IN SEARCH OF A DIABETIC CARDIOPATHY - A STUDY OF LEFT VENTRICULAR FUNCTION IN 25 ASYMPTOMATIC DIABETICS USING M Mode ECHOCARDIOGRAPHY — A PILOT STUDY

S Balasingam, P K Mah, C H Lee

SYNOPSIS

The left ventricular function of 13 insulin dependant and 12 non insulin dependant diabetics without cardiac symptoms was studied using M mode echocardiography. The fractional shortening and ejection fraction were used as indices of left ventricular systolic function. The left atrial-aortic root index was measured to detect dilatation of the left atrium. The fractional shortening (FS) of the left ventricle was reduced to < 25% in 16 out of the 25 patients ie in 64% of patients. The ejection fraction (EF) closely paralleled the changes in FS and was reduced to < 60% in the same 16 patients. The ratio of the left atrium to aortic root (LA/AOR) was normal in all our patients. The FS was observed to decrease as the glycosylated haemoglobin (HbA_{1c}) increased but the correlation was not statistically significant. The FS in the insulin dependant group was significantly lower than the FS in the non insulin dependent group p = 0.006. We found that the non insulin dependent group had significantly lower HbA_{1c} values than the insulin dependant group. We found no significant correlation between the FS and age, serum cholesterol and triglyceride or the duration of diabetes mellitus.

SING MED J. 1988; 29:246-251

INTRODUCTION

Several studies notably the Framingham study(1) have shown that there is a marked increase in the incidence of acute myocardial infarction and congestive cardiac failure in diabetic patients. Furthermore in patients without prior coronary artery disease studies point to an increased risk for congestive heart failure in diabetic patients, that is not attributable to coronary artery disease alone(1). It is known that the main cardiac complication of diabetes mellitus with or without myocardial infarction is a decrease in myocardial contractility as well as relaxation ie. both systolic as well as diastolic function are compromised(1,2). In experimental diabetes histopathological examination of the myocardium has revealed increased connective tissue accumulation in diabetic hearts(2). Recent animal experiments have shown that the hyperglycaemic state can induce sarcolemmal dysfunction which is reversible by short term insulin infusion(2,3). We studied a small group of diabetics without clinical heart disease, to determine 1) the state of their left ventricular 2) whether measurement of LV function by M mode echocardiography could reveal early left ventricular dysfunction in these patients. We are aware that silent coronary artery disease can exist in the absence of symptoms or ECG changes. We aimed to establish that if early left ventricular dysfunction could be detected by this simple procedure, then high risk patients could be detected early and treated more vigourously. In the light of recent experimental evidence it is possible that good metabolic control can reverse early cardiac dysfunction in diabetic patients(3).

Department of Medicine
Alexandra Hospital
Singapore 0314

S BALASINGAM MBBS (Cey), MRCP (UK), Senior Registrar

P K Mah MBBS, FRACP, Consultant Physician & Cardiologist

C H Lee, MBBS (Sing), Medical Officer

MATERIAL AND METHOD

The left ventricular function of 25 diabetic patients and 15 controls (age and sex matched) was studied using M mode echocardiography. Criteria for the selection of patients and controls were as follows - None of the patients or controls had angina pectoris, heart failure, hypertension or anaemia. All the patients and controls had normal resting ECGs normal heart size on the chest Xray and normal serum creatinine.

The indices that were measured were:

(1) End systolic diameterŽESD)

(2) End diastolic diameter (EDD)

(3) Heart rate

(4) Ejection time

(5) Left atrial internal diameter (LA)

(6) Aortic root internal diameter (Ao)

The indices that were derived using the Pombo(4) equation were:

(1) Ejection fraction

(2) Fractional shortening

The LA/AOR ratio was calculated from (5) and (6).

All measurements were carried out as illustrated by Feigenbaum(5). A single operator performed all the measurements.šandom measurements were checked by a second operator using the same method of measurement.

Other laboratory investigations carried out were:

(1) Glycosylated haemoglobin in 18 patients

(2) Serum cholesterol and triglyceride

The results were analysed using students' t statistic. Fractional shortening was used as an index of left ventricular systolic function. An Aloka ultranoscope with a

3.5 MHz medium focus transducer was used for these studies.

It has been demonstrated that some relationship existed between the echocardiographic measurements and angiographic measurements of LV size and function. The use of fractional shortening as a measurement of LV function is based as calculation of the per cent shortening of the LV dimension and no assumptions are made concerning volumes or circumferences. In calculating fractional shortening one does not assume knowledge of the entire ventricular function as one does when using ejection fraction. The limitation of fractional shortening is that one can only assess the areas of the ventricle examined by the ultrasonic beam(5).

