# UNIT 4   DIABETES MELLITUS

**Structure**

## 4.0   OBJECTIVES

After reading this unit, you should be able to:

- classify and diagnose different clinical types of Diabetes Mellitus;

- identify the risk factors in the common clinical forms;

- diagnose Diabetes Mellitus and confirm by laboratory investigations;

- treat Diabetes Mellitus in the elderly persons;

- identify, prevent and manage the complications of Diabetes Mellitus.

## 4.1   INTRODUCTION

Some metabolic and endocrinal disorders in the elderly develop but their nature, course, severity and management is different in elderly. In elderly the diabetes is more commonly of type of II, also called as Non Insulin dependent diabetes mellitus.

It is a metabolic disorder with absolute for relative deficiency of insulin resulting in hyperglycemia and glycosuria. It leads to disturbances in carbohydrate, protein and fat metabolism. It is not a single disease but consists of a group of heterogeneous disorders with glucose intolerance. There has been an alarming increase in incidence of diabetes mellitus. By 2010 the largest number of diabetics in the world will be in India. About 10% elderly aged 65 or more have Diabetes, Type II, at age 40, glucose tolerance begins to decline and between 65-70 years of 23% have impaired glucose tolerance. Incidence of overt diabetes mellitus may be as high as 40% in person aged 80 or older. Patients own insulin is sufficient to prevent ketoacidosis but is not adequate in the face of increased needs because of tissue insensitivity.

Diabetes Mellitus leads to complications like kidney disease, heart disease, blindness, sexual dysfunction and peripheral neuropathy with long standing hyperglycemia. Timely diagnosis and management prevent these complications.

## 4.2  RISK FACTORS AND CLASSIFICATION OF DIABETES MELLITUS

You may already know from your undergraduate studies about the high risk factors and classification of diabetes mellitus. This action deals with the risk factors and classification of diabetes mellitus.

### 4.2.1  Risk Factors

Risk factors help you to suspect diabetes in those individuals with risk factors and confirm your suspicion by biochemical investigations. The risk factors are given in Table 4.1.

Table 4.1:  Risk Factors of Diabetic Mellitus

a)  Race

   — African American

   — Hispanics

   — Native Americans

b)  Obesity (Risk increases twice for every 20 % excess body weight)

   — Waist : Hip Ratio     ( More than 0.9 in males)

                                ( More than 0.8 in females)

   — Increased (body mass index) >27

c)  Sedentary Life Style

d)  Chronic Diseases  (Cirrhosis, haemochromatosis)

e)  Drugs — Glucocorticoids, diuretics

The causes of Diabetes Mellitus are not known but one has to consider the following factors:

● Tissue insensitivity to insulin.  It may be due to genetic predisposition with aggravating and precipitating factors e.g. obesity.

● Impaired ß cell response to glucose which is made worse by hyperglycemia

● Strong genetic influence is suggested from study of twins and epidemiological data.

● No genetic marker has been identified.

### 4.2.2  Clinical Classification of Diabetes Mellitus

You may be already aware that majority of elderly diabetes mellitus belong to non-insulin dependent type (Type II ). The clinical classification of diabetes mellitus is given in Table 4.2.

Table 4.2: Clinical Classification of Diabetes Mellitus

| Type | Clinical Features | Management |
|------|-------------------|------------|
| Type II Non Insulin Dependent Diabetes Mellitus (NIDDM) | • Old subjects<br>• Absent risk of ketosis<br><br>• Absence of Islet cell Antibodies<br>• Absence of positive HLA association. | |
| i) Non obese | No ketosis responds to oral drugs can present intially with complication and symptoms of cardiac, renal and nervous system | a) Diet<br>b) Diet plus antidiabetic therapy. |
| ii) Obese | Mild non ketotic. Target organ do not respond to insulin action, there is obesity. | Weight reduction with Hypocaloric diet and antidiabetic therapy. |

NIDDM (Type II Diabetes Mellitus) is a heterogeneous group seen mostly in elderly and majority of diabetes cases belong to this category. The important characteristics points are that it:

- is a non ketotic form

- is not linked to HLA markers in Chromosome

- has no islet cell antibodies

- has no immune component

- is not dependent on exogeneous insulin to sustain life.

