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## A study on microvascular complications in patients with newly detected Diabetes Mellitus

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### Abstract

**Introduction:** Microvascular complications such as diabetic retinopathy, diabetic neuropathy, and diabetic nephropathy are associated with considerable medical and economic impact among persons with diabetes. In the UK Prospective Diabetes Study [UKPDS], 37% of patients with newly diagnosed type 2 diabetes developed at least one microvascular complication over a ten years period.

**Methodology:** The procedure was told to the patients. 5.07 Simmes Weinstein monofilament consisted of a plastic handle supporting a nylon filament. The filament was placed perpendicular to the skin of the foot, and the pressure was applied until the filament buckles. The filament was held in place for approximately 1 second, then released. The patients were asked to elicit a 'Yes/No' response to monofilament pressure and correctly identify the site of contact. Inability to perceive the 10 g of force it applies was associated with clinically significant large fibre neuropathy. Like this 9 plantar sites and 1dorsal site were tested in each foot.

**Results:** Statistical analysis of above obtained data reveals that patient with HbA1c  $\geq 8\%$  have 4.4 times higher risk of developing microvascular complications than patient with HbA1c  $\leq 8\%$ . This indicates HbA1c is a better predictor of microvascular complications in diabetics. Most of the patients had normal Blood urea and Serum creatinine levels. 25 patients had urea  $> 40\text{mg/dl}$ . 2 patient had creatinine  $> 2\text{mg/dl}$ .

**Conclusion:** It is clear that significant increase in Blood urea and Serum creatinine levels which is indicative of renal involvement is less common at diagnosis of diabetes mellitus.

**Keywords:** Micro vascular complications, diabetes mellitus, diabetic retinopathy

### Introduction

Diabetes Mellitus has become a global health problem due to rapidly increasing prevalence of obesity and physical inactivity. It is common and a serious disease with chronic complications and constitutes a substantial burden for both patient and health care system. There is, therefore, an urgent need to prevent diabetes and its complications [1].

In 2003, the global prevalence of diabetes was estimated at 194 million this figure is predicted to reach 333 million by 2025 as a consequence of longer life expectancy, sedentary life style and changing dietary patterns [2, 3].

Diabetes mellitus is characterized by asymptomatic phase between actual onset of hyperglycemia and clinical diagnosis which has been estimated to last at least 4-7 years [4].

Microvascular complications such as diabetic retinopathy, diabetic neuropathy and diabetic nephropathy are associated with considerable medical and economic impact among persons with diabetes. In the UK Prospective Diabetes Study [UKPDS], 37% of patients with newly diagnosed type 2 diabetes developed atleast one microvascular complication over a 10 year period [5].

Various micro vascular complications in diabetes mellitus includes

- Diabetic Retinopathy
- Diabetic Nephropathy
- Diabetic Neuropathy

With newly diagnosed diabetes mellitus [6]. It is seen in 39% of men and 35% of women, with marked retinopathy present in 8% men and 4% women at the time of diagnosis of diabetes mellitus in UKPDS [7]. It remains the leading cause of blindness in working aged Americans. With appropriate medical and ophthalmologic care, more than 90% visual loss can be prevented.

The rate of development and progression of retinopathy were significantly reduced after intensive Insulin therapy. 20% of patients have retinopathy at the time of diagnosis of diabetes [8].

The prevalence of overt nephropathy is about 3% in newly diagnosed diabetes mellitus [9]. Type 1 diabetes with microalbuminuria have median risk ratio of 21 for developing nephropathy and median risk ratio of 8.5 in microalbuminuric type 2 diabetes patients. Diabetes constitutes 44.5% of end stage renal disease.

Symptomatic peripheral neuropathy is found in up to 1.5% of newly diagnosed diabetes, whereas by clinical signs it is found in 2.3% of newly diagnosed diabetes [10]. The degree of neuropathy is associated with degree of hyperglycemia [11] and responsible for 50-75% of non-traumatic amputations.

Presence of microvascular complications at the time of diagnosis of diabetes mellitus are showing increasing trend in India. Early detection of micro vascular complications and its treatment at this time by intensive therapy can prevent progression of these complications and hence morbidity and mortality among patients.

The use of haemoglobin A1C [HbA1C] to diagnose pre-diabetics and diabetes recently was recommended by American Diabetes Association (ADA) [2]. HbA1C testing has an advantage over glucose based testing because it does not require fasting and can be performed anytime. Guidelines recommended an HbA1C  $\geq$  6.5% to diagnose diabetes and HbA1C between 5.7 and 6.4% for identifying prediabetes.

