MATERIAL AND METHODS
G-7000 Automatic full discloser monitor with keyboard and keypad.
Health Track II Treadmill.

Echocardiography Machine
Patient on health track during Treadmill testing.

Researcher at work during echocardiography.
MATERIAL AND METHODS

PATIENTS

The material, comprising of 38 patients, was selected from out patient medical department, cardiology, diabetic clinic and medical wards of M.L.B. Medical College, Hospital, Jhansi. The study was extended to the period of 12 months.

CRITERIA FOR DIAGNOSIS OF DIABETES MELLITUS PATIENTS

Following criteria were used for diagnosis:

1. Presence of polyphagia, polyuria, polydypsia weight loss and elevation of plasma glucose.
2. Fasting plasma glucose level more than 140 mg/dl.
3. Oral glucose tolerance test positive cases. O.G.T. test is said to be positive when venous plasma glucose more than 200 mg/dl or venous whole blood glucose more than 170 mg/dl within and at 2 hours.

Previously known diabetics who were already under antidiabetic treatment were also included in this study.

All diabetic patients were subjected to detailed history and thorough clinical examinations with special attention to the age, sex, age of onset of diabetes, duration of illness, type of diabetes (I or II) presence of complications, ischemic heart disease,
hypertension, obesity, family history of diabetes, autonomic dysfunction and retinopathy were accurately recorded.

**CRITERIA FOR STATUS OF CONTROL OF DIABETES MELLITUS**

The dietary control was done and antidiabetic drugs were given for controlling the diabetes mellitus. Blood and urinary sugar were recorded regularly during the course of disease.

**Good Control**

If the therapy was regular and adequate to keep the blood sugar level near normal limits without any significant glycosuria at any time.

**Fair Control**

If the treatment was taken regularly and less than 25% of the reports were mildly abnormal.

**Poor Control**

If the treatment was discontinued for a period of four weeks or more and a majority of reports were not satisfactory.

**ELECTROCARDIOGRAM**

Routine standard 12 leads resting electrocardiogram was recorded in all patients.
TREADMILL TEST SYSTEM

Treadmill test system includes following parts:

1. Health track II treadmill.
2. HT controller.
3. G-7000 automatic full disclosure monitor.

Treadmill could be operated by eight HT-7 programmable controller or treadmill controller fixed on front hand rail or monitor which was kept along the side of treadmill.

I operated treadmill with the programmable automatic G-7000 monitor using pre-recorded modified Bruce protocol on a floppy disc.

FUNCTIONS

G-7000 system functions are initiated by using a combination of key board and the keypad informative functions are generally accomplished by using the key board. Patient's information entry were done.

E.C.G. TRACE DISPLAY

The monitor displays four ECG traces. Lead V5, II, VI were selected for first three tracer, the bottom trace is a 2.5 second continuous rotation in 12 leads.

HEART RATE DISPLAY

Heart rate is displayed in the monitor. V5 lead was used for heart rate display. If R wave in V5 was too small to give enough signal for displaying heart rate, an alternative appropriate lead was shifted
to trace position to obtain heart rate display.

ST SEGMENT MEASUREMENTS

There are three methods used to calculate the ST segment measurements. Method used to calculate the J point by measuring a percentage of R-R interval. J point is set at 13% of the R-R interval. S-T segment was measured directly from tracing.

OPERATION MODE SELECTION

We used protocol mode by using modified Bruce protocol disk. Stress test is automatically controlled by touching "load protocol" on key board.

12 LEAD RECORDING

At the end of every stage 12 lead ECG is automatically recorded. 12 lead recording can be obtained at any time by touching "12 lead" on key pad.

3 LEAD RECORDING

Three lead recording of the three traces on monitor can be generated by touching 3 lead on key pad.
PROTOCOL USED: Modified Bruce protocol (Prerecorded disc)

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<th>Speed</th>
<th>Grade</th>
<th>Duration</th>
<th>MET (Unit)</th>
<th>Total time elapsed (min)</th>
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SOURCE OF PATIENTS

The subjects for treadmill testing were selected from the patients who attended OPD, admitted in ward and referrals from other hospitals. Detailed history, clinical examination and investigations were completed.

INSTRUCTIONS TO THE PATIENTS

1. The patient was told to stop consumption of drugs affecting the cardiovascular system like digitalis, beta blockers, Ca channel blockers, nitrates, tricyclic anti depressant, antiarrhythmic drugs 3 days prior to treadmill testing so as to avoid false positive and false negative results.

ACE inhibitors, methyl dopa can be given to the hypertensive patients instead of above said anti-
hypertensive drugs.

2. Patient was asked to stop smoking and consumption of alcohol at least 24 hours prior to the test.

3. Patient was asked to have only a light meal 2-3 hours before the test.

Each patient performed the treadmill exercise test by the modified Bruce protocol. The electrocardiogram was monitored continuously by 3 lead system (V5, II, VI) and 12 leads ECG was recorded at each stage, at the time of onset of ST segment depression, at peak of exercise and at regular interval after exercise (recovery period).

The patients were instructed to exercise until limited by symptoms of fatigue or increasing chest pain.