i) **Obese Type II Diabetes Mellitus**

In this, there is a mild non ketotic diabetes which is due to insensitivity to endogenous insulin caused by extra pancreatic factors. The target organs do not respond to insulin action. This leads to ß cell hyperglycemia and leading to ß cell failure.This is called β cell desensitization for glucose and is reversible after correction and recovery of β cells. There is obesity. Obesity is characterized by abnormal distribution of fat with high waist to hip ratio. On CT scan, it is seen that fat is collected in omental and messenteric region. Unlike fat in subcutaneous tissues of abdomen, this distribution is correlated with insulin resistance. Lipolysis of visceral fat alters liver metabolism and increases hepatic glucose output and is mobilized in portal system and is influenced by exercise. Peripheral fat is mobilized into systemic veins.

A postreceptor defect in insulin action causes insulin resistance in target tissues and there is saturation of storage depots. This reduces the ability to clear nutrients post meal from circulation and results in hyperinsulinism. This enhances insulin resistance by down regulation of insulin receptors. With resultant hyperglycemia, there is down regulation of specific glucose transporter protein in the target tissue. This will further result in post receptor insulin action aggravating hyperglycemia. This is corrected by exercise which improves insulin sensitivity. There is increased blood flow to the muscle with increased muscle mass and desaturation of depots resulting in reduction in hyperinsulinism and hyperglycemia.

### 4.2.3 Syndrome X

Syndrome X is also called CHAOS or insulin resistance syndrome.

In this there is hyperglycemia hyper insulinemia, dyslipidemia and hypertension.

CHAOS is acronym for coronary artery disease, hypertension, atherosclerosis, obesity and stroke.

| | | |
|---|---|---|
| C | : | Coronary artery disease |
| H | : | Hypertension |
| A | : | Atherosclerosis |
| O | : | Obesity |
| S | : | Stroke |

### 4.2.4 Clinical Presentation

Elderly diabetic patients with NIDDM Type II may not present with the usual clinical features e.g., polyuria, thirst, polyphagia, weight loss, etc. but can present with complications and symptoms like pruritis, neuropathy, cardiovascular and renal complications. Often there are no symptoms at all but obesity and family history of diabetes may be found. Often there are chronic skin infections. One should suspect diabetes in women with history of delivery of large babies and complications like hydraminios, pre-eclampsia and unexplained foetal loss.

The obesity in diabetes shows a special pattern of distribution. It is more in upper parts like abdomen, chest, neck and face. Waist to hip ratio more than, 0.9 in males and more than 0.8 in females is associated with increased risk.

## 4.3 LABORATORY INVESTIGATIONS

Laboratory investigations are mandatory for establishing the diagnosis of diabetes. The following investigations are usually undertaken:

### 4.3.1 Urine Examination

Tests are done to find glycosuria and ketonuria, intake of Ascorbic acid, Salicylates methyl dopa and levo dopa interfere with results. To diagnose the conditions from urine tests the renal threshold should be normal for glucose and reliable bladder emptying is essential.

### 4.3.2 Blood Examination

The following biochemical tests in blood are done:

a) **Glucose Tolerance Test**

Subjects should have normal activity and carbohydrate diet with 150-200 gm of carbohydrate daily 3 days before test. Medicines interfering with test results should not be given. These are diuretics glucocorticoids, nicotinic acid, phenytoin and hormones. In elderly, it is more important to depend on fasting hyperglycemia for diagnosis of diabetes mellitus. There is slight increase in values with aging. After an over night fast patient's venous blood sample is taken and measured for serum or plasma glucose. 75 gms of glucose in 300 ml water is then given and 2 hour sample of blood is again tested for plasma glucose.

Criteria for interpreting test is in accordance with those recommended by National Diabetes Data Group is shown in Table 4.3:

**Table 4.3: Criteria for Interpreting Glucose Tolerance Test**

| Normal | Fasting Plasma Glucose | Less than 115 mg/ dl |
|---|---|---|
| | 2 hour postprandial plasma glucose | Less than 140 mg/dl |
| Impaired | Fasting plasma glucose | More than 116 mg/dl |
| | 2 hour postprandial plasma glucose | Less than 160 mg/dl |
| Diabetes Mellitus | Fasting plasma glucose | More than 140 mg/dl |
| | 2 hour postprandial plasma glucose | More than 200 mg/dl |

b) **Glycosylated Haemoglobin (Hb A₁C)**

This is governed by globin component of the patients haemoglobin. This reflects the diabetic patients metabolic control in the preceding 8-12 weeks depending upon life of red blood corpuscles. This is high in chronic hyperglycemia can be measured 3-4 times in a year to make therapeutic adjustment.

