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TYPE-1 DIABETES MELLITUS - THE MULTIFACTORIAL CHRONIC AUTOIMMUNE DISORDER: A REVIEW

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ABSTRACT

Type 1 diabetes is a autoimmune disorder in which immune system attacks and destroy cells in the pancreas that produce insulin. This can lead to high blood sugar levels, which can have severe problems. Early signs include frequent urination, increased hunger and thirst and vision changes but diabetic ketoacidosis can also be the first indication. In time, complications may develop. There is no known cure for type 1 diabetes. Diagnosis can include fasting blood glucose level test, random blood glucose level test and haemoglobin A1C test. Treatment with insulin is necessary for management diabetes and prevention of complications. Regular diabetic diet and physical exercise can also helps in the treatment of type 1 diabetes. With the treatment, a person with type 1 diabetes can live a full and active life.

KEYWORDS: Type 1 diabetes, Immune system, Blood sugar levels, Insulin.

INTRODUCTION

A body is a fuel - burning machine and the main fuel it burns is sugar, also known as glucose. Type-1 diabetes is a potentially life – threatening multifactorial chronic autoimmune disorder. Type 1 diabetes also known as juvenile diabetes or insulin-dependent diabetes. In people who have type 1 diabetes, though, the body doesn't effectively store and use sugar for energy. As a result, sugar builds up in the blood, where it can lead to serious problem like blindness and nerve damage. That means immune system, which normally protects body, turns against. In type 1 diabetes case, the immune system attacks the cells in the pancreas that produce insulin. Insulin is a hormone that moves sugar into the cells. There it's stored until body moves needs it for energy. Without enough insulin, sugar can't move into cells, so it builds up in bloodstream. The first signs are usually a person feel very thirsty and tired. A person may lose weight without having planned to or feel numbness or tingling in hands or feet. If blood sugar has already gotten very high then the body can't use sugar for energy, so it uses fat instead. This leads to a condition called diabetic ketoacidosis. Breath of a person will smell fruity. The breathing will get faster and a person may feel sick to stomach. Doctor will test blood sugar level to find out if a person have Type 1 diabetes. The test may be done when a person haven't eaten anything, this is called a fasting blood glucose test. When a person have type 1 diabetes, then they need to take insulin to replace what the body isn't making. Insulin is only available as an injection. Managing diabetes also means watching diet so they don't get too much or too little sugar at once. They also need to check blood sugar levels regularly and keep track of them over time.

Chart: Type 1 diabetes mellitus facts.

Symptoms

High Blood Sugar

Following symptoms may be the first signs of type 1 diabetes. Or, they may happen when blood sugar is high.

- Being very thirsty
- Feeling hungry
- Feeling tired all the time
- Having blurry eyesight

- Feeling numbness or tingling in feet
- Losing weight despite an increased appetite
- Urinating more often (including urinating at night or bedwetting in children who were dry overnight before)

For other people, these serious symptoms may be the first signs of type 1 diabetes. Or, they may occur when blood sugar is very high (diabetic ketoacidosis)

- Deep, rapid breathing
- Dry skin and mouth
- Flushed face
- Fruity breath odour
- Nausea and vomiting; inability to keep down fluids
- Stomach pain

Low Blood Sugar

Low blood sugar (hypoglycemia) can develop quickly in people with diabetes who are taking insulin. Symptoms usually appear when a person's blood sugar level falls below 70 milligrams per decilitre (mg/dL), or 3.9 mmol/L. the symptoms are

- Headache
- Hunger
- Nervousness, irritability
- Rapid heartbeat (palpitations)
- Sweating
- Weakness

Etiology

The exact cause of type 1 diabetes is not known. More likely, it is an autoimmune disorder. Type 1 diabetes is a condition that occurs when the immune system mistakenly attacks and destroys healthy body tissue. The tendency to develop autoimmune diseases, including type 1 diabetes, can be inherited from parents.

Type 1 diabetes can take place at any age. It is most frequently diagnosed in children, adolescents, or young adults.

Insulin is a hormone produced in the pancreas by cells called beta cells. The pancreas is below and behind the stomach. Insulin is needed to move blood sugar (glucose) into the cells. Inside the cells, glucose is stored and later it is used for energy. With type 1 diabetes, beta cells produce little insulin or no insulin.

Without enough insulin, glucose develop in the bloodstream instead of going into the cells. This development of glucose in the blood is called hyperglycemia. The body is unable to use the glucose for energy. This leads to the symptoms of type 1 diabetes.

