3.3 Sample Size

Total: 50, 25 cases and 25 controls between age of 40-70years
Group I: 25 patients of type2 diabetes mellitus without micro vascular complications.
Group II: 25 patients of type2 diabetes mellitus with micro vascular complications.

Inclusion criteria

- Group I**:** Patients willing to participate in the study, in the age group of 40–70 years with type 2 diabetes without proven micro vascular complications
- Group II: Patients willing to participate in the study, in the age group of 40–70 years with type 2 diabetes with proven micro vascular complications, like nephropathy, neuropathy and/or retinopathy were selected.

Exclusion criteria

Patients with diabetic keto acidosis,coronary artery disease,stroke,peripheral vascular disease,immunological disorder, taking diuretics and magnesium supplements or containing antacids,malabsorption syndrome,chronic diarrhea,chronic renal failure due to factors other than type 2 Diabetes Mellitus,pancreatitis,alcoholism and liver diseases were excluded from the study .

3.4 Statistical analysis:

Student `t' test /Chi-square test has been used to find the significance of homogeneity of study characteristics between both groups of patients. Analysis of variance has been used to find the significance of study parameters between the groups. Results were expressed as mean + SD. Probability values of P< 0.05 were considered to indicate statistical significance.

4. Results

Table 1: Patient demography

	Group I(n=25)	Group II(n=25)
Age (years)	56.82±10.07	59.07±9.52
Sex Males females	16 9	15 10
BMI	26.06±2.95	27.45±6.60
Duration of diabetes(yrs)	3.58±3.406	10.15±5.977
Treatment- none OHA Insulin Both	6 16 2 1	2 11 8 4
FBS(mg/dl)	180.30	180.77
PPBS(mg/dl)	255.92	264.90
HbA1c %	8.98±2.26	9.93±2.50
Hypertension	9	19

The average serum magnesium levels were measured as 1.92 ±0.25 and 1.46±0.32 in Group I and Group II respectively. Patients in Group II showed significant hypomagnesaemia as compared to Group I. The average HbA1C (%) values were measured as 8.98 ± 2.26 and 9.93 ± 2.50 in Group I and Group II respectively. The HbA1C (%) values were found to be significantly higher in group II. The values of HbA1C (%) were positively correlated with blood glucose level and negatively correlated with serum magnesium levels.

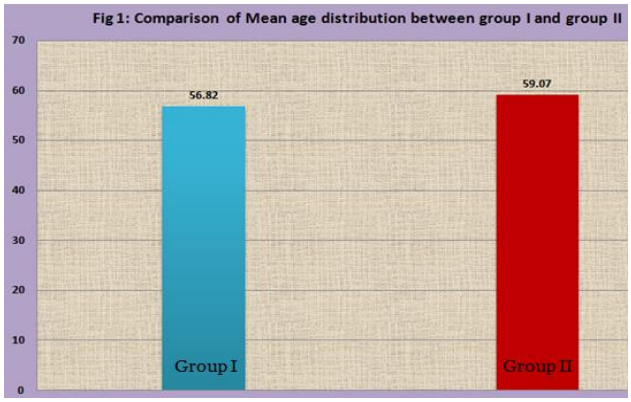

Figure 1: Mean age distribution

Table 2: FBS, PPBS, HbA1c, S. Magnesium

FBS,PPBS, HbA1c and serum magnesium levels in study population								
		N	Mean	SD	Min.	Max.	't' value	'p' value
FBS (mg/dl)	Group I (N=25)	25	180.3	84.178	65	524		
	Group II (N=25)	25	180.77	67.205	59	414	0.001	0.973
PPBS (mg/dl)	Group I (N=25)	25	255.92	109.417	125	564		
	Group II (N=25)	25	264.9	94.78	86	566	0.231	0.632
Glycated HbA1c(%)	Group I (N=25)	25	8.985	2.2662	6.1	14		
	Group II (N=25)	25	9.938	2.5039	6.8	16.3	4.781	0.031
Serum Magnesium	Group I (N=25)	25	1.922	0.2512	1.4	2.4		
	Group II (N=25)	25	1.468	0.3202	0.9	2.2	74.451	<0.001