The size of the left atrium is important in patients with mitral valve disease and in patients with chronic left ventricular failure. The left atrium to aorta ratio was recommended as a better technique to correct for size of the patient than using body surface area(5).

RESULTS

Table 1 - shows the data sorted out according to fractional shortening from lowest to highest 16 out of the 25 patients had FS less than 25%. Nine out of the 25 had fractional shortenings greater than 25%. In the latter group all had non insulin dependant diabetes except for one.

The fractional shortening and ejection fraction showed a linear relationship.

The relationship of the fractional shortening to glycosylated haemoglobin (Figure Ia) - Although the fractional shortening appears to decrease as the glycosylated haemoglobin increases the relationship was not statistically significant, p = 0.629.

Comparison of fractional shortening and ejection fraÂtion in the 2 groups. Fractional shortening and ejection fraction in the insulin dependant group were significantly lower than in the non insulin dependant group (Figure Ib & II).

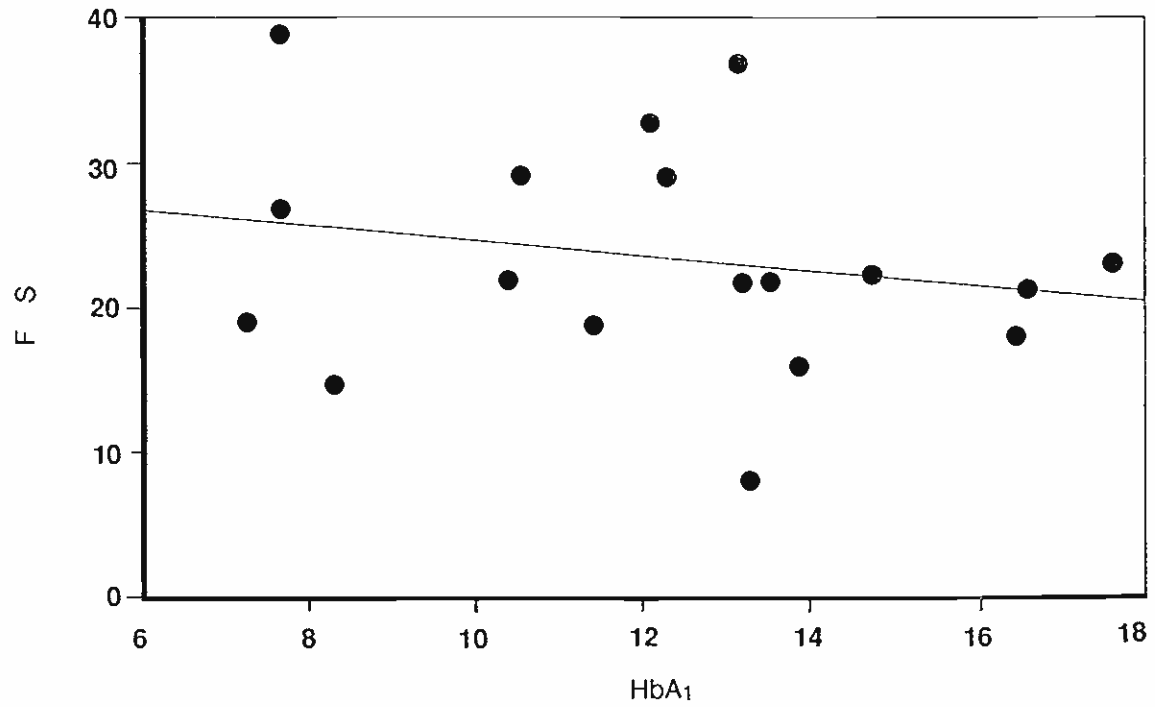
Relationship of fractional shortening to age, duration of diabetes, and serum lipids (Fig III, IV, V) - No significant correlation was found. The duration of diabetes in the insulin dependant patients(5) was longer but neither the FS or EF showed a correlation to the duration of diabetes in either group.