Normal values in serum of $HbA_1C$ are 3.9 to 6.9 depending on method. False results can occur with diseases of haemoglobin and intake of aspirin.

c) **Serum Fructosamine Tests**

Depends on glycosylation of serum protein mostly albumin. It reflects metabolic control in preceding 23 weeks because it is dependent of half life of serum albumin of individual.

Normal values are 1.5 to 2.4 M mol/L with serum albumin 5 gm/dl.

d) **Lipoprotein Abnormalities**

Insulin has influence on the levels of lipoproteins in both Type I and Type II Diabetes. The elevation of lipids is reversible with control of hyperglycemia. In obese Type II and Type II diabetes, there is a insulin resistance giving rise to diabetic dyslipidemia. Serum triglycerides are raised 300-400 mg/dl and serum HDL cholestrol is low i.e. less than 30 mg/dl. There is also a qualitative change in LDL particles which are smaller dense with their membrane carrying supra normal amounts of free cholestrol. This has to be treated with exercise, diet and antidiabetic therapy. If primary lipid disorder co-exists with Diabetes Mellitus in your patient this will require additional treatment. Low HDL cholestrol predisposes to macrovascular disease.

# 4.4 SELF MONITORING OF BLOOD GLUCOSE

Your patient measures capillary blood glucose with the help of a portable instrument called glucometer. There are many types of this available for use. With careful education and training your patient can monitor metabolic control.

**Glucometer**

Most commonly used glucometers in this country are:

1) Accutrend alpha

2) Accu-chek active

3) New improved accutrend sensor

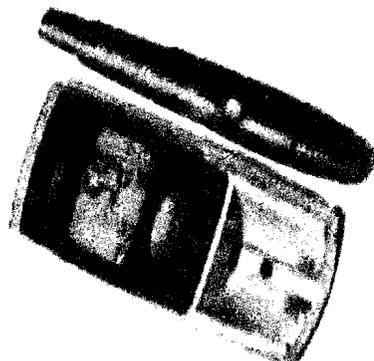They are valuable in home monitoring of glucose with fair accuracy, which check capillary blood.



**Fig. 4.1: Glucometer**

*Advantages*

1) Easy to handle

2) Fastest way to test blood glucose

3) Minimal blood required only 3 µ l.

4) Soft clix finger pricker allow to draw minimum blood (virtually pain free)

5) Easy to carry.

*Disadvantages*

1) Blood glucose level differ from capillary versus venous blood as level of glucose is higher in capillary blood.

2) Suitable only in monitoring the blood glucose level. Since the values are only approximate ones.

## 4.5 NON DIABETIC HYPERGLYCEMIA (SECONDARY HYPERGLYCEMIA )

Various other disorders can cause hyperglycemia. They are discussed in this section.

a) **Secondary Causes**

Disorders associated with target tissue insensitivity to insulin:

i) Endocrine disorders — Acromegaly

— Glucagonoma

— Cushing syndrome

— Pheochromocytoma

ii) Administration of drugs — Gluco corticoids

— Sympathomimetics

— Nicotinic acid

iii) Liver disorders — Cirrhosis

— Haemo chromatosis

iv) Muscle disease — Myotonic dystrophy

v) Fat deposition disorders — Lipoatrophy, lipodystrophy, truncal, obesity.

vi) Insulin receptor disorders — Acanthosis Nigricans

b) **Hyperglycemia Due to Insufficient Insulin Secretion**

i) Hormonal tumours — Pheochromocytoma

ii) Pancreatic Disease — Chronic pancreatitis

iii) Drug therapy — Thiazide diuretics

— Phenytoin

— Pentamidine

— Rodenticide

c) **Renal Glycosuria**

In this condition, glucose appears in urine even when blood glucose is normal. It can occur with proximal renal tubule dysfunction and during pregnancy. In these renal threshold for glucose excretion is lowered. In your elderly patient also, it can occur with lowered renal threshold for glucose excretion.

**Check Your Progress 2**

1) What is the waist-hip ratio which indicates the risk factors for diabetes mellitus in the elderly?

