# **MEDICAL EDUCATION TRAINING**

# **Classification of Diabetes**

#### Type 1 Diabetes

In persons with type 1 diabetes, the beta cells of the pancreas, which are responsible for insulin production, are attacked by the misdirected immune system. It is believed that the tendency to develop abnormal antibodies in type 1 diabetes is, in part, genetically inherited, though the details are not fully understood.

Type 1 diabetes tends to occur in young, lean individuals, usually before 30 years of age; however, older patients do present with this form of diabetes on occasion. This subgroup is referred to as latent autoimmune diabetes in adults (LADA). LADA is a slow, progressive form of type 1 diabetes.

#### Type 2 Diabetes

In type 2 diabetes, patients can still produce insulin, but due to prevalent insulin resistance, it is inadequate for their body's needs. In many cases this actually means the pancreas produces larger than normal quantities of insulin. A major feature of type 2 diabetes is a lack of sensitivity to insulin by the cells of the body.

In addition to the problems with an increase in insulin resistance, the release of insulin by the pancreas may also be defective and suboptimal. In fact, there is a known steady decline in beta cell production of insulin in type 2 diabetes that contributes to worsening glucose control. Finally, the liver in these patients continues to produce glucose through a process called gluconeogenesis despite elevated glucose levels. The control of gluconeogenesis becomes compromised.

While it is said that type 2 diabetes occurs mostly in individuals over 30 years old and the incidence increases with age. Most of these cases are a direct result of poor eating habits, higher body weight, and lack of exercise.

While there is a strong genetic component to developing this form of diabetes, there are other risk factors - the most significant of which is obesity. There is a direct relationship between the degree of obesity and the risk of developing type 2 diabetes, and this holds true in children as well as adults.

Regarding age, data shows that for each decade after 35 years of age regardless of weight there is an increase in incidence of diabetes.

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#### **Gestational Diabetes**

Diabetes can occur temporarily during pregnancy. Significant hormonal changes during pregnancy can lead to blood glucose elevation causing gestational diabetes. Gestational diabetes usually resolves once the baby is born. However, 35% to 60% of women with gestational diabetes will eventually develop type 2 diabetes over the next 10 to 20 years, especially in those who require insulin during pregnancy and those who remain overweight after their delivery. Women with gestational diabetes are usually asked to undergo an oral glucose tolerance test about six weeks after giving birth to determine if their diabetes has persisted beyond the pregnancy, or if any evidence (such as impaired glucose tolerance) is present that may be a clue to a risk for developing diabetes.

#### **Risk factors**

There is an increased risk of gestational diabetes if: Body mass index (BMI) is 30 or more If the previous baby weighed 4.5kg (10lbs) or more at birth Gestational diabetes in a previous pregnancy Family history of diabetes South Asian ethnicity (specifically India, Pakistan or Bangladesh)

#### Prediabetes

The evolution of T2DM follows through different stages. Impaired fasting glucose and impaired glucose tolerance are the fore-runners of future T2DM (collectively termed as Prediabetes). These states include a proportion of people who belong to the intermediate group, whose glucose levels, although do not meet the criteria for diabetes are nevertheless too high to be considered normal. These patients may develop diabetes in future if their glycemic status is not maintained by modification of lifestyle.

Impaired Fasting Glucose is present when the fasting level is  $\geq$  110mg/dl and  $\leq$  125mg/dl and the 2 hour value is < 140mg/dl.2

Impaired Glucose Tolerance is present when the 2 hour value is in the range of  $\geq$ 140 mg/dl - < 200 mg/dl.

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# **References:**

Standards of Medical Care in Diabetes—2015, Diabetes Care Volume 38, Supplement 1, January 2015

Definition and Diagnosis of Diabetes and Intermediate Hyperglycemia – Report of a WHO/IDF consultation. Geneva: Whorl Health Organization; 2006

Symptoms

Typical symptoms of diabetes may not be present in 70% of people with raised blood glucose. Most often the diagnosis of diabetes is incidental during blood test performed for general health check up, medical screening for new jobs or during life insurance examinations etc.

Increased urine output

Excessive thirst

**Excessive Hunger** 

Weight loss

Fatigue

Skin problems

Slow healing wounds

Blurred vision

Tingling or numbness in the feet or toes.



#### Diagnosis

The biochemical hallmark of diabetes is elevated blood glucose. Therefore, diagnosis of diabetes is made by estimation of glucose concentrations in the blood.

