DISCUSSION
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It is a well known fact that the involvement of heart and vessels is an outstanding factor in over all diabetic mortality and morbidity. That is why early recognition of damage to the heart is necessary in diabetics for evolving appropriate measures to arrest their progress, if possible.

The present study was conducted on thirty eight diabetics. Majority of the patients belonged to middle class and most of them were from urban areas. Male to female ratio in this study was approximately 4 : 1. This is in contrast to western studies in which female predominance was observed (Joslin, 1959; Marks, 1962) and John Malins, 1968). Low incidence in our study could be because of social customs and general indifference by females to their health or by other family members in our country.

Peak incidence was in 41-50 years age group (42.10%) which is in conformity with findings of Tikoo and Bajpai (1974). Incidence was 10.50% below 40 years age group as against 6.9% reported by Tikoo and Bajpai (1974), 4% by Pathania et al (1967) and 2.6% by Banerjee (1966). In patients above 60 years of age incidence was 15.80% while this incidence was reported to be 15.4% by Tikoo (1974), 21% by Vaishnava (1964), 15% by Pathania (1961) and 9.2% by Patel (1958).
CARDIOVASCULAR MANIFESTATIONS IN DIABETES MELLITUS

A. Profile of coronary artery disease

About two thirds (63.15%) diabetics in our study suffered from coronary artery disease. Reports of various authors vary from 1.4 to 70%.

There was male dominance in occurrence of coronary artery disease (78.94%). Pathania (1961), Banerjee (1966), Urs (1966), Shan (1970) and Tikoo (1974) also reported male dominance. However, many western workers have reported higher incidence among female diabetics.

Although evaluation of cardiovascular function for the resting stage provides some useful information but examination of circulatory response to stress is much more sensitive and informative (Epstein et al, 1967). Treadmill is one of the most important and valuable non-invasive diagnostic tests in the clinical evaluation of patients with suspected or known coronary artery disease (Chung, 1973).

In the present study the following criteria were utilized to call the test positive:

1. S-T segment depression of one mm or more, if it is horizontal or down sloping.
2. When S-T segment depression was upsloping, the test was considered positive only when it was more than 1 mm 0.08 seconds after J point.
The criteria for strongly positive treadmill test were:

1. Early onset (first three minutes of Bruce protocol) ST depression.
2. More than 2 mm ST depression (Horizontal or down sloping).
3. Slow recovery (persistence of ST segment depression for more than eight minutes in post exercise period).

The concept that marked ST segment depression is associated with a more severe degree of coronary artery disease has been demonstrated by many investigators. Four patients who came out with a strongly positive treadmill test in our exercise laboratory had gone for selective coronary angiography elsewhere. All of them were found to have left main coronary artery involvement.

In this study, subjects were classified in three groups on the basis of nature of their chest pain. Group I (with typical chest pain), included nine patients, among them eight (88.88%) were positive for ischemic exercise response. Group II (with atypical chest pain probably of ischemic origin), included eight patients, out of these six (75%) had positive ischemic exercise response. Group III where chest pain was considered probably of non-ischemic origin, included twenty-one patients and among them exercise ischemic response was positive in ten (47.62%).

In present study, out of thirty-eight patients sixteen (42.10%) had chest pain during exercise as
compared to 42.6% by Sharma et al (1992).

Cole and Ellestad (1978) assessed the significance of chest pain during treadmill exercise and found that in patients with chest pain, coronary events were twice as frequent as in individuals with ST segment depression alone.

J point depression (when ST becomes isoelectric after 80 m sec) is not as good indicator of coronary artery disease as are horizontal and downsloping patterns of ST depression.

It is believed by many that an increase in R wave amplitude associated with ischemic ST changes enhanced the likelihood that a patient with coronary artery disease had extensive involvement, probably associated with left ventricular dysfunction.

In the present study, 4 (10.53%) subjects had abnormal R wave amplitude and in three of them, there was associated ST depression which is similar to the study of Sharma et al (1992).

Eight (21.05%) patients had abnormal blood pressure response and six (15.78%) had associated angina. Recognition of this response is essential because of the value of this sign as a predictor of critical narrowing of coronary arteries, as suggested by a number of reports.

Pontius et al (1978) reported the coronary arteriographic findings of the 44 patients in whom
systolic blood pressure either failed to rise or fell in absence of other abnormal exercise responses. Nine patients had left main coronary artery disease and 20 had triple vessel disease. In our study, out of thirty eight patients, two (5.26%) had ventricular premature contractions, both the patients had angina and both of them had ST depression. 20-72% incidence of ventricular arrhythmia during exercise testing was reported by various authors. Sharma (1992) reported in 4.7% of diabetics.

The duration of diabetes had a linear relation with incidence of coronary artery disease. The patients who were diabetic for longer duration had not only higher incidence of coronary artery disease but disease was more severe in them as compared to those who were diabetic for shorter duration. These findings clearly resemble other reports. However, Brodley (1956), Abokhatava (1963) and Urs (1966) denied any such relationship.

