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A REVIEW ON DIABETES: ARTIFICIAL PANCREAS

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Abstract:

Diabetes is a major problem in the world wide. It is a chronic disease. In human body insulin Plays a vital role in blood glucose levels. The Pancreatic gland is in GIT system which produce insulin hormone. It maintains the normal glucose level in blood. Imbalance of insulin levels leads to diabetes. The diabetes characterizes to type 1 is an insulin dependent disease and type 2 diabetes is insulin resistance disorder. Recently gestational diabetes discovered, is caused by genes or imbalance of insulin levels in before labour. To treat the diabetes in present days there is allopathic and herbal medication which drugs are used in now a day for diabetes. Allopathic medicines have therapeutic actions and also these drugs have side effects which leads alteration in body functions furthermore it causes severe health problems for that reason most of people using herbal medicines for treating the diabetes. If any person suffering with diabetes slowly it leads complications in human body. It effects on CNS, kidney and eyes etc. The most common symptoms for diabetes are thirst increases, vision in hazy and fatigue etc. To prevent from the diabetes, use anti-diabetic agents, avoid carbs in diet, eat fiber content food and exercise these activities control the diabetes. Artificial pancreas acts like as pancreas gland it produces the insulin like as natural pancreas gland. To diagnose the diabetes there is 3 main tests. statistical analysis of diabetes is year wise from 2014 upto 2019. Diabetes is controlled by proper medication by patient.

Key words: Chronic disease, Diabetes, Artificial Pancreas, Herbs in Diabetes.

Introduction:

Diabetes is a chronic disease that develops when the pancreas stops producing insulin. Insulin is a hormone produced by the pancreas that functions as a key to allow the glucose from our diet to move from the bloodstream into our cells for energy production.[1] In the blood all carbohydrates containing foods are broken down into the glucose in the liver. Insulin aids glucose absorption into the cells.[1]

Statistical analysis of Diabetes:

The number of people with diabetes rise from 108 million in 1980 to 422 million in 2014. Prevalence has been rising more rapidly in low- and middle-income countries than in high-income countries.[2] Diabetes is a major cause of blindness, kidney failure, heart attacks, stroke and lower limb amputation. Between 2000 and 2016, there was a 5% increase in premature mortality from diabetes.[2] In 2019, an estimated 1.5 million deaths were directly caused by diabetes. Another 2.2 million deaths were attributable to high blood glucose in 2012. A healthy diet, regular physical activity, maintaining a normal body

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weight and avoiding tobacco use are ways to prevent or delay the onset of type 2 diabetes.[2] Diabetes can be treated and its consequences avoided or delayed with diet, physical activity, medication and regular screening and treatment for complications. Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin. Insulin is a hormone that regulates blood sugar. Hyperglycemia, or high blood pressure is a common effect of uncontrolled diabetes and over time leads to major damage to many body systems, mainly nerves and blood vessels.8.5 %of adults aged 18 yrs. and older had diabetes in the year 2014. As in 2019, diabetes was the direct cause of 1.5 million deaths. Deaths caused by diabetes due to higher than optimal blood glucose through cardiovascular disease, chronic kidney disease and tuberculosis should be added. According to the latest available data in the year 2012 there were another 2.2 million deaths due to high blood sugar.

Between 2000 and 2016, there was a 5%increase in premature mortality from diabetes. In higher income countries the premature mortality rate due to diabetes decreased from

2000-2010 but then increased in 2010-2016. In lower income countries, the premature mortality rate due to diabetes increased across both periods.[2]

Normal Physiology of pancreatic gland:

The pancreatic gland plays a vital role in the maintenance of macronutrient digestion because of metabolism and energy homeostasis of different hormones and digestion enzymes. The pancreas gland is a part of GIT and it is present at the back of the stomach region within the left upper abdominal cavity.[3] The pancreatic gland majorly works along with 2 systems in the body.

- Exocrine system: The cells produce the pancreatic juice which contain digestive enzymes.
- Endocrine system: Pancreatic hormones, on the other hand, are secreted directly in the bloodstream in an endocrine system.[4]

