

Pre-diabetes and Diabetes 101

I am not a diabetologist, but there is a strong association between pre-diabetes, diabetes and heart disease. I'm hoping that this discussion will help at least some of you.

Glucose is the primary fuel source for humans. While some tissues, such as muscles can use glucose or alternative fuels, the brain relies solely on glucose for normal function. Because of this, regulating blood glucose level is critical for maintaining brain and body function. Normal blood sugar is tightly controlled within range of 70 to 140 mg/dl to ensure adequate energy for bodily functions.

NORMAL GLUCOSE CONTROL The body has developed mechanisms to help to manage glucose levels, ensuring the rise appropriately after meals and to store glucose for use during fasting periods when food intake is lower.

ROLE OF INSULIN Insulin is the key hormone responsible for glucose regulation. When we eat, carbohydrates are absorbed, causing the sugar to rise in the blood and this rise in the blood sugar triggers the release of insulin from the pancreas. Primary role of insulin is to keep blood sugar levels within normal range after meals .

It does this by acting at multiple sites in the body, predominantly at the tissue levels, stimulating glucose uptake by muscles and fat after meals. Insulin also acts in the liver to promote glycogen formation or the storage of glucose for use between meals in the fasting state.

The liver helps to maintain blood glucose levels by releasing stored glycogen and producing glucose through what is called gluconeogenesis during fasting. This ensures a steady supply of fuel for the brain and other tissues, like the gut and muscles, even when we are not eating.

These two roles of insulin-namely, limiting the glucose spikes after meals and ensuring steady glucose levels during fasting.-are key to maintaining balance in the blood sugar.

WHAT HAPPENS WITH DIABETES With diabetes, this precise regulatory system is disrupted. Insulin action is impaired, leading to elevated blood sugar or hyperglycemia. Diabetes can be due to one of the two disruptions to the system **INSULINE DEFICIENCY**: This is when the pancreas does not produce enough insulin. This happens mostly in type 1 diabetes.

INSULINE RESISTENCE: this is when the body produces insulin, but it does not work effectively at the tissue level. This is more common in type 2 diabetes.

INSULINE RESISTENCE With insulin resistance, there is plenty of insulin, but it cannot act effectively on peripheral tissues, which leads to elevated blood glucose level due to decreased glucose uptake by the tissues **HOW DOES THIS CAUSE ELEVATED BLOOD GLUCOSE**: Hyperglycemia with insulin resistance is due to multiple causes **PERIPHERAL TISSUES DON'T "SEE" THE INSULIN**: With insulin resistance, insulin continues to be produced from the pancreas after meals, but the peripheral tissues don't "SEE" the insulin, and are unable to take glucose from the blood, resulting in post-meal hyperglycemia.

THE LIVER ALSO CANNOT "SEE" THE INSULIN: Normally, insulin suppresses the release of glucose from the liver after meals. In Insulin resistance, the liver thinks that the body is fasting and continues to release glucose, even when blood sugar levels are already high, further contributing to hyperglycemia.

This combination of reduced glucose uptake by the peripheral tissues and increased glucose production by the liver leads to persistent hyperglycemia, which is the hallmark of type 2 diabetes. Overtime, these elevated blood sugar levels contribute to the long-term complications of diabetes, including damage to the eyes, kidneys, nerves, and blood vessels

DIAGNOSIS OF DIABETES Type 2 diabetes affects about 6% of the world's population. Nearly half of these individuals are unaware of their diagnosis. The lack of awareness often leads to delay or insufficient treatment, resulting in significant morbidity and mortality. Early diagnosis is crucial to improve patient outcomes and to prevent long-term complications.

IDENTIFYING RISK The first step in the diagnosis is identifying patients at risk of developing type 2 diabetes. Most guidelines recommend screening the following population- -Adults over the age of 45 -overweight individuals of any age who have one or more risk factors.

These risk factors include.- -family history: having a first-degree relative with diabetes. -Ethnicity and ancestry: Diabetes is more prevalent among African-Americans, Latinos, indigenous people of North America, South Asian, specially people from Indian subcontinent Gestational diabetes history: Women with history of gestational diabetes are more likely to develop type 2 diabetes after pregnancy Certain comorbidities: These include cardiovascular disease, hypertension, and hyperlipidemia.