PROFILE OF HYPERTENSION IN DIABETES

The incidence of hypertension in present study was 78.95%. Incidence varying from 2.6 - 68% has been reported by other authors, Deld and De Alouzo (1967) reported in 54%. The difference may be due to adoption of different criteria. Incidence of hypertension was higher in diabetic women than men. These findings are in accordance with findings of Holm et al (1932), Bland et al (1951), Bryfogle et al (1957), Friedman (1958) and Talloch (1962).
Blood pressure levels were found to increase with advancing age and increasing duration of diabetes mellitus. Females showed a higher level of systolic and diastolic pressures in every age group. This is in conformity with the observations made in the Framingham study (Garcia et al, 1973), London, Civil Survey (Reid et al, 1974) and Bedford Civil Survey (Sharp et al, 1961), Banerjee (1959). Banerjee (1956) and Pathania (1951) also reported similar results.

RESTING ELECTROCARDIOGRAPHIC ABNORMALITIES

Multiple electrocardiographic abnormalities among patients with diabetes mellitus have been reported. Commonest were the changes suggesting myocardial ischemia or infarction. ST-T changes are very frequently encountered. Banerjee and Roy (1959) asserted that diabetics have a special predilection for anteroseptal infarction, In present study changes of ischemia and infarction were noted in 31.57% diabetic patients, out of which 26.31% patients had ischemia (ST depression) and 5.26% patients had healed infarction.

Left ventricular hypertrophy was noted in 13.51% cases and 5.26% cases had right ventricular hypertrophy.

Various conduction defects were noticed in 20.52% patients. Root and Brodley (1959) observed almost similar incidence.
Increased frequency of ECG changes are probably the result of myocardial ionic derangements (e.g. hyperkalemia developing due to diabetic ketosis or hypokalemia) and ischemia due to compromised oxygen supply (Raheja, 1972), changes in small vessels, (Osterde, 1970), their narrowing or occlusion (James, 1968; Ladet, 1968). Presence of diabetic cardiomyopathy may form another contributory factor (James, 1967; Varenaska, 1967; Eliot, 1967).

ECHOCARDIOGRAPHIC ASSESSMENT OF DIABETICS HAVING CORONARY ARTERY DISEASE

Twenty four patients having positive treadmill testing among thirty eight were selected for echocardiographic assessment.

Echocardiographic findings were as follows:

We observed frequent abnormalities in LV function both systole and diastole as well as significant reduction of indicators of myocardial performance among diabetics, few of them had no manifestation of cardiac involvement.

1. EF Slope: Mean EF slope was 53.0 ± 6.32 mm which is less than the normal average of 70 mm. Cause of decrease in EF slope in our patients was because of development of diabetic cardiomyopathy which leads to left ventricular dysfunction. Shapiro (1980) and Sanderson et al (1978) reported similar findings. In our study EF slope decreased as the duration of diabetes increased (<5 years: 59.20 ± 5.93, 5-10 years: 53.54 ± 4.57 and >10 years: 45.66 ± 5.80).
2. End diastolic diameter (EDD) : Mean of the EDD was 51.91±5.56 mm which is towards higher side of the normal. This increase in EDD was because of chamber enlargement. Similar claim have been made by Shapiro et al (1981). As the duration of illness increased EDD increased i.e. in diabetes of less than 5 years duration it was 44.60±2.96, 5-10 years : 52.30±4.0 and 710 years : 56.60±2.94.

3. Fractional shortening(FD) ranged from 16-26% and mean was 20.13±3.16 against the normal range of 24±0.42%. which means that diabetes affects the contractility of myocardial fibres. These observations closely resembles the findings of other authors (Sinevirante, 1977; Shapiro et al, 1981; Das et al, 1982). With increase in the duration of illness the fractional shortening decreases (≤5 years : 24±2.73; 5-10 years : 20±2.23 and 710 years : 17±1.6).

4. Ejection fraction (E.F.) was reduced in our subjects. It ranged from 38 to 62% with a mean of 54.75±5.17. It is less than the normal limits. Similar observations have been made by many authors (Sinevirante, 1977; Shapiro et al, 1981, Das et al, 1982). Reduction of ejection fraction was paralleled with increase in duration of diabetes mellitus (i.e. ≤5 years duration 60±13.16; 5-10 years : 56.84±3.51 and 710 years : 51.67±1.96).
5. Posterior wall thickness (PwT) : In our subjects mean PwT was 18.24±2.99 with a range of 11 to 25 mm, greater than the normal limits of 6 to 11 mm. Posterior wall thickness increases with increase in duration of diabetes (i.e. 17.60±2.70 in less than 5 years duration, 19±3.6 with duration of diabetes 5-10 years and 18±1.44 was more than 10 years of illness).

6. Interventricular septum (IVS) : Similarly we observed increase in the thickness of interventricular septum. It came out to be 9.62±1.99, against the normal range of 6-11 mm with increasing duration of diabetes interventricular septum thickness increased (i.e. ≤5 years : duration of illness it was 8.6±1.14; 5-10 years duration : 9.23±1.18 and in ≥10 years : 11.33±2.66).