



Evaluation of Microvascular and Macrovascular complications in patients with Type 2 Diabetes Mellitus

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Abstract

Background: DM comprises a group of common metabolic disorder that shares the phenotype of Hyperglycemia.

Aim: To evaluate the Microvascular and macrovascular complications of Type 2 Diabetes Mellitus among patients attending the General Medicine OPD and IPD.

Materials and Methods: The study was a cross-sectional study done on patients with age more than 40 years with type 2 Diabetes Mellitus attending OPD and IPD for a period of 12 months. The sample size was 147 and estimated through purposive sampling method. The selected patients underwent detailed clinical and biochemical evaluations.

Results: Maximum patients with diabetes were between 60 - 69 years of age. Of the total number of patients 49% were found to be hypertensive, 39% were found to be obese, 16% of the study population were smokers and 50% were found to have hypercholesterolaemia. The prevalence of retinopathy, neuropathy and nephropathy were 37%, 24% and 20% respectively. The prevalence of coronary artery disease, peripheral vascular disease and cerebrovascular disease was found to be 29%, 5% and 10% respectively.

Conclusion: In this study 64% of patients were males and 36% were females. The mean age of the patients was 57 years. 52% of patients had duration of diabetes < 5 years. Hypertension was found in 49% of patients.

Keywords: Diabetes Mellitus, Nephropathy, Neuropathy, Retinopathy.

Introduction

One of the most challenging problems of the 21st century concerning health is diabetes mellitus. India is the second leading country with 65.1 million people suffering from diabetes in 2013,

which is expected to go up by 109 million by 2035¹. Diabetes Mellitus comprises a group of common metabolic disorder that shares the phenotype of Hyperglycemia. Several distinct types of DM exist and are caused by complex

interaction of genetic, environmental factors and lifestyle choices.

The Two Broad Categories of DM are designated as Type 1 and Type 2 Diabetes.

- Type 1 Diabetes occurs due to auto-immune Beta cell destruction.
- Type 2 DM is a heterogeneous group of disorder characterised by variable degrees of insulin resistance, impaired insulin secretion and increased glucose production.

The chronic complication of DM affects many organ systems and is responsible for the majority of morbidity and mortality associated with the disease. The vascular complication of DM are further subdivided into Microvascular (Retinopathy, Neuropathy, Nephropathy) and Macrovascular (coronary artery disease, peripheral arterial disease and cerebrovascular disease). The microvascular complications of both Type 1 and Type 2 DM result from chronic hyperglycaemia. Since Type 2 DM often has a long asymptomatic period of hyperglycaemia, many individuals with type 2 DM have complications at the time of diagnosis. Evidence implicating a causative role of chronic hyperglycaemia in macrovascular complications is less conclusive. Moreover, coronary heart disease events and mortality are two to four times greater in patients with Type 2 DM. Other factors like dyslipidaemia and hypertension play an important role in macrovascular complications.

Aim of the Study

- 1) To evaluate the microvascular and macrovascular complications of Type 2 Diabetes Mellitus.
- 2) To evaluate the risk factors such as hypertension, hypercholesterolaemia, obesity, and smoking.

Materials and Methods

Study Design

The study was a cross-sectional study done on patients with age more than 40 years with type 2 Diabetes Mellitus attending General Medicine

OPD and IPD for a period of 12 months. The sample size was estimated by purposive sampling method.

Selection of Cases

Patients with type 2 DM aged more than 40 years attending the General Medicine OPD and IPD at Sri Siddhartha Medical College and Hospital were evaluated for

- A. Risk factors- Hypertension, Obesity, Smoking and Hypercholesterolaemia.
- B. Microvascular Complications- Retinopathy, Neuropathy and Nephropathy.
- C. Macrovascular Complications- CAD, Cerebrovascular Disease, Peripheral Vascular Disease.
- D. For evaluation of complication, they were categorised according to the duration of Diabetes.
 - DM of < 5 years.
 - DM for 6 - 10 years.
 - DM for 10-15 years
 - DM of > 15 years.

A detailed history was taken, particularly the duration of Type 2DM, Smoking, Complications, Family History of DM.