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2) State **True or False**

   i) For the GTT in the elderly, the Diabetics Data Group has recommended 100 gms of glucose.  T/F

   ii) Fasting plasma glucose of more than 115 mg/dl is abnormal.  T/F

   iii) In the GIT, 2 hours plasma glucose of 160 mg/dl indicates diabetes.  T/F

3) Name three drugs causing hyperglycemia.

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## 4.6  MANAGEMENT OF TYPE II DIABETES MELLITUS

In the past, diabetes in the elderly was not treated aggressively but now it is evident that abnormal levels of blood sugar are related to diabetic complications. You should know that presently, it is considered more important to treat than in the past and there is need to maintain the blood sugar, as near normal as possible. In elderly there is higher incidence of macrovascular disease and an episode of severe hypoglycemia is more risky than in Type 1. Initial treatment is started with diet and exercise. Exercise reduces insulin resistance and improves lipid abnormalities. It is also beneficial for hypertension and obesity. Treatment has to be individualized in each of your diagnosed patients. A typical presentation of diabetes in your patient may make it difficult to prevent hypoglycemic and hyperglycemic events. You have by now understood the reason for controlling blood sugars in your elderly patient and you will also remember the conventional treatment by remembering acronymn NEEDS.

| | | | |
|---|---|---|---|
| **N** | : | Nutrition | — Diet Planning |
| **E** | : | Exercise | — Weight Reduction |
| **E** | : | Education | — Patients and Family |
| **D** | : | Drugs | — Oral and Injection Therapy |
| **S** | : | Self monitoring | — By patient himself/herself |

### 4.6.1  Assessing Your Patient for Management

Before you start management of your elderly diabetic patient, you have to note the following facts about your patient:

a) **History**

   ● Presence of obesity

   ● Family History of Diabetes with special reference to:

      a) age of onset in the relative

      b) obese or not obese relative

      c) insulin used or not in the relative

   ● Smoking details

   ● Hypertension — duration and treatment received

   ● Hyperlipidemia — present or absent; if present latest lipid profile.

b) **Physical Examination**

- Peripheral pulses
- Neurological examination
- Examination of feet, skin and teeth
- Opthalmologic check up
- ECG

c) **Laboratory Values**

- Fasting plasma glucose 140 mg or more/dl
- Postprandial plasma glucose 200 mg or more/dl
- Glycosylated Hb values >6.0%
- Total lipids in blood
- Urine analysis for albumin excretion and microalbuminuria
- Kidney functions.

### 4.6.2 Principles of Management

In any diabetic management, your aim is to achieve near normal blood glucose level in the patient with minimum possible incidence of undesirable side effects from therapy. You should also aim to prevent acute illness and reduce the risk of long term complications. The benefits of therapy have been confirmed by diabetes control and complications trials. Treatment delays onset and slows progression of many complications. Besides long term benefits of controlling hyperglycemia, it improves resistance to infection, visual disturbances and risk of dehydration and cardiovascular problems.

It is important to remember that the treatment has to be individualized in each patient but special care is needed in elderly who have a high risk for hypoglycemia. With a typical presentation, it may be difficult to prevent hypoglycemic and hyperglycemic events.

The goal of therapy is to:

- treat hyperglycemia
- prevent hypoglycemia
- avoid/delay chronic complications
- enhance quality of life

After learning above important points and noting the goal of therapy in your elderly diabetic patient, let us learn the steps in management of Type II Diabetes Mellitus.

It is easy to diagnose diabetes but it is difficult to treat it. Most effective management for elderly diabetic is change in life style to achieve the desired loss of weight—attention to diet physical activity, learning early signs of complications. You will find it difficult to make an asymptomatic patient understand that unless they follow your advice, some complication can take place.

### 4.6.3 Non-pharmacological Therapy

**Diet Exercise and Education Form**

The non-pharmacological therapy of obese NIIDM. These require life style changes and needs counselling.

a) *Diet*

Diet forms the first step in management and is very effective in controlling 33 % of the subjects. Total calories should be reduced with reduced fat intake and increase in fibre content of the

diet. About 10-20 % calories should come from protein while fat content should be less than 30% out of which saturated fat should be less than 8%. Limit cholestrol intake to 300 mg/day. Fibre content of diet should be increased and 25-35 gm of dietary fibre should be given. The rest can be made up of complex carbohydrates, allow moderate sodium intake and may supplement with β carotene, vitamin C and E, minerals like selenium and magnesium. In the elderly other factors have to be considered also e.g. living conditions, income, preparation of meals, mobility problems, cognitive defects, dental problems, anorexia and therefore risk of hypoglycemia.

