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## Study of microvascular complications in newly diagnosed diabetes mellitus

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### Abstract

**Background Objective:** Microvascular complications are the major outcome of Diabetes Mellitus progression, which reduce the quality of life, incur heavy economic burdens to the health care system and increase diabetic mortality. The aims of this study were to assess the prevalence of microvascular complications among newly diagnosed diabetic patients and to analyze the association between these complications and poor glycemic control.

**Methods:** A total of 100 newly diagnosed Diabetic patients admitted in SIMS, Hyderabad over a period of 1 year formed the study population. Detailed clinical examination and relevant investigations were carried out. Neuropathy was diagnosed by Semmes-Weinstein monofilament and 128 HZ tuning fork, Retinopathy by Direct Ophthalmoscopic examination of fundus, Nephropathy by ACR estimation and cardiomyopathy by Echo cardiography.

**Results:** The total of 100 patients with newly diagnosed DM were studied out of which 52% were males and 48% females. The mean age duration was found to be  $48.99 \pm 10.31\%$  of the patients presented with classical symptoms of DM, 30% with symptoms due to microvascular complications and 4% were asymptomatic. 44% of newly diagnosed diabetics had positive family history. Out of 100 newly diagnosed diabetics 80% of the patients were overweight, 20% were normal weight. 100% of females had central obesity compare to 38.46% in males. 3% of the total patients had some infections at the time of diagnosis of DM. 18% of the patients had peripheral neuropathy. 18% of the patients had Retinopathy at the time of diagnosis of DM in which mild NPDR is more common accounting for 14%. 4% of the patients had PDR. 18% of the patients had diabetic nephropathy at the time of diagnosis of DM with 14% of them having incipient nephropathy and 4% of the patients had diabetic cardiomyopathy at the time of diagnosis of diabetes mellitus.

**Conclusion:** 50% of the newly diagnosed diabetics had microvascular complications. Hence microvascular complications at the time of diagnosis of DM were high in our cases which signals physicians to have serious awareness about these unusual presentations and helps in concentrating on further evaluation and appropriate intensive control of diabetes to prevent further complications.

**Keywords:** Diabetes mellitus, diabetic neuropathy, diabetic nephropathy, diabetic retinopathy, diabetic cardiomyopathy, microvascular complications

### Introduction

Diabetes mellitus is a global epidemic that affects more than 150 million people worldwide<sup>[1]</sup>. It is estimated that global number of adults suffering from any form of diabetes will reach 439 million in 2030; most of them type 2 diabetes mellitus cases<sup>[2, 3]</sup>. Diabetes mellitus is a major cause of morbidity and mortality. Data from prospective and cross-sectional studies consistently points to the fact that diabetic patients are more likely to develop micro- as well as macrovascular conditions<sup>[1]</sup>.

Epidemiological data in India shows the same upward trend, with 32 million people suffering from Diabetes Mellitus in the year 2000 to 79 million in the year 2010 thus making India the Diabetic Capital of the World<sup>[2, 3]</sup>. Therefore Diabetes predisposes to the development of microvascular and macrovascular complications which have a significant impact on quality of life and result in a substantial increase in morbidity and mortality. Some of the complications of Diabetes Mellitus include nephropathy, retinopathy, neuropathy, coronary artery disease, heart failure, autonomic dysfunction, cardiomyopathy, abnormalities in ventricular function, peripheral artery disease, etc. The incidence of these complications increases in the presence of co-existing risk factors like hypertension, smoking, obesity, dyslipidaemia or microalbuminuria together mentioned as Metabolic Syndrome or Syndrome X.

Long-standing untreated hyperglycemia is responsible for the relatively high prevalence of microvascular complications in newly diagnosed diabetes mellitus (NDDM) patients<sup>[4]</sup>.

Presence of microvascular complications at the time of T2DM diagnosis are showing increasing trend in India. It is apparent that evidence on prevalence of T2DM related complications is essential for the adjustment of policies and practices in diabetic care management [5]. Screening for microvascular complications in NDDM patients will have important implications for understanding the need of vigorous screening, effective prevention, and management of T2DM as well as reduced healthcare expenditure [6].