The following Criteria were taken/ Diagnosis of Diabetes:

| |
|--|
| FBS \geq 126 mg/dL (7.0 mmol/L)* |
| 2-hr PPBS \geq 200 mg/dL (11.1 mmol/L) during OGTT (75-g)* |
| HBA1C \geq 6.5% (48 mmol/mol)* |

Criteria for Risk Factors Diagnosis of Hypertension

| Stages | Systolic | Diastolic |
|----------------------|----------|-----------|
| Pre-Hypertension | 120-139 | 80-89 |
| Hypertension Stage 1 | 140-159 | 90-99 |
| Hypertension Stage 2 | >160 | >100 |

Obesity

- (a) Body Mass Index= Weight in kgs/Height in m²
 - Overweight 25-30
 - Obese >30
- (b) Waist Circumference
 - Male > 90 cm
 - Female > 80 cm

(c) Total Cholesterol

- < 200 Normal.
- 200 - 239 Borderline High.
- >240 High.

Criteria for Microvascular Complications

1. **Diabetic Retinopathy:** Ocular Fundus examination by ophthalmoscope after dilatation of pupils.

(a) Non-proliferating Diabetic Retinopathy:

- Microaneurysm, Haemorrhage, Hard Exudates

(b) Proliferative Retinopathy:

- New Vessels on Disc (NVD)
- New Vessels Elsewhere (NVE)

(c) Clinically Significant Macular Oedema (CSME):

- Thickening of retina located 500 μ U/m from the centre of macula.
- Hard exudates with thickening of adjacent retina located 500 μ U/m from the centre of macula.
- Zone of retinal thickening of one disk area or larger in size, located one disk diameter from the centre of macula.

2. Diabetic Nephropathy

(a) Macroproteinuria-Protein excretion of > 500 mg/day, out of which 50% is albumin. Macroalbuminuria was tested. Microalbuminuria was not tested.

(b) Serum Creatinine

- Calculation of GFR done based on Cockcroft-Gault Formula.

$$\text{Estimated creatinine clearance (ml/min)} = \frac{(140 - \text{age}) \times \text{body weight (kg)}}{72 \times \text{P creatinine (mg/dl)}}$$

- Multiply by 0.85 for women.

Criteria for Macrovascular Complications**1. Cardiovascular Disease History:**

Symptoms of Angina- Chest pain.

ECG:

- LVH.
- Ischaemic Heart Disease- ST - T changes.

- Features of old MI.

Echo: (Taken where necessary as follows)

- Diastolic dysfunction in HT.
- Regional wall motion abnormalities.
- Ejection Fraction.

2. Peripheral Vascular Disease:

- Clinical examination of peripheral palpable arteries done.
- Doppler study was done in relevant cases.

3. Stroke: Clinical examination and detailed history for stroke was done.

Results

Total number of Patients were 147. Mean Age of Patients was 57 years.

Sex distribution in this study showed male predominance (64%) and females (36%). Maximum patients with diabetes are between 60 - 69 years as shown in **Table 1**. 52% of Patients have duration of Diabetes of < 5 years as shown in **Table 2**. Positive Family History of DM in 32% of Patients as shown in **Table 3**. Total Number of Patients with Hypertension in Diabetes is 49% as shown in **Table 4**. Total Number of Patients with obesity in Diabetes is 39% as shown in **Table 5**. Total Number of Patients with Hypercholesterolaemia in Diabetes is 39% as shown in **Table 6**. In our study most common risk factor with DM is hypercholesterolaemia followed by hypertension and overall risk factors are more in males when compared to females as shown in **Table 7**. Retinopathy is the most common microvascular complication followed by neuropathy as shown in **Table 8**. Non-proliferative Retinopathy is the most common complication in Retinopathy as shown in **Table 9**. The most common macrovascular complication is CAD (29%) as shown in the **Table 10**.