**CRITERIA FOR TERMINATION OF TREADMILL TEST**

1. On patient's request.

2. Moderately severe chest pain, ataxia, vertigo, confusion, pallor, cyanosis.

3. Reduction of blood pressure and/or heart rate with increasing work load.

4. Occurrence of arrhythmia.

5. Acute myocardial infarction.

6. Marked hypertension (systolic BP more than 220 mm Hg; diastolic BP more than 120 mm Hg).

7. Marked ST segment depression or elevation.

8. Achievement of 85% to 90% of target heart rate.
<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>85-90% of max H.R.</th>
<th>Maximal H.R.</th>
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<tr>
<td>70 +</td>
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Following exercise ECG parameters were recorded for interpretation –

- Resting ECG.
- Total grade achieved.
- Total duration of exercise.
- The presence or absence of typical ischemic chest pain.
- Time of onset of S-T segment depression (71 mm).
- The HR at the onset of ST segment depression.
- The maximum heart rate achieved.
- The blood pressure at peak exercise.
- The product of heart rate and systolic blood pressure.
- The R wave amplitude.
- Total duration of recovery, duration of persistence of ST segment depression, chest pain, ventricular arrhythmias during recovery.
- Signs of left ventricular dysfunction.
- Functional aerobic impairment.
- Total METS at peak exercise.
- Maximum VO₂.

**CRITERIA FOR STRONGLY POSITIVE TEST**

1. ST segment depression 72 mm.
2. Early onset (first 2 minutes) of ischemia - ST depression (71 mm).
3. Prolonged duration (78 minutes) in the post exercise recovery period of ischemic ST segment depression.

**DIAGNOSTIC CRITERIA OF CORONARY ARTERY DISEASE**

A. Myocardial Infarction (Q wave M.I.).

1. Typical precordial chest pain lasting for more than 30 minutes not relieved by rest with or without radiation to neck and inner aspect of left arm.
2. Electrocardiographic evidence of myocardial infarction as follows:
   a. Presence of Q wave.
   b. Elevation of ST segment.
   c. Inversion or flatting of T wave.
3. Characteristic serum enzyme changes rise like:
   a. SGOT  b. Total CPK  c. CPK-I/M

B. Angina Pectoris

1. Typical chest pain or chest discomfort and heaviness in chest for more than 3 minutes duration but less than 30 minutes, developing on exertion and relieved by rest.
2. ECG changes: ST depression of ischaemic type or indirect evidence of ST-T changes.


\[
\text{Obesity Index (OI)} = \frac{\text{Weight (lbs)}}{\text{Height (Inch)}} \times 100
\]

**Diagnosis of Hypertension**

Patients with blood pressure readings above 160/95 mm Hg were claimed as hypertensive (WHO, 1962).

**ROUTINE INVESTIGATIONS**

Blood count, hemoglobin, erythrocyte sedimentation rate, serum creatinine, serum cholesterol and triglycerides levels, 24 hours urinary protein excretion, routine urine examination and a posteroanterior view of chest roentgenogram were routinely performed in all the patients.

**CARDIOTHORACIC RATIO**

Ratio of transverse diameter of heart shadow at its maximum width to the transverse diameter of the bony thorax. Cardiac enlargement was diagnosed when CT ratio was 75.5% (Friedberg, 1970).

**ECHOCARDIOGRAPHIC MEASUREMENTS**

The echocardiogram was recorded using "Electronics for Medicine" VR-12. Recorder used was 2.25 Mega Hz and transducer with an active diameter of 1.25 cm and an internal focus of 4-7 cm. The repetition frequency was 1000/Hz. Recordings were made at a paper speed of 25 and 50 mm/sec. An electrocardiogram was recorded simultaneously.
The patients as well as normal subjects were examined in the supine or partial left lateral position. The transducer was placed perpendicular to the surface of the chest wall in the fourth left intercostal space just left of the sternum. Occasionally transducer had to be placed in the third or the fifth left intercostal space to obtain resolution of the interventricular septum and posterior wall endocardial echoes. The ultrasonic beam was directed posteriorly and slightly medially until the echogram of anterior mitral valve cusp was identified. Only those tracings were recorded which displayed simultaneous echoes from the interventricular septum and posterior ventricular wall endocardium.

1. **End diastolic diameter (EDD)**
   
   Measured in centimeters from the left endocardial surface of the IVS to the endocardial surface of the posterior ventricular wall (PW) at the peak of QRS deflection.

2. **End systolic diameter (ESD)**
   
   Measured in centimeters is the distance from the left endocardial surface of the posterior wall of left ventricle at the time of maximal approximation of these two surfaces.
3. **Percentage fractional shortening of the internal diameter (\% D)**

\[
\% D = \frac{EDD - ESD}{EDD} \times 100
\]

4. **Ejection fraction (EF) = SV/EDV \times 100**

5. **Diastolic closure rate (EF slope)**

Calculation from the EF slope at its point of maximal excursion. Relaxation of left ventricle and consequent filling is reflected in the outward wall movement seen echocardiographically, and this movement is closely related to movement of the mitral valve both event showing an identical pattern of movement (Sanderson et al, 1978).

6. **Posterior LV wall thickness (P:T) was measured at end diastole.**