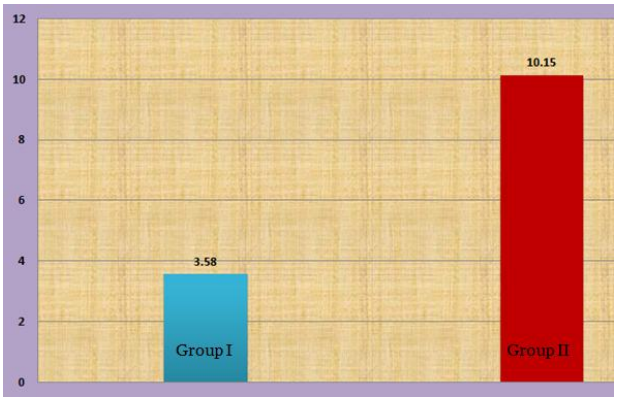

Figure 2: Mean duration of diabetes

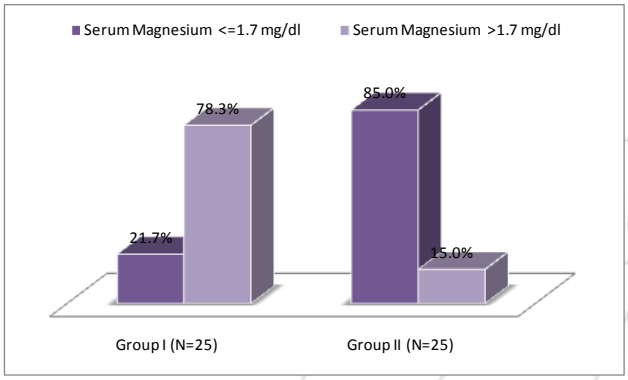

Figure 3: Hypomagnesaemia in group I and II

5. Discussion

Mg is the second predominant component in the intracellular compartment, an important regulator of the cellular processes, co-factor of more than 300 essential metabolic reactions, including the ones that produce or use the MgATP complex [3].

However, its functionality is related to the synthesis of tissue constituents, growth and thermo genesis, and with the activity of tyrosine kinase, in the metabolism of glucose [3]. The almost universal involvement of magnesium in a wide variety of cellular processes critical to glucose metabolism, insulin action and cardiovascular functions has been well-appreciated [6]. The incidence of subclinical magnesium deficiency is common in diabetes and cardiovascular disorders [6].

Table 3: Comparison of previous studies

Study	Sample	Mean s.Mg in microvascular complications	Observation
Mirza Sharif Ahmed Baig (2012)	90	1.29±0.31	Low levels of serum magnesium were found in patients with diabetic complications when compared with diabetic patients without complications.
Asha S Khubchandani (2013)	75	1.32 ±0.28	Low S.Mg in T2DM with complications and significant correlation between HbA1C and magnesium levels.
Arundhati Dasgupta (2013)	150	1.02±0.31	Hypomagnesemia in diabetes was associated with poorer glycemic control, retinopathy, nephropathy, and foot ulcers.
Present study	50	1.46±0.32	Low s.Mg and poor glycemic control in T2DM with microvascular complications.

In our study we found that diabetics with micro vascular complications had significantly lower level of serum magnesium (1.46±0.32) compared to diabetics without micro vascular complications (1.92 ±0.25). Studies have shown that although the binding of insulin to its receptor does not appear to be altered by magnesium status, the ability of insulin once bound to receptor to activate tyrosine kinase is reduced in hypomagnesaemia states [2][7]. As a result reduced peripheral glucose uptake and oxidation are often noted in subjects with hypomagnesaemia [2][8]. Thus hypomagnesaemia may be a possible risk factor in development and progress of diabetic complications. The precise mechanism for development of micro vascular changes is not fully understood, it is possible that hypomagnesaemia inhibits prostacyclin receptor function producing an imbalance between prostacyclin and thromboxane effect which has marked atherogenic potential which is responsible for micro vascular complications [2]. Some studies have shown that oral supplementation with MgCl2 solution restores serum magnesium levels improving insulin sensitivity and metabolic control in type 2 diabetic patients with decreased serum magnesium levels [5].

Also, we found diabetics with micro vascular complications had poorer glycemic control than diabetics without micro vascular complications. Previous studies showed that higher level of HbA1C increases risk for development of micro angiopathy [9] and macro angiopathy [10] in diabetics [6].

6. Conclusion

- Hypomagnesaemia is associated with micro vascular complications and poor glycemic control.
- It is important to regularly monitor magnesium levels in all type 2 diabetic patients.
- Further studies on the role of magnesium supplementation in T2DM in the Indian population are necessary.

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