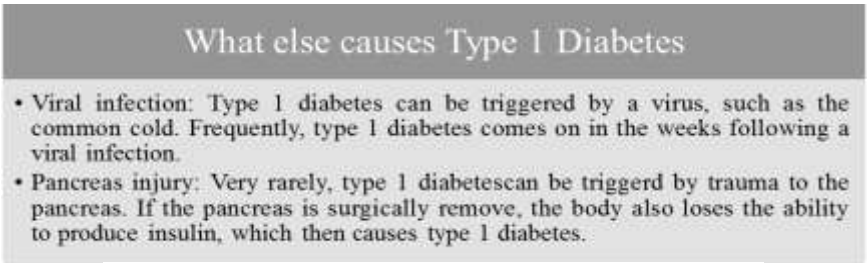

Chart: These are some common causes of Type 1 Diabetes

Pathogenesis

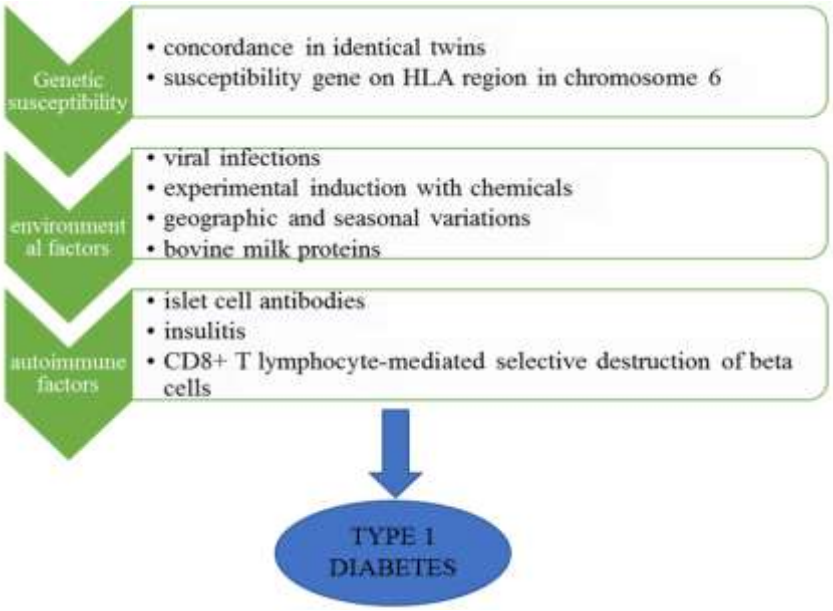

Chart: Pathogenesis of type 1 diabetes mellitus

Complications

After many years, diabetes can lead to serious health problems:

- A person could have eye problems, including trouble in seeing (especially at night) and sensitivity to light. They could become blind.
- Feet and skin could develop sores and infections. If these sores have for too long, the foot or leg may need to be amputated. Infection can also cause pain, swelling and itching.
- Diabetes can weaken immune system and make it more likely for a person to come down with infections.
- Diabetes may make it harder to control blood pressure and cholesterol. This can lead to heart attack, stroke and other problems. It can become harder for blood to flow to the legs and feet.
- Nerves in the body can become damaged, causing pain, itching, tingling and numbness.
- High blood sugar and other problems can lead to kidney damage. The kidneys may not work as well as they used to. They may even stop working, so that a person need dialysis or a kidney transplant.

Diagnosis

Diabetes is diagnosed with the following blood tests

- Fasting blood glucose level – a blood sample will be taken after fast overnight. A fasting blood sugar level is less than 100 mg/dL (5.6 mmol/L) is healthy. A fasting blood sugar level is from 100 to 125 mg/dL (5.6 to 6.9 mmol/L) is considered as prediabetes. If it's 126 mg/dL (7mmol/l) or higher on two separate tests means a person have diabetes.
- Random (non-fasting) blood glucose level – A blood sample will be taken at a random time and may be confirmed by additional tests. Blood sugar values are expressed in milligrams per decilitre (mg/dL) or millimoles per litre (mmol/L). No matter when a person last ate, a random blood sugar level of 200 mg/dL (11.1 mmol/L) or higher means a person have diabetes.
- Haemoglobin (A1C) test – This blood test shows average blood sugar level for the past 2 to 3 months. A1C measures the amount of blood sugar attached to the oxygen carrying protein in red blood cells. The higher the blood sugar levels the more haemoglobin have with sugar attached. An A1C level of 6.5% or higher on two separate tests means a person have diabetes.

