Material & Method
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The present study was carried out in the Department of Medicine M.L.B. Medical College Jhansi in 2003 - 04. In this study 70 patients of Type-2 DM whose BMI <18.5 (low body weight) were enrolled for study group.

Selection of cases
For this study patients were selected from
1. General Medicine OPD
2. Diabetic Clinic OPD
3. Gynaecology & Obstetrics OPD
4. Skin OPD
5. Tuberculosis & Chest OPD
6. Patient admitted in Ward

Criteria for selection
Any individual who volunteered himself or herself fulfilling the criteria of LB type-2 DM i.e., BMI <18.5% kg/m^2 25. The type-1 DM patients were excluded on the basis of age, clinical presentation and insulin dependence from starting.

Method of study
study of clinical profile includes following :-
1. Full clinical history about disease and its complication & total duration of illness.
2. Family history maternal or paternal and siblings.
3. Age and sex of the patient.
4. Educational status.
5. Dwelling – Rural or Urban.
6. Socioeconomic status of the patient dividing into
   i) Lower class
   ii) Middle class
   iii) Upper class
7. Dietary history
8. Habit
   - Vegetarian / Non Vegetarian
   - Alcoholic / Non Alcoholic
   - Smoker / Non Smoker
   - Tobacco Chewing / Non Tobacco Chewing
   - Other
9. Occupational history
10. General Examination includes
    - Built and body proportion
    - Nutrition
    - Pallor, Icterus, Cyanosis, Clubbing
    - Edema, Lymphadenopathy
    - Skin, hair, Nails
    - Vertebral column and joint
    - Temperature
    - Pulse
    - Blood pressure
    - Respiration
11. Systemic Examination

- CNS
  - Higher functions
  - C.N.
  - Motor system
  - Sensory system
  - Other

- CVS

- Respiratory

- Abdomen

- Others

12. Investigations

- Haemogram
- Fasting blood sugar
- Fasting serum insulin

- Renal parameters
  - Urine – Routine and microscopic examination
  - 24 hours urinary protein
  - Serum creatinine

- Lipid profile
  - Total serum cholesterol
  - High density lipoprotein
  - Low density lipoprotein
  - Very low density lipoprotein
Specimen collection and handling

A. Blood collection
Collect 10 ml of fasting blood sample from venipuncture and dispense it as mentioned below.

1. Double OX tube 2ml blood for haemogram.
2. Fluoride tube 2ml blood for fasting blood sugar
3. Plain tube for serum insulin and serum creatinine
   plain tube Serum Creatinine 4ml blood.

B. Urine collection
Collect 2 ml of urine from 24 hrs urine pool in plain tube and note the total 24 hrs urinary volume for micro albuminurea.

C. Samples can be stored at 2-8°C upto 24 hours, for longer periods store samples at –20°C. Avoid repeated freezing and thawing.

Methods used

Haemogram – Biochemistry Dox blood
Fasting blood sugar – Biochemistry Plasma
Insulin – ELISA
24hr urinary albumin
S.Creatinine – Biochemistry
Lipid profile – Biochemistry
Insulin Assays

Insulin assays play a central role in the investigation of glucose metabolism disorders. Particularly useful in the investigation of the causes of hypoglycemia, insulin assays are also used in the determination of the pathogenesis of Type I and Type II diabetes, assessment of β-cell function and for studies on the pharmacology of insulin itself.

Insulin is a polypeptide consisting of two chains linked by disulphide bonds. The A and B chains consist of 21 and 30 amino acids respectively, with disulphide bonds located at positions A7-B7 and A20-B19. The A chain also has an internal disulphide bond bridging the amino acids A6 and A11. Insulin and C-peptide are secreted in equimolar amounts into the portal circulation together with small quantities of proinsulins. 2-6% of the insulin released from the secretory granules is actually in the form of proinsulins and these represent 5-10% of the bioactivity of insulin.

In human circulation, the half-life of insulin is approximately 3-5 minutes. Almost all tissues have the ability to metabolize insulin, but 80% is degraded in the liver and kidneys. In fact 50% of insulins is removed in a single pass through the liver. As the liver does not remove proinsulins and C-peptide, they accumulate in blood and account for 15-20% of the total amount of insulin and proinsulins in the basal state. Glucose is the primary signal that stimulates insulin secretion. Therefore, to correctly interpret an insulin measurement, a simultaneous measurement of the glucose level is also needed.
Clinical use of insulin measurements

The main clinical application of plasma insulin measurements is in the investigations of the causes of hypoglycemia. This disorder can be caused by hyperinsulinism, insulinoma, insulin autoimmune syndrome or by non-insulin mediated factors. For epidemiological use, insulin assays have been proposed as a marker or risk factor for the development of coronary heart disease and as an early marker for the development of diabetes.