The endocrine cells from islets of Langerhans, which are small island-like structures inside. The exocrine pancreatic tissue that makes up only 1-2% of the overall organ. The glucagon release alpha cells account for 15-20%, amylin c- peptide and insulin release beta cells, account for 65-80% of the total cells pancreatic polypeptide (PP) release gamma cells, account for 3-5% of the total cells, somatostatin release delta cells account for 3-10% and ghrelin release ε cells which reduce less than 1% of the total islet cells.[5] These are five types of cells which are releasing various hormones through the endocrine system. Each hormone has their specific function. Insulin lowers blood glucose levels whereas glucagon raises them.[6] Somatostatin suppresses the release of both glucagon and insulin, whereas PP modulates the pancreas exocrine and endocrine secretory activity. In vertebrates these hormones monitor the glucose homeostasis. Insulin is subsequently released into the bloodstream by the pancreas, allowing it to reach various secretions of the body.[7] Insulin has a variety of functions, but the most important is that it regulates how the body consumes carbs present in particular foods. The human body produces glucose which is converted from carbohydrates and which is a form of sugar.[8] Cells use glucose as their primary energy source. Insulin enables cells in the muscles, liver, and fat (adipose tissue) to absorb glucose and use it as a source of energy, allowing them to function normally.[9] Without insulin, cells will be unable to use glucose as a source of energy and will begin to malfunction. Extra glucose not used by the cells is transformed and stored as fat, which can be used to supply energy when glucose levels are too low. Insulin also has a number of other metabolic impacts (such as stopping the breakdown of protein and fat). In healthy persons, the release of insulin is strictly regulated in order to balance food intake with the body's metabolic needs.[10] This is a

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complicated process, and other hormones in the gut and pancreas have a role in blood glucose management as well. When we consume, glucose is taken into the bloodstream from our gut, elevating blood glucose levels. When blood glucose levels rise, the pancreas releases insulin, allowing glucose to enter and be utilized by cells.[11]The amount of glucose in the bloodstream returns to normal when glucose moves into the cells, and insulin release slows. Proteins in food, as well as other hormones produced by the gut in reaction to meals, cause insulin to be released. Hormones such as adrenaline, which are generated during times of acute stress, inhibit the production of insulin, resulting in greater blood glucose levels to help cope with the stressful event. Insulin acts in conjunction with another hormone generated by the pancreas, glucagon. While insulin's job is to lower blood sugar levels when they're too high, glucagon's job is to raise them when they're too low.[12] The body uses this system to keep blood glucose levels within prescribed ranges, allowing the body to function normally.

Pathophysiology:

Insulin is the main hormone that controls the uptake of glucose from the blood into most body cells, including the liver, adipose tissue, and muscle, with the exception of smooth muscle, where insulin functions through the IGF-1 receptor. As a result, insulin insufficiency or receptor insensitivity play a key role in all types of diabetes mellitus.[13] The breakdown of glycogen (glycogenolysis), the storage form of glucose found in the liver, and gluconeogenesis, the production of glucose from non-carbohydrate substrates in the body, are the three main sources of glucose in the body. Insulin is a hormone that regulates glucose levels in the body.[14] Insulin inhibits the breakdown of glycogen or the gluconeogenesis process, stimulates glucose transfer into fat and muscle cells, and stimulates glucose storage in the form of glycogen. Insulin is released into the bloodstream by beta cells (-cells) in the pancreas' islets of Langerhans in reaction to rising blood glucose levels, usually after eating. About two-thirds of the body's cells utilize insulin to take glucose from the bloodstream for use as fuel, conversion to other molecules, or storage. Lower glucose levels cause beta cells to release less insulin and glycogen to be broken down into glucose.[15] The hormone glucagon, which works in the opposite direction of insulin, is largely responsible for this process.If the amount of insulin supplied is insufficient, or if cells react poorly to insulin's actions (insulin resistance), or if the insulin itself is defective, glucose is not absorbed effectively by the body cells that require it, and is not stored appropriately in the liver and muscles. In cases of total insulin shortage, the overall impact is persistently high blood glucose levels, inadequate protein synthesis, and other metabolic abnormalities, such as metabolic acidosis. When blood glucose levels remain high for an extended period of time, the kidneys pass a reabsorption threshold, and the body excretes glucose in the urine (glycosuria). This raises the osmotic pressure of the urine and prevents the kidney from reabsorbing water, leading to increased urine production (polyuria) and fluid loss. Dehydration and increased thirst are caused when blood volume is lost and refilled osmotically from water in human cells and other body compartments (polydipsia).[16] Furthermore, a lack of intracellular glucose enhances hunger, resulting in overeating (polyphagia).

***Causes**:*

Ideal blood glucose level is 100 mg/dl.

There are three blood glucose levels.

They are;

Hypoglycemia: Low glucose levels in blood.

Normal Glycemia: Normal glucose levels in blood.

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Hyperglycemia: High glucose levels in blood. It is a temporary condition that may not be diabetes.

When the body is unable to make or utilise insulin properly blood glucose levels rise this type of condition is known as hyperglycemia. High blood glucose levels are linked to long term harm to the body as well as organ and tissue failure. Diabetes is becoming one of the most common problems around the world.