Our study is to detect microvascular complications at the time of diagnosis in Indian population.

### Methodology

**Sample Size:** 100 cases.

**Sample procedure:** Cross-sectional study.

### Clinical Examination

#### Neuropathy

#### Peripheral Neuropathy

Detection of Diabetic Peripheral Neuropathy by:

- Foot sensitivity testing by Semmes Weinstein mono filament.
- Deep tendon reflex testing by percussion hammer.
- Vibration perception testing by 128HZ tuning fork.

#### Simmes-Weinstein 10gm monofilament

Cutaneous pressure perception of the foot was assessed by using 10gm monofilament. The procedure was explained to the patients. 5.07 Simmes Weinstein monofilament consisted of a plastic handle supporting a nylon filament. The filament was placed perpendicular to the skin of the foot, and pressure was applied until the filament buckles. The filament was held in place for approximately 1 second, then released. The patients were asked to elicit a 'Yes/No' response to monofilament pressure and correctly identify the site of contact. Inability to perceive the 10 g of force it applies was associated with clinically significant large fibre neuropathy. Like this 9 plantar sites and 1 dorsal site were tested in each foot.

Insensitivity to 10gm monofilament at any one site on either foot was taken as abnormal sensation having significant neuropathy.

### Autonomic Neuropathy

#### Cardiovascular test

#### Parasympathetic test

##### (a) Heart rate response to Valsalva maneuver

The BP falls and heart rate raises during strain phase of Valsalva maneuver and after release BP raises with slowing of heart rate. In patients with autonomic neuropathy BP falls during strain period and after release slowly returns to normal with no change in heart rate. The patient I asked to blow the rubber tubing connected to BP apparatus to raise the pressure to 30mmhg for 15 seconds. The ratio of the length of longest R-R interval and the shortest R-R interval during the manoeuvre is measured. Normal 1.21 or more, abnormal is 1.20 or less.

##### (b) Heart rate response to deep breathing

The patient takes deep breaths at the rate of 6 breaths/min. The maximum and minimum heart rates are evaluated from the ECG recording during each cycle. The difference between three successive breathing cycles gives "maximum-minimum heart rate", expressed as E:I ratio. Normal-15 beats/minute or more. Abnormal-  $\leq$ 10 beats/minute.

#### Sympathetic test

##### 1) BP response to standing up

BP recording is done when the subject is lying down and again one min after standing up. The difference in the systolic pressure from lying to standing is taken as a measure of postural hypotension. Normal 10mmhg or less, borderline-11 to 29 mm hg and abnormal -30mm hg or more and diastolic pressure difference of more than 15mmhg is abnormal.

- Gustatory sweating
- Erectile dysfunction
- Diabetic diarrhea
- Urinary incontinence
- Pupillary abnormalities
- Detection of Diabetic Retinopathy

### Results

**Table 1:** Showing total number of patients with peripheral neuropathy based on signs and symptoms

Peripheral neuropathy	Male	Female	Total
Only symptoms	17	12	29
Both signs and symptoms	16	12	28
Only signs	5	3	8

Symptomatic peripheral neuropathy are more common than asymptomatic. 65% of the patients presented with peripheral neuropathy at the time of diagnosis of diabetes.

29% of the patients (17% males and 12% females) were presented with only symptoms of peripheral neuropathy, 8% of them were presented with only signs of peripheral neuropathy, 28% of them (16% males and 12% females) were having both signs and symptoms.

**Table 2:** Showing number of patients presenting with retinopathy at the time of diagnosis of diabetes mellitus

Retinopathy	Male	Female	Total
BDR	9	3	12
PPDR	6	4	10

From the above data it is clear that BDR is more common than PPDR at the time of diagnosis. Totally 22% (12% males and 10% females) of the patients had retinopathy at the time of diagnosis.

**Table 3:** Showing number of patients with diabetic nephropathy in patients with newly diagnosed diabetes mellitus

Proteinuria	Male	Female	Total
Microalbuminuria	12	16	28
Macroalbuminuria	2	2	4

From the above data it is clear that 28% of the patients presented with incipient nephropathy at the time of diagnosis. 4% of the patients had microalbuminuria. 24% of the patients were presented with diabetic nephropathy at the time of diagnosis of diabetes mellitus.