Table 1 Age and Sex Distribution

| AGE (YRS) | MALE | FEMALE | N=147 |
|------------|------|--------|-------|
| 40-49 | 25 | 14 | 39 |
| 50-59 | 25 | 17 | 42 |
| 60-69 | 29 | 14 | 43 |
| 70-79 | 12 | 6 | 18 |
| 80 & ABOVE | 3 | 2 | 5 |
| | 94 | 53 | 147 |

Table 2. Duration of DM

| DURATION | FREQUENCY(%) |
|----------|--------------|
| ≤5YRS | 77(52.4) |
| 6-10YRS | 35(23.8) |
| 11-15YRS | 21(14.3) |
| >15YRS | 14(9.5) |
| TOTAL | 147 |

Table 3. Positive Family History with DM

| FAMILY HISTORY OF DM | TOTAL N=147 |
|----------------------|-------------|
| POSITIVE | 32% |
| NEGATIVE | 68% |

Table 4. Category of Hypertension and DM

| CATEGORY | <5YEARS (N=77) | 6-10 YEARS (N=35) | 11-15 YEARS (N=21) | >15 YEARS (N=14) | TOTAL (N=147) |
|------------------------------------|-------------------|-------------------------|--------------------------|---------------------|------------------|
| PRE-HT 120-139 80-89 | 5 | 12 | 3 | 2 | 22 |
| STAGE 1 140-159 90-99 | 11 | 14 | 10 | 4 | 39 |
| STAGE 2 160/100 AND ABOVE | 6 | 2 | 1 | 2 | 11 |
| TOTAL | 22(29%) | 28(80%) | 14(67%) | 8(57%) | 72(49%) |

Table 5. Obesity and Duration of DM

| OBSEITY | <5YEARS (N=77) | 6-10 YEARS (N=35) | 11-15 YEARS (N=21) | >15 YEARS (N=14) | TOTAL (N=147) |
|---------------------|-------------------|-------------------------|--------------------------|---------------------|------------------|
| OVERWEIGHT 25-30 | 14 | 18 | 9 | 5 | 46(31%) |
| OBESE >30 | 3 | 3 | 3 | 2 | 11(8%) |
| TOTAL | 17(22%) | 21(60%) | 12(57%) | 7(50%) | 57(39%) |

Table 6. DM and Hypercholesterolaemia

| TOTAL CHOLESTEROL MG/DL | <5YEARS (N=77) | 6-10 YEARS (N=35) | 11-15 YEARS (N=21) | >15 YEARS (N=14) |
|-------------------------------|-------------------|----------------------|-----------------------|---------------------|
| 200-239 | 8 | 14 | 8 | 5 |
| 240 AND ABOVE | 13 | 14 | 9 | 3 |
| TOTAL | 21(27%) | 28(80%) | 17(81%) | 8(57%) |

Table 7. Risk Factor and DM

| RISK FACTOR | MALE | FEMALE | TOTAL |
|-----------------------|------|--------|---------|
| HYPERTENSION | 42 | 30 | 72(49%) |
| OBESITY | 30 | 27 | 57(39%) |
| SMOKING | 24 | 0 | 24(16%) |
| HYPERCHOLESTEROLAEMIA | 38 | 36 | 74(50%) |

Table 8. Microvascular Complication and Duration on DM

| MICROVASCULAR COMPLICATION | <5YEARS (N=77) | 6-10 YEARS (N=35) | 11-15 YEARS (N=21) | >15 YEARS (N=14) | TOTAL (N=147) |
|-------------------------------|-------------------|-------------------------|--------------------------|------------------------|------------------|
| RETINOPATHY | 8(10%) | 13(37%) | 19(90%) | 14(100%) | 54(37%) |
| NEUROPATHY | 6(8%) | 9(26%) | 12(57%) | 9(64%) | 36(24%) |
| NEPHROPATHY | 6(8%) | 4(11%) | 8(38%) | 11(76%) | 29(20%) |

Table 9. Types of Diabetic Retinopathy

| TYPES | TOTAL (N=54) |
|-------------------------------|--------------|
| NON PROLIFERATIVE RETINOPATHY | 39(72%) |
| PROLIFERATIVE RETINOPATHY | 12(22%) |
| MACULOPATHY | 3(6%) |