Types of diabetes:

There are 3 main types of diabetes.

- **Diabetes mellitus**

  ***Type -1**

  ***Type -2**

  ***Gestational diabetes**

- **Diabetes insipidus**

Diabetes mellitus:

Diabetes mellitus is a abnormal condition of blood glucose levels are in high due to body does not contain less insulin and it effects and changes physiological functions of body and it mainly effects on kidney function and it leads to more urine formation and more release of urine and it increases thirsty those who are suffering with this diabetes mellitus disease.[17] Type 1 diabetes, type 2 diabetes, hybrid forms of diabetes, hyperglycemia first discovered during pregnancy, "unclassified diabetes," and "other particular types" are the six classifications of diabetes mellitus.[18]

Type 1 diabetes:

Type 1 diabetes affects about 10% of people worldwide. Type 1 diabetes is produced by an autoimmune response in the body's defense system that attacks insulin- producing cells.[19] It occurs when the immune system attacks pancreatic beta cells, which are the only cells in the body that produce the hormone insulin, which regulates blood glucose levels. Then it results the body can produce very less amount of insulin or no formation of insulin.[20] The exact reason for type 1 diabetes is not yet known but there are some links to a combination of genetic and environmental conditions to this type 1 diabetes disease. Type 1 diabetes can be effective on people at any age but especially it develops in children or young adults. The people who are suffering from type 1 diabetes need daily injections of insulin to control their blood glucose level. The people who were suffering with type 1 diabetes if they do not have access to insulin they will die. Type 1 diabetes has an etiology that is unknown. What is known is that your immune system, which is generally responsible for fighting harmful bacteria and viruses, assaults and destroys your pancreas' insulin-producing cells. You will have very little or no insulin as a result of this. Sugar builds up in your bloodstream instead of being delivered to your cells. Type 1 diabetes is assumed to be caused by a mix of genetic predisposition and environmental factors; however, the exact nature of those variables is unknown. Weight isn't thought to play a role in type 1 diabetes. People with type 1 diabetes must have insulin administered by injection or a pump in order to survive.

Type 2 diabetes:

Type 2 diabetes is the most common type of disease and 90% of people suffer from this type 2 diabetes.[21]Type 2 diabetes is caused by a combination of genetic and environmental factors that impair beta-cell function and insulin sensitivity in several

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tissues (muscle, liver, adipose tissue, and pancreas). In type 2 diabetes, the body either produces insufficient insulin or the cells ignore it. Insulin resistance, a disease in which the cells do not utilize insulin adequately, is usually the starting point. The pancreas eventually loses its ability to make insulin as the requirement for it grows. When glucose builds up in the bloodstream instead of being absorbed by cells, it can lead to heart disease, nerve damage, and kidney damage. In the United States, diabetes is the primary cause of kidney failure, non-traumatic lower-limb amputations, and new cases of blindness in people. It is commonly caused by insulin resistance, whenever the body does not properly respond to the insulin because whenever the insulin is unable to work properly it causes blood glucose levels to increase and produce more insulin.[22] In some people who are suffering with type 2 diabetes this can slowly damage the pancreas gland and it results in the body containing less insulin and finally it leads to higher blood sugar levels (hyperglycemia)There are basically two connected problems at work in type 2 diabetes. Your pancreas does not create enough insulin, a hormone that controls the transport of sugar into your cells, and your cells do not respond well to insulin, resulting in decreased sugar intake. Type 2 diabetes is most commonly diagnosed in older adults but it is increasingly seen in adolescents, younger adults and children because of increasing blood glucose levels due to poor diet, physical activity and obesity. Your cells become resistant to the action of insulin in prediabetes — which can develop to type 2 diabetes — and type 2 diabetes, and your pancreas is unable to create enough insulin to overcome this resistance. Sugar accumulates up in your bloodstream instead of going into your cells, where it is needed for energy.

Gestational diabetes:

Gestational diabetes mellitus (GDM) is a one of the severe and harmful to maternal and fetus health. So many women are facing this problem in their pregnancy due to high blood glucose levels and blood pressure. It affects the fetus it causes heavy weight babies during birth of a fetus and obstructed labor. In the world, 50 % of women are suffering from GDM.[23] Furthermore, it develops as type 2 diabetes within five to ten years after delivery of a pregnant woman. The main reason for high blood glucose (hyperglycemia) during pregnancy is that it furthermore rises faster with age and highest in women over the age of 45. The GDM also comes through genes in some cases.

Diabetes insipidus:

Diabetes insipidus is caused due to an Imbalance of fluids in the body and it is an uncommon disorder.[24] Those who are suffering with this diabetes insipidus this imbalance makes them very thirsty even if they have had something to drink and it leads to more urine.