When the fasting plasma glucose is  $\geq$  126 mg/dl or random blood glucose  $\geq$  200 mg/dl on more than one occasion.<sup>1</sup>

#### Fasting Plasma Glucose:

Elevated fasting plasma glucose is always regarded to have a high degree of specificity for the diagnosis of diabetes. It is more consistent and reproducible than postprandial plasma glucose because there are more variable in the latter, such as timing and carbohydrate load. FPG may be easier to control with medications than PPG. An overnight fasting for 8 – 12 hours is considered desirable.

The ADA and WHO have recommended FPG value of  $\geq$  126 mg/dl as the diagnostic value for diabetes and the value of 110 – 125 mg/dl have been termed as impaired fasting glucose which is a prediabetic stage.<sup>1</sup>

#### Postprandial Blood Glucose:

The word postprandial means after a meal and hence it refers to plasma glucose concentration after food intake. The optimal time to measure postprandial glucose concentrations is 2 hr after the start of a meal. An elevated PPG concentration is one of the earliest abnormalities of type 2 diabetes, and represents an independent risk for cardiovascular disease. Postprandial changes precipitate atherosclerosis before FPG concentrations are affected. The recommended PPG goal of treatment is a value of <160mg/dl.

#### **Oral Glucose Tolerance Test**

It is recommended for diagnosis/exclusion for diabetes.

The Oral Glucose Tolerance Test (OGTT) is done in the morning after 8-10hrs of overnight fast (water may be taken). A fasting blood sample should be taken before giving glucose load. The person then drinks 75gm of glucose in 250-300 ml of water (the glucose load should be consumed over a period of five minutes). A further blood sample must be collected 2 hours after the load.

Diabetes is diagnosed if the fasting value is  $\geq$  126 mg/dl or 2 hour plasma glucose is  $\geq$  200mg/dl.<sup>1</sup>

Impaired Glucose Tolerance is present when the 2 hour value is in the range of  $\geq$ 140 mg/dl - < 200 mg/dl.

Impaired Fasting Glucose is present when the fasting level is  $\geq$  110mg/dl and  $\leq$  125mg/dl and the 2 hour value is < 140mg/dl.

Glucose tolerance is normal when the fasting and the 2 hour values are < 110mg/dl and < 140mg/dl respectively.

#### Understanding your blood glucose values DIABETES DIABETES DIABETES 6.5% 126 mg/d 200 mg/d < 6.5% < 126 mg/di 200 mg/d DIABETES DIABETES DIABETES PRE 5.7% 110 mg/d 140 mg/d 110 mg/d 140 mg/ < 5.7% NORNA NORNA HbAIC% FPG OGTT **Glycosylated Haemoglobin Fasting Plasma Glucose Oral Glucose Tolerance Test**

#### Hemoglobin A1C (HBA1c)

The red blood cells that circulate in the body live for about three months before they die off. When sugar sticks to these hemoglobin proteins in these cells, it is known as glycosylated hemoglobin or hemoglobin A1C (HbA1c). Measurement of HbA1c gives us an idea of how much sugar is present in the bloodstream for the preceding three months. In most labs, the normal range is 4%-5.6 %. In poorly controlled diabetes, its 8.0% or above, and in well controlled patients it's less than 7.0% (optimal is <6.5%). The benefits of measuring A1c is that gives a more reasonable and stable view of what's happening over the course of time (three months), and the value does not vary as much as finger stick blood sugar measurements.

While there are no guidelines to use HbA1c as a screening tool, it gives a physician a good idea that someone is diabetic if the value is elevated. Right now, it is used as a standard tool to determine blood sugar control in patients known to have diabetes. The recommended cut-off points are <sup>2</sup>

Normal range: 4.5 – 5.6%

Prediabetes range: 5.7 – 6.4%

Diabetic range:  $\geq$  6.5%

# **Gestational Diabetes Diagnosis:**

"One-Step" Strategy

75-g OGTT with Plasma Glucose measurement fasting and at 1 h and 2 h, at 24-28 wks in women not previously diagnosed with overt diabetes Perform OGTT in the morning after overnight fast (≥8 h) GDM diagnosis made if PG values meet or exceed: Fasting: 92 mg/dL (5.1 mmol/L) 1 hour : 180 mg/dL (10.0 mmol/L) 2 hour : 153 mg/dL (8.5 mmol/L)