These complications vary in prevalence in different populations depending on various factors such as genetic predisposition, ethnicity, type of diabetes, associated predisposing factors and even definition of the respective complications [7].

In view of the non-availability of such data in our local population, the presence of these complications need to be assessed among diabetic patients. In Indian setup regular health checkup is not undertaken because of large population and lack of medical facilities, many of the patients of diabetes mellitus are diagnosed late. Hence this study is taken up to know the late complication of diabetes like nephropathy, neuropathy, retinopathy and cardiomyopathy at the time of detection of diabetes mellitus first time.

#### Aims and Objectives

- To study the presence of various microvascular complications in patients with newly detected Diabetes Mellitus.

#### Source of data

Patients with newly diagnosed Diabetes mellitus presenting to department of medicine, SIMS, Hyderabad from June 2017 to May 2018 were taken for study. They presented to physician either for routine checkup or have been admitted for some other illness and diabetes was detected by chance for first time.

**Sample Size:** 100 subjects

**Study Design:** Cross sectional study

**Duration of Study:** One year study from June 2017 to May 2018

**Study Setting:** Department of Medicine, SIMS, Hyderabad.

#### Methodology

Detailed history regarding the symptoms of diabetes with history of microvascular complications will be taken.

Detailed clinical examination and relevant investigations will be done

**For neuropathy:** Semmes - Weinstein mono filament and 128 Hz tuning fork. For retinopathy: Direct ophthalmoscopic examination of fundus.

**For nephropathy:** ACR estimation.

**For cardiomyopathy:** Echo Cardiography, ECG

#### Inclusion criteria: (ADA Criteria)

Patients with newly diagnosed Diabetes Mellitus presenting to SIMS.

#### Criteria for establishing Diabetes Mellitus

1. Fasting plasma glucose  $\geq 126$ mg/dl (7.0mmol/dl). (Fasting is defined as no calorie intake for at least 8 hours)

2. Postprandial plasma glucose  $\geq 200$ mg/dl (2 hours after 75gm of oral glucose)
3. HbA1C  $> 6.5$

#### Exclusion criteria

1. Congestive cardiac failure
2. Urinary tract infection
3. Known hypertensives
4. Fever
5. Renal diseases
6. Other diseases causing peripheral neuropathy

#### Method of collection of data

##### Clinical history

- Detailed history regarding the symptoms of diabetes like polyuria, polydipsia, polyphagia and weight loss were taken.
- History of microvascular complications were taken in detail.

##### Peripheral neuropathy

Any history of tingling, numbness, burning sensation or any sensory loss.

##### Diabetic Retinopathy

History of blurred vision, black spots, floaters and sudden visual loss

##### Diabetic Nephropathy

History of polyuria, oliguria, puffiness of face, distension of abdomen and pedal edema.

Diabetic cardiomyopathy

History of dyspnea on exertion and chest pain.

#### Clinical Examination

##### Neuropathy Peripheral neuropathy

1. Detection of Diabetic Peripheral Neuropathy by:
  - a) Foot sensitivity testing by Semmes Weinstein monofilament.
  - b) Deep tendon reflex testing by percussion hammer.
  - c) Vibration perception testing by 128HZ tuning fork.

##### Simmes-Weinstein 10 gm monofilament

Cutaneous pressure perception of the foot was assessed by using 10 gm monofilament. The procedure was explained to the patients.

#### Investigations

- Fasting plasma glucose
- Postprandial plasma glucose
- HbA1C
- Blood routine
- Urine for proteinuria
- Blood urea & Serum Creatinine
- Urine Culture and Sensitivity

#### ESR

- Microalbuminuria detection by Albumin Creatinine Ratio estimation
- Nerve conduction study whenever necessary
- Echocardiography ECG.

