chapter 3
material and methods
MATERIAL AND METHODS

The lung function test was carried out in 133 cardiac patients who visited to Out Patients Department (OPD) and were admitted to Cardio-Thoracic Surgery Department of Government Medical College and Hospital, Aurangabad with known and diagnosed cardiac disorders. The disorders investigated include rheumatic heart disease (RHD), ischaemic heart disease (IHD), congenital heart disease (CHD). The determination of RHD which consists of valvular and myocardial manifestation, that of IHD which consists of coronary artery disease of CHD that consists of mainly left to right shunt and congenital valvular stenosis was done by the concerned experts. Before any type of assessment of the patients, biometric parameters like race, sex, age, height, weight, were noted. Other parameters, which interfere in pulmonary function were also noted: they included residential area, occupation, smoking and nonsmoking status and any obvious respiratory disease. Patients having any history of intrinsic respiratory disorder were excluded from the present study to avoid further complications in the proper assessment of functional status of the cardiac patients.

Initially, all the patients were classified into four functional classes as per the guidelines given by the New York Heart Association (NYHA, 1945), since grouping of patients had to be done on some basis. The lung function test was carried out in seating position by using Morgan, electronic lung function (ELF) machine (Fig. 2 a, b). Some important specifications of Morgan ELF machine are given below which make the machine perform better than any other model.

Flow tube : Anodised aluminium construction, Bidirectional
FIG.2a.

FIG.2b.
variable iris-type orifice.
Flow meter head: Milled nylon holder with 3 sealing O-rings (30X3 mm) housing the pressure sensor.
Flow sensor (pressure type): I. Temperature-comensated monolithic pressure transducer,
   II. Linearity: 1.5% of full scale.
Flow resolution: I. Range 0-2 l/s: 0.02 l/s.
   II. Range 0-12 l/s: 0.1 l/s.

At the time of lung function test, for proper warming of the machine, the machine was switched on ten minutes prior to the test. The nylon flowmeter head was inserted into the recess provided on the upper surface of the flowmeter box. Connecting cable from the flowmeter assembly was inserted into the connecting socket provided on the machine. The sterilised mouth piece was connected to nylon flowmeter. The medium test speed of two was selected, which offers a useful compromise of resolution and time saving. The data regarding the race, sex, age, height, weight necessary for the determination of the normal predicted values of respiratory parameters was inserted through the key board of the machine. For documentation purpose, the other parameters like type of cardiac disorder, occupation and smoking/nonsmoking status were also entered into the machine and printed out immediately. After auto calibration the patient was connected to the mouth piece and instructed to hold the mouth piece firmly between teeth and lips. After positioning the noseclip the patient was requested for the quite breathing. After the quite breathing massage on the screen; the space bar of the machine was pressed to start the test. After pressing the press bar the tidal breathing pattern was traced on the screen. After the single sweep the screen was cleared. The patient was then
SPIROMETRIC AND FLOW VOLUME VARIABLES

IC 
VT 
FRC 
FEV₁ 
VC 
RV 
TLC 

PEFR 
FEF25 
FEF50 
FEF75 
FIF 50 
PIFR 

FIG-3
instructed to exhale slowly down to residual volume. After pressing the space bar the patient was requested for maximum inspiration and expiration after a slight pause. The test was terminated by instructing the patient to inhale slightly. The mouth piece was disconnected and nose clip was removed. After analysis and compilation of the data by the machine final report was printed out. The final report consists of predicted forced expiratory flow volume curve followed by measured forced inspiratory and expiratory graphs, the measured predicted and percent predicted values of forced expiratory vital capacity (FVC), forced inspiratory capacity (FIVC), residual volume (RV), total lung capacity (TLC), RV/TLC ratio, functional residual capacity (FRC), forced expiratory volume in one second (FEV1), FEV1/FVC ratio (FEV1%), forced expiratory flow at 25%, 50% and 75% of expired vital capacity (FEF 25, FEF 50, FEF 75 Respectively), peak expiratory and inspiratory flow rates (PEFR and PIFR), airway resistance (Raw), volume independent exponential curve fitting index of lung elastic recoil (Kst (L)), time constant of lung emptying at 50% and 75% of expiratory vital capacity (t @ 50 and t @ 75 ), and diagnostic interpretation of respiratory disorders. Flow volume curve used in this machine to determine the various respiratory parameters is presented in Fig. 3.

Lung function test was also carried out using another portable lung function machine 'Spiroscreen', Gould Inc., Dayton, Ohio (Fig. 4 a, b). In this case the patient was instructed for forceful inspiration before connecting him to the mouth piece. After full inspiration by the patient, the mouth piece with sensor was immediately inserted in the mouth of the patient. The subject was instructed for rapid and forceful expiration. Other details did not differ from those of Morgan ELF. The parameters recorded
FIG. 6.
by this machine included forced expiratory vital capacity (FVC), forced expiratory volume in one second (FEV1), FEV1/FVC ratio (FEV1%), forced expiratory flow at 50% and 75% of expiratory vital capacity (FEF 50 and FEF 75), peak expiratory flow rate (PEFR) and mid maximum expiratory flow rate (MMF).

The cardiothoracic (CT) ratio was measured from the chest X-ray of the patient for determination of cardiac enlargement (Fig. 5). For this purpose transverse diameter of the heart, which is the sum of the perpendicular from outermost point of the right cardiac border to the midsternal line (MR) and perpendicular from the outermost point of the left cardiac border to the midsternal line (ML) and the internal diameter of the chest at its widest point (IR) just above the level of the dome of the diaphragm was measured from the chest X-ray. The percent ratio of the transverse diameter of the heart to the internal diameter of the chest was calculated as a cardiothoracic ratio (Fig. 6).