# "Two-Step" Strategy

50-g GLT (nonfasting) with Plasma Gluocse measurement at 1 h (Step 1), at 24-28 wks in women not previously diagnosed with overt diabetes If Plasma Glucose at 1 h after load is  $\geq$ 140 mg/dL (7.8 mmol/L), proceed to 100-g OGTT (Step 2), performed while patient is fasting

GDM diagnosis made when two or more Plasma Glucose levels meet or exceed:
Fasting: 95 mg/dL or 105 mg/dL (5.3/5.8 mmol/L)
1 hour: 180 mg/dL or 190 mg/dL (10.0/10.6 mmol/L)
2 hour: 155 mg/dL or 165 mg/dL (8.6/9.2 mmol/L)
3 hour: 140 mg/dL or 145 mg/dL (7.8/8.0 mmol/L)

# **References:**

Definition and Diagnosis of Diabetes and Intermediate Hyperglycemia – Report of a WHO/IDF consultation. Geneva: Whorl Health Organization; 2006.

World Health Organization. Use of Glycated Haemoglobin in the Diagnosis of Diabetes Mellitus. Abbreviated Report of a WHO Consultation. Geneva: WHO; 2011.

Standards of Medical Care in Diabetes—2015, Diabetes Care Volume 38, Supplement 1, January 2015

Diabetes Myths

**People with diabetes cannot lead a normal life** – No. This is a metabolic disorder either due to defective action or deficiency of insulin. When the blood sugar is kept under control by healthy life style and drugs, a diabetic can have a healthy, normal life.

**Diabetes is more common in Men** – No. In most population it is not very different. Women seem to have higher prevalence in certain populations due to increased obesity. Today in India, diabetes is found almost equally in men and women.

**Testing urine sugar alone is sufficient for diagnosing diabetes** – No, urine testing alone will not help. In some diabetic patients there may be an increase in blood sugar without any traces of it in the urine. In few persons, urine sugar with normal blood sugar is seen. This condition is called renal glycosuria and is not related to diabetes.

**People with diabetes should not donate blood** – No. A diabetic person can donate blood provided he/she does not have any contagious illnesses, which are usually contraindications for blood donations. Diabetes is not contagious. A well controlled diabetic can donate blood.

**Diabetes can be cured** – No. Diabetes cannot be cured. It can only be controlled. In certain cases of type 2 diabetics who are obese, weight reduction can achieve a normal state without use of drugs.

**All types of diabetes are same** – No. The two most common types of Diabetes are; Type 1 diabetes: In this type, there is no insulin secretion and the patient has to take insulin injection throughout life. Type 2 diabetes: This type of diabetes may be managed without insulin. It can be managed with diet, exercise, tablets and may require insulin occasionally. This is the most common form of diabetes.

**Diabetes does not develop after 60 years** – No. Diabetes can develop at any age and it is not true that it always develops before the age of 60. The peak incidence occurs between 35 and 50 years, but it can occur at any age.

**People with Type 1 diabetes have short span of life** – No. A well-controlled diabetic can have a normal life span. However, one has to follow a very systemic life, controlling his/her diet, taking insulin injections without fail, making necessary adjustments in the dose of insulin with his physician's help and seeking medical advice when infection or other emergency situations occur.

**People with diabetes should not travel** – No. A diabetic can have a normal life just as anybody else. However, even while travelling he should try, not to break the diet rules as far as possible. He/She should also take his drugs regularly and eat at regular intervals. If these simple rules are followed, the diabetic can travel anywhere and whenever he/she likes.

**Drugs for diabetes should never be withdrawn** – No, is some diabetics, it is possible to withdraw the oral drugs completely and normal blood sugar is maintained only with diet regulations and exercise. These people may have had severe hypoglycaemia at diagnosis, but with the help of diet and oral drugs, they show rapid response. The drugs can be gradually reduced and then withdrawn if the blood sugar response is continuously under control. Such people show hypoglycaemia symptoms with small doses of drugs. However, they must always be under proper dietary regulations and periodic blood sugar estimations must be done.

**Insulin injections can be taken at the same site repeatedly** – No. The best sites for injecting insulin are the abdomen around the navel and outer aspects of the thighs. It is advisable to change the sites. The site can be changed every day, by half to one inch space from the previous site of injection.