**Fibre** is the undigestible component of plants like cellulose, gum and pectin. **Insoluble fibre** is found in brain and it increases intestinal transit time and is therefore beneficial for colonic function. **Soluble fibre** consists of gums and pectins found in beans, oat meal and apple skin. It delays glucose absorption and has a favourable effect on blood cholestrol levels.

b)  *Exercise*

Regular exercise can achieve desired weight loss. Exercise improves circulation, lowers blood glucose by increasing glucose uptake by muscle. It increases the number of insulin receptors in-patients with insulin resistance. Advise your patient to increase exercise slowly depending on his/her health and progress to low stress exercise three times per week (at least). Low stress exercise means the exercise which does not cause breathlessness.

c)  *Education of Patient and Family*

You will help your patients by giving them desired information on exercise, artificial sweeteners and about diabetes. The type of Artificial sweeteners available are described.

i)  *Artificial Sweeteners*

Nutritive and non-nutritive artificial sweetners are available. Non-nutritive sweeteners should preferably be used.

*Non Nutritive*

a)  **Aspartance:** Nutra sweet is Aspartane which has Amino acids Aspartic acid and Phenyl alanine. It is 180 times as sweet as sucrose. Avoid use in hot foods, baking and cooking.

b)  **Saccharin:** Its carcinogenic effect on bladder has been reported after long term use was advertised. Its use is, however, allowed in U.S.A. since 1994.

*Nutritive*

a)  **Fructose:** It raises serum cholestrol and LDL cholestrol.

b)  **Sorbitol:** In large doses cause diarrhoea.

Both are not advisable to use in diabetes because of their side-effects.

ii)  *Diabetes Education*

Diabetes education includes information on:

- Nature of illness

- To recognise prevent and treat acute and chronic hazards

- The need for regular blood glucose estimation

- To adjust drug, dose, food and exercise.

### 4.6.4  Drug Treatment

Pharmacological therapy is needed in your patients when they are not controlled on diet and exercise. Drug treatment can be through oral or parental routes. You should know the dosage, side effects, drug interactions and potency of all drugs that are used commonly.

a)  **Oral Therapy**

Oral hypoglycemic drugs are needed to maintain plasma glucose levels within the desired range. The oral drugs used are the following:

- Sulphonylurea
- Biguanides
- Thiazolidinediones
- Alphaglucosidase inhibitor

i) *Sulphonylurea*

In India, the first and second generation sulphonylureas have been available for a long time. You may be aware that elderly patients may be taking three to four different medicines for different problems. It is therefore important to know about them. Sulphonylureas are tightly bound to albumin. Examples are sulphonamides, N.S.A.I.D. These if given, your patient is exposed to risk of hypoglycemia. There are other drugs which can interact with Sulphonylureas e.g. warfarin, salicylates and even A.C.E. inhibitors. Sulphonylurea drugs improve insulin secretion and increase sensitivity in elderly with type II Diabetes Mellitus. One of the first generation sulphonylurea is chlorpropamide and it has a long biologic half life. It should be avoided in elderly patients because there is a risk of prolonged hypoglycemia and hyponatremia.

Both first and second generation sulphonylurea are metabolised in both liver and kidney.

Second generation sulphonylureas are many times more potent, therefore care is needed in elderly with cardiovascular diseases because of risk of prolonged hypoglycemia. In the elderly, start with the lowest possible dose and increase slowly for desired effects. When dose exceeds 50% of maximum recommeneded dose then give twice- once, before breakfast once before dinner.