**Results**

**Table 1:** Showing number of patients according to age and sex distribution.

| Age in yrs | Male (%) | Female | Total (%) |
|------------|----------|--------|-----------|
| 35-44      | 22       | 12     | 34(34)    |
| 45-54      | 10       | 22     | 32(32)    |
| 55-64      | 10       | 8      | 18(18)    |
| 65-74      | 10       | 2      | 12(12)    |
| 75-84      | 0        | 4      | 4(4)      |
| Total      | 52       | 48     | 100(100)  |

Above data suggest that out of total 100 patients with newly diagnosed diabetes, 52% were males (52 males) and 48% were females (48). 34% of the patients were within age of 35-44yrs, 32% of them were within 45-54yrs. Mean age duration was found to be 48.99±10.31

**Table 2:** Showing number of patients who were asymptomatic, with classical symptoms of diabetes and who had symptoms due to microvascular complications

|   | Male | Female | Total (%) |
|---|------|--------|-----------|
| Asymptomatic                                | 0    | 4      | 4(4)      |
| Classical symptoms                          | 32   | 34     | 66(66)    |
| Symptoms due to microvascular complications | 14   | 16     | 30(30)    |

Above data suggests that 66% of the patients (32 males and 34 females) presented with classical symptoms of diabetes

**Table 5:** Showing number of patients who were presented with different symptoms.

| Symptoms                                  | Male | Female | Total (%) |
|---|------|--------|-----------|
| General symptoms                          | 34   | 36     | 70(70)    |
| Symptoms suggestive of infections         | 6    | 0      | 6(6)      |
| Symptom suggestive of cardiac involvement | 0    | 4      | 4(4)      |
| Peripheral nerves system                  | 10   | 8      | 18(18)    |
| Symptom suggestive of renal involvement   | 0    | 2      | 2(2)      |
| System suggestive of involvement of eyes  | 6    | 2      | 8(8)      |
| System suggestive of vascular disease.    | 0    | 0      | 0(0)      |

From the above data suggests 70% of the patients at the time of diagnosis of diabetes mellitus had general symptoms. 6% had symptoms suggestive of infections, 4% had symptom suggestive of cardiac involvement, 18% had Peripheral nerves system, 2 % had symptom suggestive of renal involvement and 8% had system suggestive of involvement of eyes.

**Table 6:** Blood pressure measurements.

| Systolic Blood Pressure mmHg | N   | Mean   | Std  |
|------------------------------|-----|--------|------|
| Supine                       | 100 | 128.73 | 7.64 |
| Standing                     | 100 | 117.93 | 9.4  |

Above data suggests mean systolic blood pressure out of 100 patients in supine is 128.23±7.64 and in standing is 117.93±9.4.

**Table 7:** Blood pressure measurements

| Diastolic blood pressure mm hg | N   | Mean  | Std  |
|--------------------------------|-----|-------|------|
| supine                         | 100 | 83.97 | 5.8  |
| standing                       | 100 | 75.65 | 5.60 |

mellitus. About 30% of the patients with newly diagnosed diabetes mellitus presented with symptoms due to microvascular complications. About 4% of the patients were totally asymptomatic.

**Table 3:** Showing number of patients who were under weight or over weight and their percentage according to BMI.

| Weight      | Male       | Female   | Total   |
|-------------|------------|----------|---------|
| Overweight  | 32(61.54%) | 48(100%) | 80(80%) |
| Underweight | --         | --       | --      |
| Obese       | --         | --       | --      |
| Normal      | 20(38.46%) | --       | 20(20%) |

Out of 100 newly diagnosed diabetics, 80% of the patients were overweight (61.54% males and 100% females). Only 20% of the patients were having normal BMI(38.46% males).

**Table 4:** Showing number of patients who were having central obesity and their percentage according to Waist and Hip ratio.

|                 | Male (N=26) | Female (N=24) | Total    |
|-----------------|-------------|---------------|----------|
| Central obesity | 20(38.46%)  | 48(100%)      | 68 (68%) |

The above data suggests 38.46% males and 100% females had central obesity. Overall 68% of the patients had central obesity at the time of diagnosis of DM. Mean Waist Hip ratio was found to be 1.0±0.03.