**Blood sugar test strips can be stored more than one year** – No. The blood sugar test strips can be stored in a cool, dark place, till the date of expiry mentioned on the bottle. The test strips contain enzyme and other chemicals which deteriorate slowly and therefore it is not possible to keep them for a very long period. If the batch of strips is fresh, its expiry date may be even longer than a year.

**Blood glucose measurement by Blood glucose meter will not be accurate** – No. The blood glucose meters are precise, convenient and very useful for home glucose monitoring. The strips only contain the reagent and it is essential to follow the instructions correctly for their use and storage. The strips can get spoiled if kept in improperly capped containers. The blood glucose values can be erroneous with such strips. If the strips are in good conditions they can very reliable results. The results are very similar to that obtained in the laboratories.

We can relax the diet regimen when diabetes is under good control – No. It is not advisable to relax the diet for long periods even when diabetes is in good control as the extra calories from forbidden foods can overstrain the pancreas in the long run. Other problems will set in later on, which means restrictions in the diet will be much more than what it was in the beginning. Increased food intake also leads to obesity and prevents control of diabetes.

**Fruits are to be avoided** – No. Fruits can be included in the diet, when the blood sugar levels are under control. Fruits that contain less carbohydrate are sweet lime, apple, papaya, and guava. Whole fruits are better than fruit juices.

#### **Diabetes Monitoring**

Self-monitoring of blood glucose is considered as an effective tool for the management of diabetes, especially for those who require insulin treatment.

Self-blood glucose monitoring allows you to know your blood glucose level at any time and helps prevent the consequences of very high or very low blood sugar. Monitoring also enables tighter blood sugar control, which decreases the long term risks of diabetic complications.

The following steps include general guidelines for testing blood sugar levels; you should get specific details for your glucose monitors from the package insert or from your doctor or a specialised nurse. Never share blood glucose monitoring equipment or finger stick lancing devices.

Sharing of this equipment could result in transmission of infection, such as Hepatitis B.

Wash hands with soap and warm water. Dry the hands.

Prepare the lancing device by inserting a fresh lancet. Lancets that are used more than once are not sharp as a new lancet, and can cause more pain and injury to the skin.

Prepare the blood glucose meter and test strips.

Use the lancing device to obtain a small drop of blood from your fingertip. If you have difficulty getting a good drop of blood from the fingertip, try rinsing your fingers with warm water, shaking the hand below the waist or squeezing the fingertip.

Apply the blood drop to the test strip in the blood glucose meter. The results will be displayed on the meter after several seconds.

Dispose of the used lancet in a puncture resistant sharps container.

Following are the routine monitoring tests for a diabetic patient during clinic visits;

Blood Glucose - Controlled (HbA1c < 7%) – every 3 months

- Uncontrolled - every 2 weeks until target sugars achieved

HbA1c - Controlled (HbA1c < 7%) – 6 months to 1 year

- Uncontrolled - every 3 months

Test for neuropathy

Monofilament	- Annual
Biothesiometer	- Annual
Foot examination	- Once in 3 months
Testing for Eyes	
Fundus examination	- Annually. If evidence of retinopathy detected at first Visit, follow-
up every 3-6 months	
Test for Nephropath	y
Urinay albumin	- Annual
Serum Creatinine	- Annual
Miscellaneous Tests	
ECG	- Annual
Treadmill Test	- By 5 years after onset of Diabetes, then once in 2 years
Lipid Profile (choleste	erol) - Annual, If abnormal every 6 months
Peculiarities of Diabe	etes among Indians

Indians in particular have high ethnic and genetic predisposition for the disease and also have lower threshold limits for the environmental risk factors. It is a matter of major concern that Indians develop diabetes at a younger age than the western populations. They also develop diabetes with minor weight gain.

Indians have peculiar characteristics due to which great economic and health care burden ensue.

Young age at onset. Diabetes is common even among people in their thirties.

Diabetes develops even in "normal weight" people.

Patients seek medical help at a late stage due to lack of awareness and economic reasons. Therefore occurrence of complications and metabolic risk factors are very common. Cultural and social factors are important. The Indian diet is rich in carbohydrates and saturated fats. A typical Indian diet has more calories and sugar than required by the body. This is the cause of obesity, which in turn leads to diabetes.

Urban migration and change in the younger generations are increasingly choosing a sedentary lifestyle. With rising standard of living comes the tendency to consume processed sugary foods.

Body mass index (BMI) of >23 kg/m2.