Ketone testing is also used sometimes. The ketone test is done using a urine sample or blood sample. Ketone testing may be done to determine if someone with type 1 diabetes has had ketoacidosis. Testing is usually done:

- When the blood sugar is higher than 240 mg/dL (13.3 mmol/L)
- During an illness such as pneumonia, heart attack, or stroke
- When nausea and vomiting occur
- During pregnancy

Following exams and tests will help a person and their health are provider monitor their diabetes and prevent problems caused by diabetes

- Check the skin and bones on feet and legs.
- Check if feet are getting numb (diabetic nerve disease).
- Have blood pressure checked at least once a year. The aim should be 140/90 mmHg or lower.
- Have an A1C test done every 6 months if diabetes is well controlled. Have the test done every 3 months if diabetes is not well controlled.
- Have cholesterol and triglyceride levels checked once a year.
- Get tests once a year to make sure kidneys are working well. These tests and exams include checking levels of microalbuminuria and serum creatinine.
- Visit eye doctor at least once a year, or more often if a person have signs of diabetic eye disease.
- Visit the dentist every 6 months for a thorough dental cleaning and exam. Make sure dentist and hygienist know that that person have diabetes.

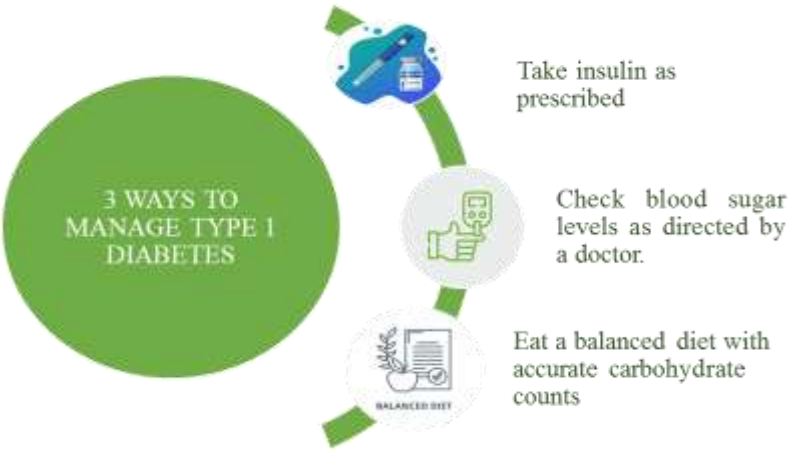

Chart: Ways for the management of type 1 diabetes.

Prevention

Type 1 diabetes cannot be prevented instantly. Using an injectable medication was only able to delay the onset of type 1 diabetes in high risk children. There is no screening test for type 1 diabetes in people who have type 1 diabetes symptoms. However antibody testing can identify children at higher risk of developing type 1 diabetes if they have first degree relatives (sibling or parent) with type 1 diabetes.

Treatment

Treatment for type 1 diabetes includes

- Pharmacological treatment
- Non- Pharmacological treatment

Pharmacological Treatment

There are two main components of Type 1 diabetes management include

- Insulin
- Blood glucose monitoring

Insulin

Insulin can't be taken by mouth to lower blood sugar because stomach enzymes will break down the insulin, preventing it from working. A person need to either get shots (injections) or use as an insulin pump.

- Injections: - using a fine needle and syringe or an insulin pen to inject insulin under the skin. Insulin pens looks like ink pens and are available in disposable or refillable varieties. If a person choose injections, they'll probably need a mixture of insulin types to use during the day and night.
- An insulin pump: - this is a small device worn on the outside of the body that program to deliver specific amounts of insulin throughout the day and when a person eat. A tube connects a reservoir of insulin to a catheter that's inserted under the skin of abdomen. There's also a tubeless pump option that involves wearing a pod containing the insulin on the body combined with a tiny catheter that's inserted under the skin.

Types of insulin

There are five types of insulin option to manage type 1 diabetes:

- Rapid acting
- Short acting
- Intermediate acting
- Long acting
- Combination

Chart: Insulin options to manage type 1 diabetes.