**Table 4.4: Common Drugs Used as OHA**

| Drug | Dose (mg) | Remarks |
|---|---|---|
| **a) Sulphonyl urea ( 1st generation)** | | |
| i) Acetohexamide | 125 mg - 1500 mg | Metabolites are active therefore risk of prolonged hypoglycemia with renal insufficiency. |
| ii) Tolazomide | 100 mg - 1000 mg | Metabolites are active therefore risk of prolonged hypoglycemia with renal insufficiency. |
| iii) Tolbutamide | 250 mg - 3000 mg | In active metabolites, duration of action 6-12 hours. |
| **b) Sulphonylurea (2nd generation)** | | |
| i) Glyburide | 0.25 mg - 20 mg Before breakfast | Metabolized in liver can cause hypoglycemia. Its metabolites are active. |
| ii) Diabeta | 2.5 mg, 5 mg 1.5 mg, 3 mg, 6 mg | Metabolized in liver and breaks quickly into products which can cause hypoglycemia. Its metbolites are active. It binds to a pancreatic β cell membrane receptor and is sequestered with β cell which explains its long biologic effect and duration of action up to 24 hrs. |
| **c) Long Acting Sulphonylurea** | | |
| i) Gliplzide | 5 mg - 10 mg | |
| ii) Repaglinide | 0.25 mg half hour before Meal 2-3 X daily. | Releases prandil Insulin from functioning β cell therefore low risk for hypoglycemia. |
| iii) Glimipiride | 1 mg - 8 mg | Helpful in postprandial hyperglycemia. |
| **d) Biguanides** | | |
| Metformin | 1000-3000 | Not to use in liver and kidney dysfunction, hypoxia (raises serum lactate) and alcoholism. |

*Caution*

Metformin should not be used with thiazides which will worsen renal flow and leads to renal insufficiency. Adverse effects are rare. Usually skin and haematological function are affected. Lactic acidosis is seen when used in situation where its use is contraindicated.

In India, you will be using Metformin with half life from half to 3 hrs.

*Actions of Metformin*

- Reduces fasting an postprandial sugars in your diabetes mellitus patient with Type II Diabetes Mellitus. Has no effect on fasting blood sugar in normal subjects.

- Reduces hepatic gluconeogenesis and improves hepatic glucose output.

- Slows glucose absorption.

- Increases glucose uptake by skeletal muscles.

- Increases insulin sensitivity.

- Lowers triglycerides.

The drug accumulates in high concentration in intestinal cells after oral intake. It increases conversion of glucose into lactose therefore reducing hyperglycemia. It is not bound to plasma proteins and is not metabolised in humans and is excreted unchanged by kidney.

iii) *Thiazolidinedione*

This class of drugs decreases insulin resistance and improves insulin action in liver, skeletal muscles and adipose tissues. It corrects hyperglycemia, hyperinsulinism and improves glucose tolerance in obese Type II Diabetes Mellitus ( NIDDM). You are advised to closely monitor liver functions with this therapy.

| Drug | Dose | Mechanism | Remarks |
|------|------|-----------|---------|
| Triglitazone | Once daily 200 mg tab 400 mg tab | Unlocks insulin resistance absence of hypoglycemia Improves dyslipidemia and hypertension | Infection, headache, pain, mild anaemia are the side effects |
| Rosiglitazone | 1 mg./2mg/6mg Daily dose | Sensitizes peripheral tissue to insulin  Higher affinity for peroxisome proliferator activator receptor-r (PPAR-r) regulates the transcription of a number of insulin responsive gene intimately involved in the control of glucose and lipid metabolism  ↓ Free fatty acid and plasma insulin  ↓ HDL and LDL | |
| Pioglitazone | 15 mg-45 mg | Through activation of the nuclear hormone receptor PPARr increases insulin sensitivity and insulin meditated glucose uptake in muscle and adipose tissue. | |

L.F.T. to be done to monitor enzyme activity.

iv) *Alphaglucosidase Inhibitor*

This group consists of drugs which are competitive inhibitor of amylase that work in the gut by slowing the degradation of complex carbohydrates. Carbohydrates digestion is thus slowed. Side effects are flatulence, abdominal pain and diarrhoea.

| Drug | Dose | Effects | Contraindication |
|---|---|---|---|
| Acarbose | 25 mg<br><br>100 mg<br><br>with first bite<br>of food | • Reduces post pandial sugar<br>• No hyperglycemia<br>• No hyperinsulinemia<br>• No weight gain<br>• No lactic acidosis | Inflammatory bowel disease, colonic ulcer, intestinal obstruction. |

Any oral antidiabetic drug can be used alone or in combination with a drug with different mechanism of action.

b) **Parental Therapy (Insulin Therapy)**

You may already be aware that when oral agents cannot maintain blood sugars near the normal range, the patient will need insulin injections. This is because with passage of time endogenous insulin secretion declines and patient will not respond to diet and oral hypoglycemic therapy and may need insulin injections.