Left atrial index - showed no significant change in either group. Other information obtained from the study - HbA1c - (Table 1) There were only 18 HbA1c values available. Nevertheless the non insulin dependant group had significantly lower HbA1c values than the insulin dependant group (p = 0.024). Only 3 out of the 18 HbA1c values were less than 10.

DISCUSSION

16 out of the 25 patients studied (64%) had reduced fractional shortenings and ejection fractions. Since the left ventricular dysfunction has to be chronic to produce any change in left atrial diameter it was not surprising to find normal LA/AOR ratios in all our patients. Total serum

Fig. 1a. THE RELATIONSHIP OF FS TO HbA_1



FS — FRACTIONAL SHORTENING

HbA_1 — GLYCOSYLATED HAEMOGLOBIN

Fig. 1b. COMPARISON OF EJECTION FRACTIONS IN THE TWO GROUPS OF DIABETICS

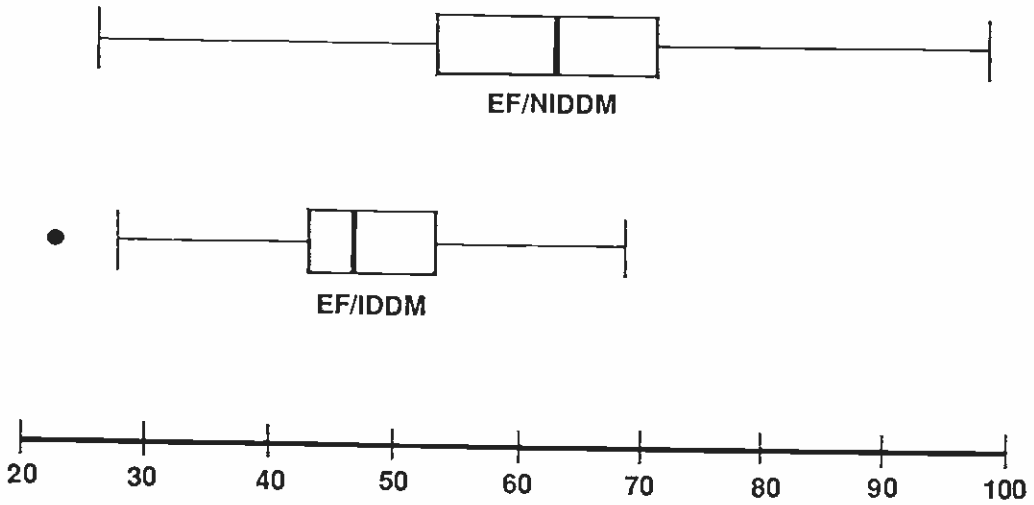
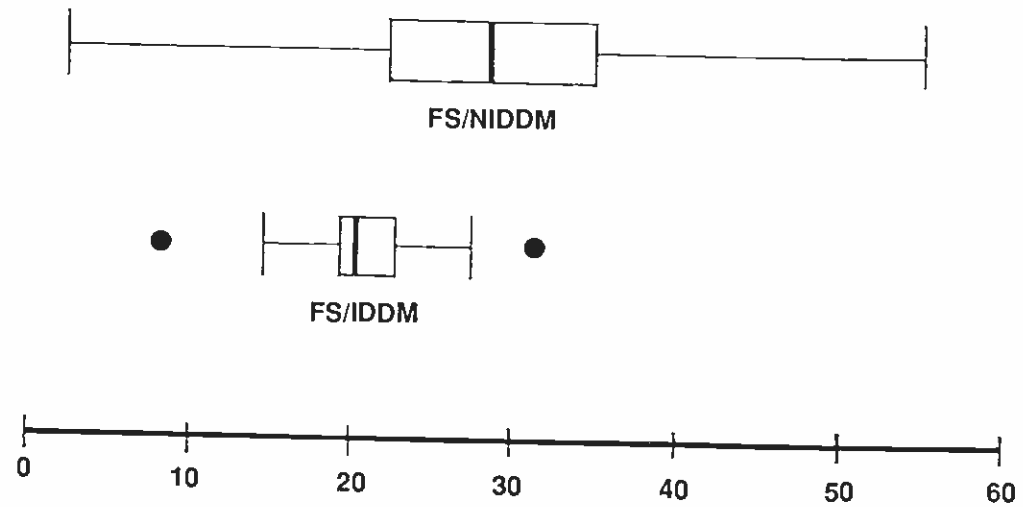