DIAGNOSING TYPE 2 DIABETES -A fasting blood sugar(after at least 8 hours of fasting) greater than 126 mg/dL -Oral glucose tolerance test- For this, the patient drinks a solution containing 75 g of glucose and their blood sugar is measured two hours later.

Reading of greater than 200 mg/dL is diagnostic of diabetes. -Hemoglobin A1c: This test measures patient's average blood sugar levels for the past three months, which can give information about both fasting and post-meal blood sugars. A A1c of 6.5% or higher confirms a diagnosis of diabetes. This test does not need to be fasting.

Regardless of the test used, any abnormal results must be confirmed with repeat testing. A confirmed diagnosis requires two abnormal results from any of these screening tests

PRE-DIABETES AND ITS DIAGNOSIS.

Pre-diabetes is diagnosed using the same test as we use for type 2 diabetes, but with different cutoffs **IMPAIRED FASING GLUCOSE:** Patients with a fasting blood sugar of 100-126 mg/dL are classified as having impaired fasting glucose , one type of pre-diabetes **IMPAIRED GLUCOSE TOLERANCE:** If a patient undergoes an oral glucose tolerance test where blood sugar is measured two hours after consuming 75 g of glucose, result of 140-200 mg/dL indicates impaired glucose tolerance,another form of prediabetes **HEMOGLOBIN A1c:** A1c between 5.7% And 6.4% indicates pre-diabetes.

MONITORING FOR COMPLICATIONS Diabetes is a complex disease that requires constant monitoring/not just of the sugar, but of the many complications that can arise over time 1. **Cardiovascular disease:** this is the number one cause of death and serious illness in patients with type 2 diabetes.

If a patient has symptoms of heart disease such as chest pain, shortness of breath, unexplained fatigue, it is essential to have cardiovascular evaluation. However, patient without symptoms, routine cardiac testing is not necessary. 2. **EYES:** patient should receive diabetes eye examination every year to check for diabetic retinopathy, which can lead to vision loss if untreated 3.

KIDNEYS: kidney function should also be monitored annually, including a urine test for microalbuminuria, which can detect early diabetic kidney disease 4. **NERVES:** diabetic neuropathy can cause foot problems, reducing sensation in the feet and increasing the risk of ulcers and infections

SLEEP APNEA: diabetes has a major impact on sleep and mental health. Sleep apnea is extremely common in patients with type 2 diabetes, and make blood sugar harder to control. Patients who snores ,wake up gasping for breath, or feel excessively tired during the day should be screened for obstructive sleep apnea. If suspected , a sleep study can confirm the diagnosis.

PREVENTING PROGRESSION TO DIABETES All patients with pre-diabetes are at risk of developing type 2 diabetes, but with proper intervention, you can prevent this. **LIFE STYLE CHANGES** The most effective way to prevent diabetes is through lifestyle changes, particularly weight loss and increasing physical activities.

Studies have shown that losing just 7% of body weight through a reduced calorie diet and at least 150 minutes of moderate intensity exercise per week can cut the risk of diabetes by 50% over three years **MEDICATIONS** Medication can also play a role, particularly for patients at high risk **METFORMIN:** metformin is the only medication that has been specifically studied for diabetes prevention.

It can reduce the risk of diabetes by 31% overall, with even greater benefits in patients with a body mass index over 35, where risk reduction reaches 58%.

GLUCAGON-LIKE PEPTIDE-1 (GLP-1) RECEPTOR AGONISTS AND SODIUM-GLUCOSE COTRANSPORTER 2 (SGLT2)INHIBITORS: These newer medications originally developed for diabetes, treatment have shown promise in diabetes prevention due to their significant weight loss effects

WHAT ABOUT STATINS? My talk will be incomplete if I don't talk about statins. A common concern in patient with prediabetes is the use of statins, which are widely prescribed to reduce cardiovascular risk. Some studies suggest that statins slightly increase the risk of developing diabetes, which might seem like a reason to avoid them in pre-diabetic patients.

However, it is essential to look at the bigger picture. Prediabetes itself is already linked to an increased risk of cardiovascular disease and statins significantly lower the risk. For most patients, the cardiovascular benefits of statins far outweigh the slight increase in diabetic risk, making them an important part of preventive care.

However, patients on statins should have regular monitoring of their blood sugar to ensure that blood sugar levels are well maintained.

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