Insulin Type	How it is delivered	Expiration Days	Onset	Peak	Duration
Rapid acting					
Novolog	Vials, pens, cartridges refills	28 days	10-20 min	1-3 hrs	3-5 hrs
Apidra	Vials and pens	28 days	10-20 min	30 mins- 2 hrs 30 mins	2-4 hrs
Humalog U-100 and U-200	Vials, pens, cartridges refills	28 days	10-20 min	30 mins – 1 hr 30 mins	3-5 hrs
Fiasp	Vials and pens	28 days	15-20 min	1hr 30 mins -2 hrs	5 hrs
Afrezza	4,8 and 12 units cartridges	3 days	3-7 min	12-15 mins	1 hr 30 min – 3 hrs
Short acting					
regular	Vials and pens	31-42 days	15-30 min	2 hrs 30 mins- 5 hrs	4-12 hrs
U-500(5x the concentration)	Vials and pens	28 days	30 min	4-8 hrs	18-24 hrs
Intermediate acting					
NPH (created in 1946)	Vials and pens	31-42 days	1-2 hrs	4-12 hrs	14-24 hrs
Long acting					
Basaglar	Vials and pens	28 days	3-4 hrs	No peak	11-24 hrs
Toujeo, U-300	Pen only	42 days	6 hrs	No peak	24-36 hrs
Combination					
NPH/Regular 70/30	Vials and pens	31-42 days vial 10 days pen	30 mins	50mins – 2hrs 6-10 hrs	18-24 hrs
Rapid acting 75/25	Vials and pens	28 days vial 10 days pen	15-30 mins	1- 6 hrs 30 min	12-24 hrs

Blood Glucose Monitoring

People with Type 1 diabetes need to monitor their blood sugar level closely throughout the day. Maintaining a healthy blood sugar range is the best way to avoid health complications. A person can monitor blood sugar level in the following ways:

- **Blood glucose meter:** prick finger and put a small drop of blood on the meter's test strip. Blood glucose level appears on the meter within seconds. A blood glucose meter is usually the least expensive home testing option, but it only reports blood sugar at the time of the check.
- **Continuous glucose monitoring (CGM):** There are many types of CGMs. Most CGMs require you to insert a small sensor under skin at home every 7 to 14 days. Some CGMs are implanted by healthcare provider. The sensor continuously records blood glucose levels. People using a CGM require fewer fingersticks. CGM systems are more expensive than fingerstick blood glucose meters, but they provide much more information about glucose levels, including where they have been and where they are going. A person can set different alarms to alert if blood sugar is trending too low or too high.

Non- Pharmacological Treatment

1) Stress Reduction - Stress causes a highly increase in the hormones which increase blood sugar levels. Hence it is important to keep our mental and physical stress under control. It is advisable to take the breathing exercises like Pranayam to attain calmness. Having a good friend circle and outings can reduce depression and anxiety.

2) Diet - Diet has a great role in the management of diabetes. People in the prediabetic state can prevent or postpone diabetes in the future by following the right diet. Those who are already diabetic would not require huge doses of medicines if they follow a strict diabetic diet. Frequent meals are always better than large meals. Fruits like pomegranate, pear and apple are advisable. Artificial sweeteners are to be avoided. Green leaf vegetables, bitter gourd and fenugreek should be included in the diet. Deep-fried and junk food are strictly avoided. Sweet dishes can be occasionally taken if the Hb A1C is good.

3) Exercise - Regular exercise not only leads to the maintenance of ideal body weight but also improves insulin sensitivity. So regular exercise is must.

4) Yoga - Certain asanas (postures) and pranayama are of great help in promoting the function of the pancreas, thereby controlling sugars. Yoga done under the guidance of an expert would definitely beneficial.

5) De-Addiction - Addiction to smoking, alcohol, etc. not only increases the risk of chronic diseases but also their complications. Diabetics who smoke are at a greater risk of heart diseases and amputation of leg/foot. So quit smoking, alcohol.

6) Regular Tests and Self Examination - Diabetics and those at risk of Diabetes should regularly check their sugars and do other tests to rule out complications. Apart from that, they are supposed to regularly examine their feet, nails, skin to report any change at the earliest.

7) Good Personal Hygiene - As the risk of infection is more in diabetes, it is important to maintain adequate personal hygiene. Feet especially should always be clean.

CONCLUSION

Type 1 diabetes is a disease in which autoimmune destruction of pancreatic beta-cells leads to insulin deficiency. Type 1 diabetes weaken immune system and make it more likely for a person to come down with infections. The most common symptoms are increase hunger and thirst, frequent urination and vision changes. Diagnosis can include fasting blood glucose level test, random blood glucose level test and haemoglobin A1C test. Ketone testing is also used sometimes. Pharmacological treatment includes insulin injection and blood glucose monitoring. Non-pharmacological treatment includes stress reduction, diabetic diet, exercise, yoga, regular tests and self examination. With the treatment a person with type 1 diabetes can live active life.

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