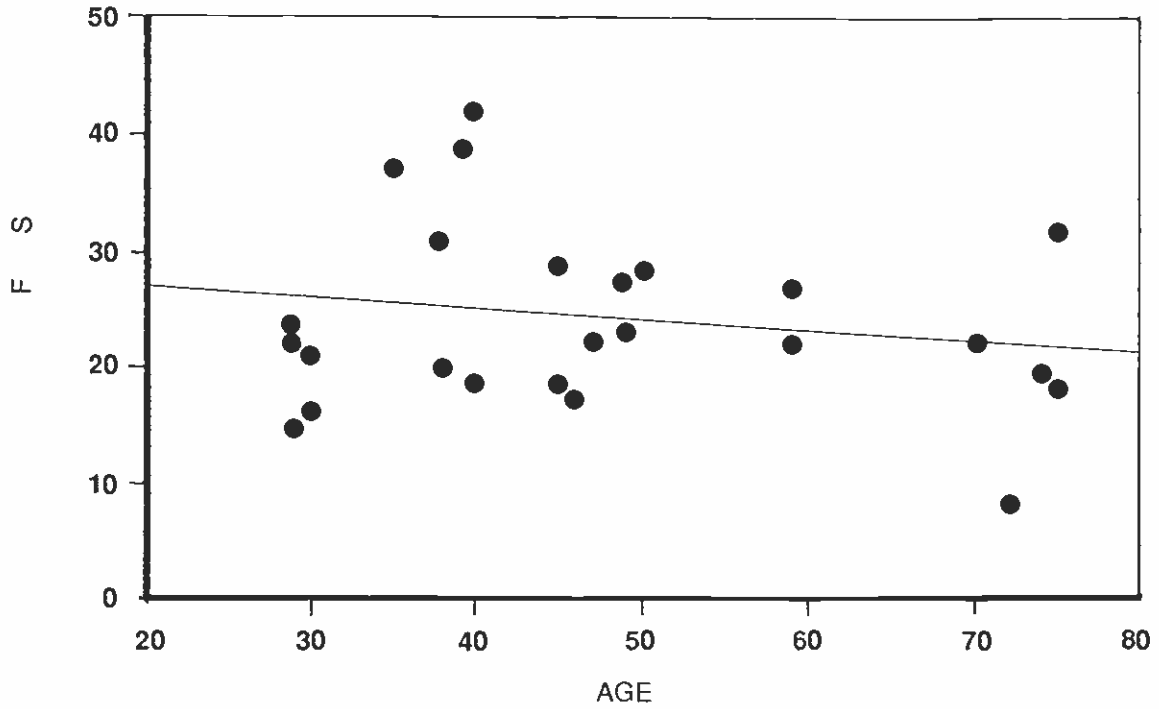
Fig. 2. FS IN NIDDM AND IDDM



NIDDM — NON INSULIN DEPENDANT DIABETES MELLITUS

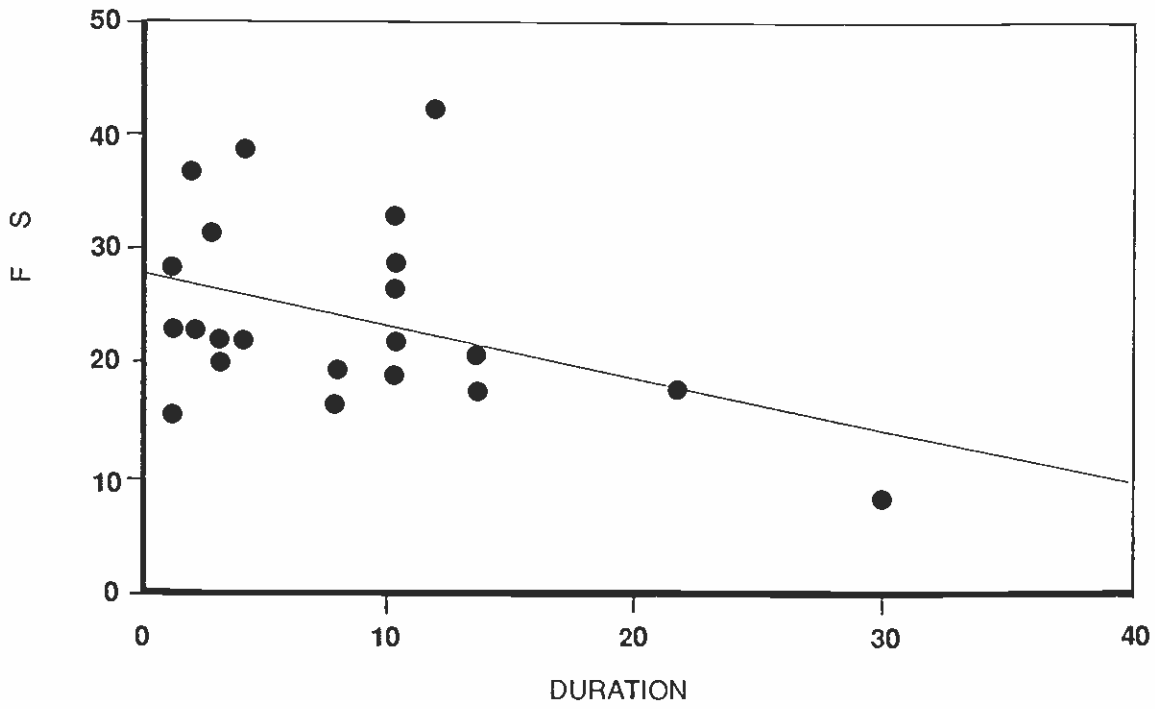
IDDM — INSULIN DEPENDANT DIABETES MELLITUS

Fig. 3. CORRELATION OF FS WITH AGE OF PATIENTS



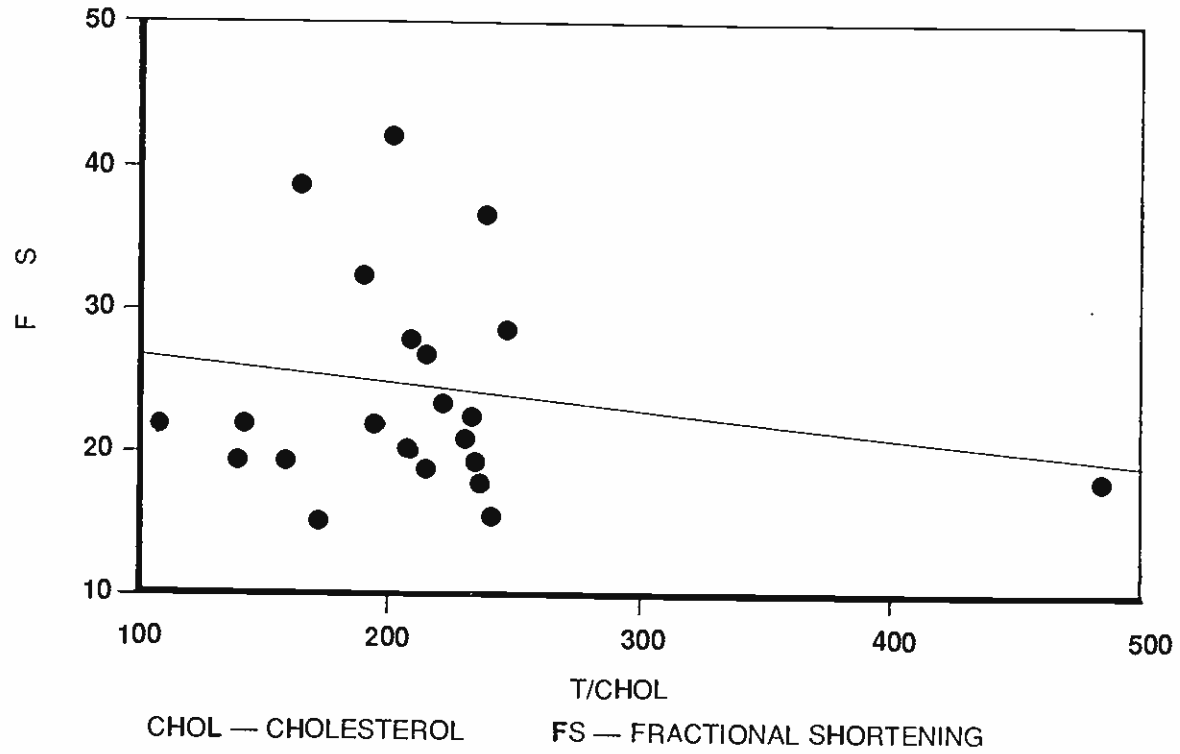
FS — TRACTIONAL SHORTENING

Fig. 4. CORRELATION OF FS WITH DURATION OF DIABETES



FS— FRACTIONAL SHORTENING

Fig. 5. CORRELATION OF FS AND BLOOD LIPIDS



CHOL — CHOLESTEROL FS — FRACTIONAL SHORTENING

cholesterol and serum triglycerides did not bear a significant correlation to left ventricular dysfunction in our patients. In our study we did not find a correlation between the duration of diabetes and left ventricular dysfunction. The late diabetic syndrome(3) is the constellation of abnormalities in various organs which accumulates in the life of a diabetic(3). Together with the classical diabetic nephropathy, retinopathy and neuropathy the existence of a diabetic specific heart muscle disease termed a diabetic cardiopathy was suggested(3). We postulate that acute metabolic changes could contribute to myocardial dysfunction in our patients(3) and this was substantiated by the fall in FS with rising HbA(1) levels. The sample that we studied was small and so a significant statistical correlation was not obtained.

Our study revealed that (1) left ventricular dysfunction was present in a significant proportion of asymptomatic diabetics and (2) that it could be detected by a simple non invasive method namely M mode echocardiography.