**Table 4:** Correlation of HbA1C in relation to microvascular complications

HbA1C	Complications	Without complications	Total
	N (%)	N (%)	
6.5-7.5	3 (37.5)	5 (62.5)	8
7.6-8.5	12 (40)	18 (60)	30
8.6-9.5	18 (62.1)	11 (37.9)	29
9.6-10.5	18 (81.8)	4 (18.2)	22
10.6-11.5	10 (90.9)	1 (9.1)	11
Total	61	39	100

Statistical analysis of above obtained data reveals that patient with HbA1c ≥8% have 4.4 times higher risk of developing microvascular complications than patient with HbA1c ≤8%.

This indicates HbA1c is a better predictor of microvascular complications in diabetics.

**Table 5:** Showing percentage of patients who had lipid in the high risk category at the diagnosis of diabetes

Lipids (high risk)	Percentage
Hypercholesterolemia	16 %
Hypertriglyceridemia	24 %
Decreased HDL cholesterol	11 %
Increased LDL cholesterol	35 %

From the above data it is clear that hyperlipidemia under high risk category was almost equal in both males and females. Total cholesterol, HDL and LDL cholesterol levels were higher in males than females under borderline risk. 24% of the patients had hyperlipidemia.

**Table 6:** Showing Blood urea and serum creatinine levels expressed in mg/dl

Blood urea	Male	Female	Total
< 20	6	10	16
20-40	37	22	59
> 40	17	8	25
Serum creatinine			
< 1	23	8	31
1-1-2	37	30	67
> 2	0	2	2

Urea: mean ± SD = 33.55 ± 12.35

Creatinine mean ± SD = 1.23 ± 0.48

Most of the patients had normal Blood urea and Serum creatinine levels. 25 patients had urea > 40 mg/dl. 2 patient

had creatinine > 2mg/dl. From the above data it is clear that significant increase in Blood urea and Serum creatinine levels which is indicative of renal involvement is less common at diagnosis of diabetes mellitus.

**Discussion**

In our study 10% of patients had pneumonia, 4% had urinary tract infections, 2% had cellulitis, 2% had gluteal abscess, 4% had tubercular pleural effusion. It probably indicates that Indians with diabetes were prone for infections and tuberculosis was little high in Indian study including present when compared to Nambuya AP *et al.* study.

It is clear that the percentage of both peripheral neuropathy and Autonomic neuropathy was high in our study compared to Ratzmann KP *et al.* [11] and Parker AL *et al.* [12] Over all percentage of neuropathy was almost equal when compared to Nambuya AP *et al.* [13] and high when compared to Thompson TJ *et al.* [14] and Ramachandran A *et al.* study [15]. Symptomatic neuropathy was present in 36% of patients in present study and 7% in Sekar V *et al.* [16] and 30% in Tripathi BB *et al.* [17] study. It was little higher when compared to study by Tripathi BB *et al.* and very high compared to V Sekar *et al.* study.

It is clear that percentage of patients who presented with retinopathy in our study was nearly equal when compared to Rajiv Raman *et al.* [18] and A. Ramachandran *et al.* [15] It was more when compared to Thompson TJ *et al.* [14] and Cathelineau G *et al.* [19]

BDR was the main presenting feature in all the studies including our study and PPDR in our study was almost equal when compared to Wang Y *et al.* study.

In present study was almost equal to Verinoca R. Collins *et al.*, Weersuriya N *et al.* and Cathelineau G *et al.* But it was higher than A Ramachandran *et al.* and Thompson PJ *et al.* study.

The percentage of microalbuminuria in present study was nearly equal to Cathelineau G *et al.* was higher than Ramachandra A *et al.* study.

The mean FBS and PPBS levels were high in our study than studies done by SS Murthy and Cathelineau G *et al.* In our study almost all patients had severe fasting hyperglycemia at the diagnosis.

The percentage of patients with hypercholesterolemia was higher in our study than Weersuriya *et al.* and lower than SS Murthy *et al.* study. The percentage of patients with hypertriglyceridemia was high in our study when compared to Weersuriya N *et al.* and less compared to SS Murthy *et al.* The percentage of patients with decreased HDL was almost equal in present study compared to Weersuriya N *et al.*

**Conclusion**

- 41 out of 100 newly diagnosed Diabetes Mellitus were presented with microvascular complications.
- Neuropathy was found to be the commonest microvascular complication followed by Diabetic Nephropathy and Diabetic Retinopathy.
- More than 50% of the patients had Microvascular complications at the time of diagnosis of Diabetes Mellitus.
- HbA1c is a better predictor of microvascular complications in diabetics.

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