It is well to remember that each patient responds differently to treatment. The patients have different eating habits and different metabolisms. This has therefore to be kept in mind when choosing insulins for the elderly diabetic patient. Some of the patients can be controlled on single injection of intermediate acting insulins. Others will need a combination of short acting and intermediate insulins. To achieve near normal glucose level, dose varies from 0.2 to 2 units/kg body weight. Age gender, duration of diabetes and other factors are not used in calculations. Some elderly are sensitive to exogenous insulin. In these individuals, starting daily dose may range from 0.005 to 1.5 units/kg body weight. Increments of 0.025 to 0.075/kg body weight are made. Usually lean patients are more sensitive while obese ones are resistant. Some of the patients will be controlled by a single injection of intermediate acting insulins. Others will require combination of short acting and intermediate acting insulins. In many countries many different formulations of insulins are available. When you have to choose for your patient, you should remember the animal species from which it has been prepared.

It is important for you to know the following about the insulin you select for your patient:

1) Purity

2) Solubility

3) Time of onset of action

4) Duration of action.

Most insulins are given by subcutaneous injections. Regular insulins can be used intravenously in emergency. Now purified human insulin preparations are available and we no longer worry about some complications which were seen earlier with insulin therapy. These were:

• Insulin allergy

• Immune insulin resistance

• Localized lipotrophy at the site of injection

Insulin preparations commonly used in our country are human insulin (bouvine) and pork insulin (porcine) which differ from human by one amino acid. Beef insulins have three amino acids different from human insulin.

The types of insulin commonly used are given below:

| Variety | Insulin Type | Actions |
|---|---|---|
| Shortacting Insulin<br><br>Useful in emergency when it can give I/v injection indicated in situations with changing needs i.e. surgery and pregnancy. | a) Regular | Onset 15 minutes after subcutaneous injections\<br>Effect lasts from 5-7 hours |
| Intermediate acting | i) NPH<br>ii) Lente | Onset in 2 hours and duration of action in 24 hours. It has 30 % semi lente. 70% ultra lente. |
| Long acting | b) Ultra Lente | |

Many doctors use regular and NPH together before breakfast and before dinner. Premixed preparations with 30% regular 70% NPH are available. Special disposable insulin syringes and needles are also available.

**Check Your Progress 3**

1) List the goal of therapy while treating diabetes in the elderly.

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2) What is the non-drug therapy for diabetes in the elderly?

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3) Name the types (source) of insulins available for treatment of diabetes.

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## 4.7 SPECIAL CONSIDERATIONS IN THE CASE OF DIABETIC PATIENTS

Besides the management discussed above, you should advise the patient about care of feet, skin and teeth.

Also you must teach your patient how to recognize hypoglycemia which may result from insulin therapy. The hypoglycemic patient may present with mental confusion, bizarre behaviour, focal neurologic deficits, coma and convulsions. There may be evidence of autonomic hyperactivity and the patient will have tachycardia, palpitation, sweating tremulousness (because of sympathetic nervous system nausea and hunger (because of parasympathetic nervous system). β blockers cause blunting of these symptoms except sweating. This is important to remember since many elderly diabetics may be taking β blockers to control the associated hypertension.

## 4.8 CHRONIC COMPLICATIONS

Chronic complications are related to duration and control of diabetes. These can be classified as below:

a) **Macrovascular Disease**

i)   In NIDDM 75 % deaths are to I.H.D. and other cardiovascular diseases. Cardiovascuar risk is 2-4 times more in females as compared to males. There are more chances of fatal myocardial infarcation and congestive cardiac failures.

ii) Death rate from stroke is 2-8 times more in diabetes.

iii) Diabetic has 40 times more risk of peripheral vascular disease. This may lead to gangrene of the feet for which ampatation is required.

**b) Eye Complications**

These are seen in 50% with duration of 15 years or more.

i) Cataract (Premature)

ii) Retinopathy

    1) Simple

        Microaneurysm, exudates Haemorrhages

        Oedema

    2) Pre-Proliferative (areas of ischaemia)

    3) Malignant—Proliferative

        Newly formed blood vessel, risk of detachment of retina and blindness.

iii) Glaucoma

**c) Nephropathy**

One-third cases of end stage renal failure are due to diabetes.

i) Microbumiuria — gross albuminuria is preceeded by microalbuminuria in one-third cases by 10 years.

ii) Progressive diabetes nephropathy.