The contribution of coronary atherosclerosis to this dysfunction can only be accurately determined by coronary angiography. However subjecting an asymptomatic patient to an invasive procedure is not entirely without risk. For the same reason histopathological study of the myocardium obtained by myocardial biopsy is not feasible. We have studied only the systolic function of the left ventricle here. Study of the diastolic function will help to further dileneate the impaired relaxation of the ventricle which has been described in these patients. From our results it appears that insulin dependent diabetics are more liable to have asymptomatic left ventricular dysfunction. Framingham researchers found an increase of heart failure in insulin treated diabetic patients even when coronary and rheumatic heart disease were excluded(6). We would advocate

(1) More rigorous control of hyperglycaemia in patients detected to have asymptomatic left ventricular dysfunction.

(2) Frequent reassessment of left ventricular function for evidence of improvement after glycaemic control.

(3) If with good metabolic control there is no improvement in left ventricular function we suggest that proceeding to angiography be seriously considered and other causes of cardiomyopathy looked for in these patients.

(4) As microangiopathy of the coronary arteries has been shown to contribute to myocardial dysfunction we advocate that the state of the retinal and renal microvasculature be assessed early in those patients with asymptomatic myocardial dysfunction.

CONCLUSION

All evidence in the literature and in clinical practice indicates that diabetic patients without coronary artery disease do suffer from congestive cardiac failure(6). Furthermore functional abnormalities of the diabetic myocardium may largely be independent of hypertension and coronary artery disease(6). Although echocardiography is an useful tool in detecting an asymptomatic cardiomyopathy, the findings are not specific to diabetes. The future lies then in

not only demonstrating a cardiomyopathy but correlating the abnormal metabolic state in diabetes with myocardial cell dysfunction at a pathological and molecular level before we can postulate a true diabetic cardiopathy.

ACKNOWLEDGEMENT

We would like to thank Associate Professor Maurice Choo of the National University of Singapore for carrying out the statistical analysis on our results.

REFERENCES

1. Shapiro LM: Functional aspects of diabetic heart disease. In: Jarrett. ed. Diabetes and heart disease 1984; 81:8.
2. Ledet AT, Gotzsche O, Heickendorff L: The pathology of diabetic cardiopathy. Pathogenetic reflections. In: Jarrett. ed. Diabetes and heart disease 1984; 25:46.
3. Gotzsche O: Myocardial cell dysfunction in Diabetes. A review of clinical and experimental studies. Diabetes 1986; 35:1158-62.
4. Pombo JF, Troy BL, Russell RO: Left ventricular volumes and ejection fraction by echocardiography. Circulation 1971; 43:480- 90.
5. Feigenbaum H: Echocardiography. Philadelphia Lea and Febiger 1981; 119-24 & 129-35.
6. Kannel WB, Hjortland M, Castelli WP: Role of diabetes in congestive heart failure: The Framingham Study. Am J Cardiol 1974; 34:29-34.