Table 10. Macrovascular Complications and DM

| COMPLICATION | TOTAL N=147 |
|--------------|-------------|
| CAD | 42(29%) |
| PVD | 8(5%) |
| CVA | 14(10%) |

Discussion

The total no. of patients analysed were 147, out of which 64% were male and 36 % were female patients. The mean age of patients found in the study was 57 yrs. These findings correlate with studies done by Raheja et al², which showed the mean age of 53.3 years. The prevalence of diabetes increases with age. In this study maximum case in elderly being 61-69 years' age group. This finding correlate with studies done by Ahuja MMS³. Epidemiological studies of DM in India showed prevalence of diabetes in elderly patients (age > 60 yrs.) in urban population as 23.4% and maximum prevalence was in age group of 61 - 69 years. Out of 100 patients, 32% cases had positive family history of diabetes. Many Indian studies show strong association of positive family history in DM type 2. These findings correlate with study of Shah et al⁴, which showed positive family history of 24.9% and Ramachandran et al⁵ which showed strong correlation of positive family history with DM type 2. **Hypertension:** The prevalence of hypertension in diabetes in the present study is 49%. CDC's National Diabetes Surveillance System 2005, USA⁶ shows 62.5% of patients have hypertension in diabetes. Among the stages of hypertension according to JNC VII report, maximum patients 54% were in Stage 1. Various Indian studies show prevalence of hypertension in DM to be around 50% - 80%. **Obesity:** This study shows that 39% patients were overweight and obese according to BMI. Many of Indian studies showed strong correlation between obesity and DM type 2. **Smoking:** 16% of the patients in the present study were smokers and all of them were males. A study by SV Madhu et al⁷ showed smokers to be 15% and an International study by

CDC- National Diabetes Surveillance System, 2005, USA⁶ shows smokers at 17.7% among diabetic patients. **Hypercholesterolaemia:** Out of 147 patients, 50% patients had hypercholesterolaemia. This study correlates with a study done by CDC- National Diabetes Surveillance System, 2005, USA⁶, which showed the hypercholesterolaemia at 60% and a study done by S Shafiq et al⁸. The most common risk factor in diabetes is hypercholesterolaemia, which is 50%. Next common risk factor is hypertension. All these risk factors play a significant role in the pathogenesis of Macrovascular complications. **Microvascular Complications:** Diabetic Retinopathy 37% is the most common microvascular complication. Out of the patients with Retinopathy, 72% had non-proliferative Retinopathy. The prevalence of Retinopathy increases according to the duration of diabetes. This study correlates with the study done by G Premalatha and V Mohan et al⁹ in Urban South Indian Population, which showed that Retinopathy was 34.1% and M Ranka et al¹⁰ found it to be 28.9% in a North Indian study. CKD in Diabetes was seen in 20% of patients in the study. Out of the patients with CKD, maximum patients i.e. 48% were in Stage 1. 18% of them had Proteinuria. Microalbuminuria was not done in this study. The finding however correlates with the study done by Ramachandra et al⁵ which showed prevalence of Proteinuria at 19.7%. Diabetic Neuropathy was prevalent in 24% of patients. This finding however correlates with the study done by G Premalatha and V Mohan et al⁹ which had 19.1% patients with Neuropathy. **Macrovascular Complications:** Coronary Artery Disease- 29% is the most common Macrovascular complication in the study. 14% of patients with

CAD had duration of DM of < 5 years. Peripheral Vascular Disease was present in 5% of patients in the study. This correlates with the study by G Premalatha and V Mohan et al⁹ which showed 4%. Cerebrovascular disease was seen in 10% of patients in the study. This correlates with the International Study CDC- National Diabetes Surveillance System, 2005, USA⁶ which showed 9% prevalence of stroke in type 2 DM.

Conclusion

- In this study 64% of patients were males and 36% were females, all of them being above 40 years of age.
- The mean age of the patients was 57 years.
- Maximum number of participants were seen in age group of 61 - 69 years.
- 52% of patients had duration of diabetes < 5 years.
- Hypertension was found in 49% of patients.
- Obesity was found in 39% of patients.
- 26% of the males were smokers.
- Hypercholesterolaemia was found in 50% of patients.
- The highest risk factor was Hypercholesterolaemia followed by Hypertension.
- Retinopathy was found in 37% of patients.
- Neuropathy was found in 24% of the patients.
- Nephropathy was found in 20% of the DM patients.
- Coronary artery disease was found in 29% of patients.
- Peripheral Vascular Disease was found in 5% of patients.
- Cerebrovascular disease was seen in 10% of patients.

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