Impaired glucose tolerance (IGT) and diabetes mellitus are diagnosed solely on the basis of chronic hyperglycemia. However, insulin measurements are used in research to study the pathogenesis of these disorders. In Type-1 diabetes, insulin measurements can be useful in pharmacological studies. Type 2 diabetes results from insulin resistance associated with an insulin secretory defect. Specific insulin assays are used to determine the relative insulin deficiency, and the inability of the pancreas to compensate for insulin resistance by adequate insulin secretion. Insulin measurements have a clinical value in the diagnosis of severe insulin resistance. Combined with C-peptide determination, insulin measurements may be used to assess the residual β-cell function, especially in newly diagnosed cases of type 1 diabetes. They may also aid in the discrimination between Type 1 and Type 2 diabetes.

The routine performance of an insulin assay may be hampered by factors related to the sample material; insulin auto-antibodies are frequently present in prediabetic states as well as in recent onset IDDM and other antibodies with equally disturbing capabilities have
been reported to be frequently present also in the general population. Heterologous antibodies and rheumatoid factors are also known to be potentially disturbing factors. The influence of such antibodies may be minimized by precipitation with polyethylene-glycol at the time of sampling, followed by the determination of free insulin immuno-reactivity in the supernatant. Haemolysis is another sample derived factor which influences most insulin measurements due to the presence of insulin degrading enzymes in erythrocytes. The impact of these types of interference on the individual insulin assay is only weakly predictable and must therefore be studied experimentally. An example is the influence of haemolysis: in competitive assays, where an insulin antibody is used in limited concentration, released enzymes may lead to insulin degradation into large fragments (half-molecules) each of which are still capable of reacting in the assay and with similar efficiency as insulin itself. In two-site assays the simultaneous presence of two immunochemical sites on the analyte-molecule are needed to allow determination. Insulin fragments may not be reactive at all. Thus, the analytical design selected has an influence on the impact of a potentially interfering factor.

**Micro Urinary Albumin**

Diabetic patients are prone to develop kidney damage as the disease progresses. The damage caused to the kidney if known in time can be reduced or eliminated by giving the patient certain drugs and full blown diabetic kidney damage can be avoided. Detection of increased levels of albumin in the urine at an early stage serve this purpose as it is the earliest marker of diabetic marker of diabetic
kidney disease. It may be worth noting that various other disorders also result in nephropathy (kidney disorders).

- Normal Albuminuria: < 30 mg/day
- Micro Albuminuria: 30-300 mg/day
- Macro Albuminuria: >300 mg/day

**Working Proforma**

1. Case No: MRD/OPD No: Date: / / 
2. Patient Name: 
3. Address: Tel: 
4. Date of Birth: 
5. Date of follow up 
6. Age: Sex: M / F Occupation: 
7. Residence: Rural / Urban Literacy status: 
8. Socio Economic status: Lower / Upper / Middle 
9. OPD Attendance: Regular / Irregular 
10. Total Duration of illness: Age at Diagnosis 
11. Complaints at Diagnosis: 
12. Present Complaints: 
13. Past History: 
14. Family History and Relation: Relation: 
15. Habit Vegetarian/Non-Vegetarian 
Alcoholic/Non-Alcoholic 
Smokers/Non-Smokers 
Tobacco Churer 
NonTobacco Churer 
Others
16. Associate Illness

<table>
<thead>
<tr>
<th>Illness</th>
<th>Present / Absent</th>
<th>Duration</th>
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<tbody>
<tr>
<td>Hypoglycemia</td>
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<tr>
<td>Hyperglycemia</td>
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<td>Ketosis</td>
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<td>CVD</td>
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<td>PVD</td>
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<td>Cataract</td>
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<td>Retinopathy</td>
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<td>Nephropathy</td>
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<td>Peripheral Neuropathy</td>
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<td>Motor Neuropathy</td>
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<td>Mixed Neuropathy</td>
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<td>Impotency</td>
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<td>GI Symptoms</td>
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<td>Diabetic Foot</td>
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<td>Tuberculosis</td>
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<td>Skin Infection</td>
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<td>Fungal Infection</td>
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<td>Other</td>
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17. General Examination

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<tbody>
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<td>Pulse rate /min</td>
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<tr>
<td>Blood Pressure</td>
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<tr>
<td></td>
<td>mm/Hg</td>
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<tr>
<td>Suspive position</td>
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<tr>
<td>Standing (After 3 min)</td>
<td></td>
</tr>
<tr>
<td>mm/Hg</td>
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</tr>
</tbody>
</table>
18. Anthropometry
   Weight Kg
   Waist cm
   Height cm
   Hip cm
   BMI

19. Systemic Examination:
   CNS
   Higher Function
   Motor System
   Others
   CVS
   Respiratory System
   Abdomen
   Other

<table>
<thead>
<tr>
<th>Cranial Nerves</th>
<th>Sensory System</th>
</tr>
</thead>
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20. E.C.G
21. ECHO
22. X-ray
23. Fundus

24. Biochemical
   Result
   1. F.B.G (mg %)
   2. Insulin (μ I.U./ml)
   3 S.Creatinine (mg)
   4. Lipid Profile
      T.Ch. (mg %)
      HDL (mg %)
      LDL (mg %)
      VLDL (mg %)
      S.Triglyceride (mg %)
      5.24hr urinary albumin (mg %)

25. Treatment
26. Treatment Complains
27. Diabetic Control Poor / Average / Good