Above data suggests mean diastolic blood pressure out of 100 patients in supine is 82.97±5.8 and in standing is 74.65±5.60.

**Table 8:** Showing investigations.

| Investigations | Male (26) mean± SD | Female (24) mean± SD | Total (50)   |
|----------------|--------------------|----------------------|--------------|
| RBS            | 212.47±32.39       | 209.17±35.89         | 211.03±33.79 |
| PPBS           | 251.93±47.59       | 267.76±42.4          | 259.68±45.32 |
| FBS            | 188.24±44.45       | 185.92±43.32         | 187.15±43.48 |
| HbA1C          | 8.16±1.83          | 7.99±1.12            | 8.07±1.52    |
| UREA           | 22.39±6.53         | 23.96±9.95           | 23.15±8.30   |
| Creatinine     | 1.22±1.12          | 1.06±0.24            | 1.14±0.82    |

Above data suggests for males 52%(52 patients) and females 48%(48 patients), the mean value of RBS in male patients was 212.47±32.39 and in females patients was 209.17±35.89, the mean value of PPBS in male patients was 251.93±47.59 and in females patients was 267.76±42.4, the mean value of FBS in male patients was 188.24±44.45 and in females patients was 185.92±43.32, the mean value of HbA1C in male patients was 8.16±1.83 and in females patients was 7.99±1.12, the mean value of UREA in male patients was 22.39±6.53 and in females patients was

23.96±9.95 and the mean value of Creatinine in male patients was 1.22±1.12 and in females patients was 1.06±0.24.

**Table 9:** Neuropathy

| Neuropathy | Total (%) |
|------------|-----------|
| Peripheral | 18(18 %)  |
| Normal     | 82(82 %)  |

**Table 10:** Showing investigations of MAU.

| MAU     | Total (%) |
|---------|-----------|
| Normal  | 86(86)    |
| Present | 14(14)    |

Above data suggests 14% had microalbumuria and 86% were normal.

**Table 11:** Showing investigations of U.ALBU.

| U.ALBU  | Total (%) |
|---------|-----------|
| Normal  | 96(96)    |
| Present | 4(4)      |

Above data suggests 14% had microalbumuria and 4% had macroalbumuria.

**Table 12:** Showing investigations of FUNDUS.

| FUNDUS    | Total(%) |
|-----------|----------|
| Normal    | 82(82)   |
| Mild NPDR | 14(14)   |
| PDR       | 4(4)     |

Above data suggests 14% had mild NPDR, 4% had PDR and 82% were normal.

**Table 13:** Showing investigations of Echocardiography.

| ECO    | Total (%) |
|--------|-----------|
| Normal | 96(96)    |
| LVD    | 4(4)      |

**Table 14:** Showing investigations of ECG.

| ECG    | Total (%) |
|--------|-----------|
| Normal | 96 (96)   |
| LVH    | 4 (4)     |

Above data suggests echocardiography showing left ventricular dysfunctional was 4% and 96% were normal Above data suggests ECG showing left ventricular hypertrophy was 4% and 96% was normal.

**Table 15:** Showing investigations of U.SUGAR.

| U. SUGAR | Total (%) |
|----------|-----------|
| Normal   | 96(96)    |
| present  | 4(4)      |

Above data suggests 4% had U.Sugar and 96% were normal.

**Table 16:** Showing investigations of NCV (Nerve conduction velocity).

| NCV     | Total (%) |
|---------|-----------|
| Normal  | 100(100)  |
| present | 0(0)      |

**Table 17:** Showing blood urea and serum creatinine levels expressed mg/dl.

| Blood urea       | Male | Female | Total (%) |
|------------------|------|--------|-----------|
| <20              | 12   | 8      | 10(20)    |
| 20-40            | 40   | 38     | 78(78)    |
| >40              | 0    | 2      | 2(2)      |
| Serum creatinine |      |        |           |
| <1               | 18   | 16     | 34(34)    |
| 1-2              | 32   | 32     | 64(64)    |
| >2               | 2    | 0      | 2(2)      |

Urea: mean± SD=23.14±8.29

Creatinine: mean± SD=1.13±0.81

The above data suggests that for urea <20 in males (12) and females (8) was 20%, for urea 20-40 in males (40) and females (38) was 78% and in urea >40 in females (2) was 2%. The above data suggests that for serum creatinine <1 in males (18) and females (16) was 34%, and serum creatinine 1-2 in males (32) in females (32) was 64% and serum creatinine >2 in males (2) was 2%.

