view to assess latent autonomic involvement and the results and conclusions are presented in this paper.

Material and Method

Cases of frank as well as borderline diabetes mellitus assessed at the Institute of Aviation Medicine, Bangalore during the last four years were included in this study. 55 subjects were studied including 26 aircrew, 25 ground duty officers and 4 airmen. Majority of the subjects belonged to the age group of 30 to 49 years. Besides the details of present, past and personal history, symptoms of autonomic nervous system involvement such as increased or decreased sweating, diarrhoea, gastric fullness, dependent oedema and urinary incontinence were elicited. A thorough clinical examination was carried out to rule out any cardiovascular, respiratory or nervous system involvement. Investigations of routine blood, urine and biochemical parameters such as blood sugar (fasting and post prandial), blood cholesterol, blood urea and standard GTT were carried out. A resting 12 lead ECG was recorded in all. ECG recordings following Double Master Two Step (DMT) exercise were carried out wherever indicated. A plain skiagram of chest for evaluation of cardiac silhoutte was also taken in all diabetic subjects.

The R-R interval ratio was recorded during quiet respiration with simultaneous recording of lead II ECG and respiratory movements through a PT 5 transducer on a Grass Model-V polygraph. The subjects were then asked to take maximal inspiration in 5 sec and maximal expiration in 5 sec for three consecutive respiratory cycles and the ECG and respiratory movements were recorded throughout. In each cycle of respiration the longest R-R interval during expiration and the shortest R-R interval during inspiration were measured and R-R ratio was calculated. The mean ratio of the three cycles was then estimated.

R-R interval ratio was also calculated in 30 age-matched normal subjects following the same technique as described above. The data obtained from the study of diabetics were compared with those of the normals by unpaired 't' test.

Results

Among the diabetic subjects, 35 (65%) were established cases of diabetes mellitus controlled on oral hypoglycaemic drugs and 20 (35%) were controlled with diet restriction only. None of them had symptoms referrable to the involvement of autonomic nervous system.

Clinical evaluation of the subjects revealed obesity in 7 cases (13%), hypertension in 8 cases (15%) and retinopathy in one (2%). Detailed and repeated neurological evaluation in these subjects had not revealed any evidence of neurological deficit to suggest either autonomic or peripheral neuropathy. Relevant biochemical parameters were found to be normal in all.

Mean R-R interval ratios in various age groups in the normal and in the diabetic subjects are shown in Table I. Diabetic subjects showed significantly lower values as compared to normal subjects in all age groups. In normal subjects, the mean R-R interval ratio was found to decrease with age : 1.44 in 30-39 yrs, 1.32 in 40-49 yrs and 1.29 in 50-59 yrs.

The age bound reduction between 30-39 and 40-49 yrs was found highly significant (p< 0.001). No such age bound decrement in R-R interval ratio was seen in diabetic subjects. For the combined age groups, diabetic subjects had a mean R-R interval ratio of 1.16 as compared to 1.35 in normal subjects (p < 0.001). Comparative study of R-R intervals in diabetics of different duration did not show any staistically significant variation (Table II). Also, when the mean R-R interval of diabetics without any complication was compared with mean R-R interval of those with complications like hypertension, ECG

Sundkvist et al[6] were the first to describe the recording of R-R interval ratio in normals and diabetics. They studied 25 normal subjects (11 women and 14 men) with mean age of 39.4 ± 1.7 yrs and found their R-R interval ratio to be 1.33 ± 0.04. Their diabetic subjects without sensory neuropathy (n=23) showed a R-R interval ratio of 1.27 ± 0.03, and diabetics with sensory neuropathy (n=18) showed R-R interval ratio as 1.16 ± 0.03, the latter being significantly different when compared with controls as well as with diabetics without neuropathy.

Table- I Comparison of R-R interval ratio [mean ± (sd)] in normals and diabetics

Age Group (Yrs)	Normals	Diabetics	p
30-39	1.44 (0.19) n = 10	1.13 (0.20) n = 9	< 0.01
40-49	1.32 (0.11) n = 10	1.17 (0.08) n = 29	< 0.001
50-59	1.29 (0.08) n = 10	1.17 (0.08) n = 17	< 0.001
30-59	1.35 (0.15) n = 30	1.16 (0.11) n = 55	< 0.001

Table - II R-R interval ratio in diabetics in relation to the duration of the ailment.

Duration of Diabetes (Yrs)	n	Mean	sd
< 2	8	1.138	0.075
2 - 5	18	1.174	0.094
6 - 10	17	1.157	0.084
> 10	12	1.163	0.069

abnormality, retinopathy, IHD and obesity, no significant difference was observed.

Discussion

Measurement of R-R interval during deep breathing is a simple but sensitive index of autonomic imbalance1. Various other tests have been used for detecting early involvement of autonomic nervous system by Bennet et al2 and they had found this technique to be equally useful for detecting autonomic imbalance. The underlying principle is considered to be the disturbances in cardiovascular reflexes due to autonomic nervous system involvement[3-5].

Murray et al[7] confirmed reduced respiratory variation in resting heart rate in diabetics without signs of autonomic dysfunction. Wheeler and Watkins[8] demonstrated a reduction or absence of beat to beat variation in diabetics with clinical features of autonomic neuropathy. This was attributed to cardiac vagal denervation. Kristensson et al[9] reported segmental demyelination and axonal degeneration similar to that seen in diabetic peripheral nerves in vagal preganglionic fibres to the heart and oesophagus. Martin[10] demonstrated involvement of autonomic nerve fibres in autonomic neuropathy.

In the present study, R-R interval ratio in diabetics were 1.13 ± 0.2 (30-39 yrs), 1.17 ± 0.08 (40-49 yrs) and 1.17 ± 0.08 (50-59 yrs). The R-R interval ratio in 30 normals as studied in this report is 1.44 ± 0.19 (30-39 yrs), 1.32 ± 0.11 (40-49 yrs) and 1.29 ± 0.08 (50-59 yrs). The R-R interval ratio in diabetics in the comparable age group showed a highly significant difference when compared with R-R interval ratio in normals. This was in consonance with various other studies[7,8].

Comparative study of mean R-R interval in diabetics of different durations in the present study did not show statistically significant variation. It is expected that autonomic or other neurological complications may occur more often in diabetics of long duration. However, Fraser et al[11], detected neurological involvement even at the time of diagnosis with various simple non-invasive autonomic function tests including R-R interval variations in resting heart rate.

The present study revealed significantly reduced value of R-R interval ratio in diabetics even when there was no clinical involvement of the nervous system. This simple test may be a predictive indicator of future neurological complications in diabetics which may be reiterated by serial repetitive assessments.

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