**d) Neuropathy**

The patient may have extensive neuropathy which may be sensorimotor, autonomic as given below:

i) Peripheral Neuropathy

    (glove stocking type, symmetrical)

ii) Isolated mononeuropathy of femoral nerve, predominately cranial nerves (motors)

iii) Painful Neuropathy

**e) Autonomic Neuropathy**

Postural hypotension, gastroparesis, alternate diarrhoea and constipation, impotence in 50% with this type of neuropathy.

**f) Skin and Mucous Membrane**

Chronic Pyogenic Infections Eruptive Xanthomas necrobiosis lipoidica diabeticorum.

**g) Complications During Surgery**

Complications occur during surgery and postoperatively.

## 4.9 SPECIAL PROBLEMS IN THE ELDERLY

Preventive approach should be adopted for reduction of complications of diabetes. Problems and a clinical approach to these problems is presented below:

| Problem | Clinical Approach |
|---|---|
| a) To reduce insulin resistance | Advise physical activity and weight reduction. |
| b) To take drug to keep sugars in the desired range. | Oral therapy with sulphonylureas biguanides, acabose etc. injection insulin |
| c) To reduce cardiovascular risk | Lowered blood lipids control blood pressure stop smoking, daily Aspirin, Relaxation. |
| d) To delay nephropathy | ACE inhibitors reduction in protein intake in diet, control of hypertension and tight control of diabetes |
| e) To minimise eye complications and vision loss | Periodic ophthalmic check up laser photocoagulation. |

Special considerations must be kept in mind when prescribing medicines to elderly patients.

Keep in mind the decreased hepatic and decreased renal function in the elderly.

- These decreased functions result in higher accumulated levels of certain medications excreted by the liver and the kidney respectively.

- Confusion and potential drug—drug interactions when multiple medications regimems are used.

- Impaired thirst and hunger sensations leading to dehydration and negative glycemic episodes.

- Inability to recognize the classic warning signs of hypoglycemia.

- Concomitant disease states that may affect drug therapy.

- Communication barriers to educating the patient on drug therapy, such as hearing, visual or cognitive impairment.

- Ability to pay for the treatment.

## 4.10   LET US SUM UP

In this unit, you learnt to recognise the individuals who has risk factors for diabetes. You also read about the classification, diagnosis, laboratory investigations and their interpretation. Subsequent section dealt with diet and exercise, oral and parenteral therapy and the special care of the other systems in the elderly. Because of their multiple problems, the drug interactions with oral antidiabetic drugs has also been emphasized. You also read about the long term complications of diabetes and how these can be delayed. Learning this unit is very essential since diabetes is quite common in the elderly.

## 4.11   KEY WORDS

Atheroselorosis :   Deposition of cholesterol in the wall of the artery.

Obesity           :   Increase in weight in the hip-waist ratio greater than 0.8 in female and 0.9 in males

## 4.12   ANSWERS TO CHECK YOUR PROGRESS

**Check Your Progress 1**

1)   The 2 types of NIDDM are:

a)   Non-obese

b)   Obese

2)   CHAOS stand for:

C   :   Coronary Artery Disease

H   :   Hypertension

A   :   Atherosclerosis

O   :   Obesity

S   :   Stroke

**Check Your Progress 2**

1)   Waste: Hip ratio   >   0.9 in males

>   0.8 in females

2)  i)   F

    ii)  T

    iii) F

3)  Three drugs causing hyperglycemia are:

    i)   Glucocorticoids

    ii)  Sympathomimetics

    iii) Nicotinic acid

**Check Your Progress 3**

1)  The goals of therapy while treating diabetes in elderly are to:

    i)   Treat hyperlycemia

    ii)  Prevent hypoglycemia

    iii) Avoid/delay complications

    iv)  Enhance quality of life

2)  Diet and exercise ( Life style changes) are the non-drug therapy for diabetes in elderly.

3)  i)   Human

    ii)  Porcine

    iii) Bovine

## 4.13   FURTHER READING

Fauci, Braunwald, Isselbacher *et al.* (ed.), *Harrison's Principles of Internal Medicine,* 14th edn., International edition — Magraw Hill Publishers, 1998.