### Discussion

We studied newly diagnosed diabetic patients admitted to SIMS, Hyderabad over a period of 1 year. A total of 100 cases were studied.

### Age

In present study 100 newly diagnosed diabetic patients were studied to determine prevalence of diabetic complications (26 males and 24 women) with mean age ± 2 SD = 48.99±10.31.

The mean age in our study is closely related to the study by Nambuya AP *et al.* [8] and was slightly higher than study done by Weersuriya *et al.* [9] and lower than the study done by Manish Sirshat *et al.* [10]

### Symptoms

In the present study 66% of patients presented with classical symptoms of Diabetes Mellitus. In a study conducted by V. Sekaret *al.* [11] classical symptoms were 21. About 30 % of patients present with symptoms due to micromascular complication, out of which i.e 32 males and 34 females. 4% of patients were asymptomatic.

### BMI

In our study over 80% of patients were overweight, 100% of female patients are overweight, 61% males are overweight and 20% of patients were normal weight. Mean BMI was 25.4±1.28.

### Central obesity

Male patients has 38.46% of central obesity, female patients has 100%. It indicates that Indian as an ethnic group have high prevalence of central obesity especially in women. Waist hip ratio 1.0±0.04.

**Blood sugar levels**

Mean FBS and PPBS levels in our study are  $187.15 \pm 43.48$  and  $259.68 \pm 45.32$ . FBS is near to the study of Cathelinu. G [12].

**HBA<sub>1</sub>C:** Mean value in our study is  $8.07 \pm 1.6$ . Mean value of HBA<sub>1</sub>C was suboptimal according to ADA (American Diabetes Association) criteria.

**Creatinine:** Mean value in our study is  $1.14 \pm 0.82$ .

**Blood Urea:** Mean value in our study is  $23.15 \pm 8.30$ .

It is high in our study compared to percentage of neuropathy when compared to Thompson T J *et al.* [13] and A Ramachandran *et al.* [14]. Percentage of neuropathy was less when compared to Weersuriya N *et al.*, [9] Nambuaya A P *et al.*, [8] Dutta *et al.* [15] and Unadike *et al.* [16].

The incidence of retinopathy in our study was nearly equal to Thompson T J *et al.* [13] and less than UKPDS Ismat Ereifezet *et al.* [18] and Verinoca *et al.* [18]. Mild NPDR was the main presenting feature in our present study (7 NPDR+2 PDR).

The incidence of nephropathy in the present study was 18% almost equal to A Ramachandran *et al.*, [14].

**Cardiomyopathy**

The incidence of cardiomyopathy in our study is 4% (4 cases).

In study of Left Ventricular Dysfunction (SOLVD), the percentage of patients with diabetes and heart failure was up to 26%. In study of the Assessment Trial of Lisinopril and Survival (ATLAS), it was 19% [19] and in the Vasodilator-Heart Failure Trial II (V-HeFT II), it was up to 20% [20]. In Rubler *et al.* study there were 4 diabetic patients with HF [21].

**Conclusion**

- 50% patients presented with microvascular complications in newly diagnosed diabetes mellitus.
- Diabetic neuropathy and diabetic retinopathy was found to be the commonest microvascular complication followed by diabetic nephropathy and cardiomyopathy.
- Early diagnosis and management of DM and its complications can prevent further progression of the disease process and reversal of initial phase of complications.
- Targeted screening for previously undiagnosed type 2 diabetics may help in prevention of emergence or delay the onset of microvascular complications.

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