Waist circumference of 90 cm for men and 80 cm for women in Asian Indians.

For a given BMI, Asian Indians have higher central adiposity.

Higher insulin resistance amongst Indians, and this is partly explained by higher body fat percentage.

Infectious complications are more common resulting in hospitalization.Cost of treatment is very high. Therefore people tend to neglect regular treatment.

Illiteracy leads to non-compliance.

References:

A. Ramachandran, C. Snehalatha, V. Vijay; Low risk threshold for acquired diabetogenic factors in Asian Indians; Diabetes Research and Clinical Practice 65 (2004) 189–195

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# Healthy Diet

# Calorie Requirements based on weight and usual activity for adults:

Obese inactive, sedentary men/women - 20 kcal/kg of present weight Normal BMI, sedentary men/women - 22 – 25 kcal/kg Normal BMI, active men/women - 30 kcal/kg Thin/Very active - 40 kcal/kg The calorie requirements, in addition to the above mentioned criteria should be based on the patient's usual food intake. One third of the total calories can be distributed for early morning and breakfast. Another one third for mid-morning snack and lunch and the remaining one third for evening snack and dinner.

# **Carbohydrates:**

Carbohydrates should approximate 55 – 60% of total calories /day Minimum of 130gm/day 25 -50gms of carbohydrates from fiber per day may be given

# **Proteins:**

Daily requirement is 15 – 20% of the total calories/day 1gm/kg of present body weight/day 1gm/kg of ideal body weight if obese 0.6-0.8 mg/kg body weight in nephropathy 50% of daily protein has to be from Class 1 sources

# Fats:

Daily requirement is 15 – 20% of the total calories/day Saturated fat < 7% Polyunsaturated fat – up to 10% Monounsaturated fat – up to 20% Intake of trans fat should be minimized (Bakery products) Limit dietary cholesterol to less than 200 mg/day Daily visible fat intake is 3 – 5 tsp/day Oil - 500 gm/month/person

Prevention of Diabetes

#### **Physical Activity**

Routine exercises belong to three categories namely: 1) Aerobic exercise, 2) Flexibility Exercise and 3) Strength exercise.

#### **Aerobic Exercise:**

This is a rhythmic, repeated and continuous movement of the large muscle groups. A total of about 30 – 45 minutes a day, at least 5 days a week is recommended. Walking, bicycling, jogging, continuous swimming, water aerobics and sports activities should be performed at sufficient intensity and frequency.

#### **Flexibility Exercise:**

Stretching the body's muscles provides freedom of movement to do the things you need to do and the things you like to do. Stretching can improve your flexibility, although it will not improve your endurance or strength.

Stretching exercise should be done after your regularly scheduled aerobic activities. You should do stretching every day. Do each stretching exercise at least 4 times each session. Slowly stretch into the desired position, as far as possible without pain, and hold the stretch for 15–60 seconds. Relax, then repeat, trying to stretch a little farther. Always remember to breathe while stretching. Counting out loud can help ensure that you are breathing.



# Strengthening exercise:

Strength exercise increases one's heart rate, works up muscles and raises the breathing rate. This uses large muscles that do not require oxygen for short period of exercise. It helps build strong bones and muscles, lower blood glucose, makes the action of insulin more effective. A common concern among health care providers is that higher intensity resistance exercise should not be performed by middle-aged or older people at risk for cardiovascular disease. The concern centre around the increase in blood pressure that might cause stoke, myocardial infarction or retinal bleeds.

# **Bodyweight** Exercises

CHART



Side Effects of Exercise

Excessive increments in blood pressure

Exercise induced orthostatic hypotension

Increased protein excreted in urine

Hypoglycaemia

Foot ulcers

Accelerated degeneration of joints

Higher intensity resistance exercise increase in blood pressure that might cause stoke, myocardial infarction or retinal bleeds in middle-aged or older people at risk for cardiovascular disease.



The type and intensity of the exercise chosen should not be too difficult for the person to master.

The activity or activities chosen should be enjoyable for the person to perform.

5 – 10 minutes of warm up exercise such as walking or bicycling at low intensity to prepare the muscles, heart and lungs.

30 minutes of aerobic exercise include walking, bicycling, jogging, continuous swimming, water aerobics and sports activities performed and sufficient intensity and frequency.

5 – 10 minutes of cool down exercise consists of the same activities as the warm up. Plan to increase intensity or duration of activity over time.