Factors influencing the Diabetes:

- ***Factors that are at risk:***

Diabetes risk factors vary depending on the type of diabetes.

- *Type 1 diabetes risk factors:*

Although the specific origin of type 1 diabetes is unknown, the following variables may indicate a higher risk

- *History of the family:* If a parent or sibling has type 1 diabetes, you're at a higher risk.
- *Environmental considerations are important:*

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Exposure to a viral disease, for example, is likely to play a role in type 1 diabetes. The presence of immune system cells that are harmful (autoantibodies). The existence of diabetic autoantibodies is sometimes examined in family members of persons with type 1 diabetes. You have a higher chance of acquiring type 1 diabetes if you have these autoantibodies.[25]

-*Geography*: Type 1 diabetes is more common in some countries, such as Finland and Sweden.

Prediabetes and type 2 diabetes risk factors:

Researchers aren't sure why some people get prediabetes and type 2 diabetes while others don't. Certain circumstances, however, clearly enhance the risk, including:

-*Weight*: Your cells become more insulin resistant as you gain more fatty tissue.

-*Inactivity:* The lower your level of activity, the higher your danger. Physical activity helps you lose weight by burning glucose for energy and making your cells more insulin sensitive. -*History of the family:* If a parent or sibling has type 2 diabetes, your risk increases. -Ethnicity or race: Although it's unknown why, particular groups of people, such as Black, Hispanic, American Indian, and Asian Americans, are more vulnerable.

-*Age:* As you become older, your risk increases.[25] This could be due to the fact that as you get older, you tend to exercise less, lose muscle mass, and gain weight. However, type 2 diabetes is becoming more common in children, adolescents, and young adults.

-*High Blood pressure:* Type 2 diabetes is connected to blood pressure levels more than 140/90 millimeters of mercury (mm Hg).

Factors that increase the risk of gestational diabetes:

Gestational diabetes can affect pregnant women. Some women are more vulnerable than others. The following are some of the risk factors for gestational diabetes:

-*Age*: Women above the age of 25 are at a higher risk.

-*Personal or family history*: If you have prediabetes, which is a precursor to type 2 diabetes, or if a close family member, such as a parent or sibling, has type 2 diabetes, your risk increases. If you experienced gestational diabetes during a prior pregnancy, delivered a very large baby, or had an unexplained stillbirth, you're at a higher risk.

-*Weight*: Being overweight prior to conception raises your chances.[25]

-*Ethnicity or race*: Women who are Black, Hispanic, American Indian, or Asian American are more prone to develop gestational diabetes for unknown causes.

Complications:

Diabetes problems that last a long time appear gradually. The longer you have diabetes and the less well you control your blood sugar, the more likely you are to have problems. Diabetes problems can become disabling or even life-threatening in the long run.

Complications that may arise include:

-*Damage to the nerves (neuropathy):* Sugar in excess can harm the walls of the tiny blood arteries (capillaries) that nourish your nerves, particularly in your legs. This might result in tingling, numbness, burning, or pain that starts at the tips of the toes or fingers and extends upward.[26]

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-*Damage to the kidneys (nephropathy):* Millions of microscopic blood artery clusters (glomeruli) filter waste from your blood in the kidneys. This delicate filtering system can be harmed by diabetes. Kidney failure or irreversible end-stage kidney disease can result from severe damage, necessitating dialysis or a kidney transplant.

-*Damage to the eyes (retinopathy):* Diabetic retinopathy causes damage to the blood vessels in the retina, which can lead to blindness. Diabetic patients are more likely to develop major eye problems including cataracts and glaucoma.[26]

-*Skin problems:* Diabetes can make you more prone to skin infections, such as bacterial and fungal infections.

Symptoms:

The severity of diabetes symptoms varies depending on how high your blood sugar is. Some patients, particularly those with prediabetes or type 2 diabetes, may not have any symptoms at all.[27] Symptoms of type 1 diabetes tend to appear quickly and are more severe.

The following are some of the indications and symptoms of type 1 and type 2 diabetes:

- Thirst increases
- Urination on a regular basis
- Hunger to the point of death
- Weight loss that isn't explained
- Ketones in the urine (ketones are a result of muscle and fat breakdown that occurs when there isn't enough insulin available)
- Fatigue\irritability
- Vision is hazy
- Sores that take a long time to heal
- Infections that occur frequently, such as gum or skin infections, as well as vaginal infections.
- Tingling in hands and feet.
- Changes in appetite.

Type 1 diabetes can strike at any age, but it is more common in childhood and adolescence.[27] Type 2 diabetes, which is the most common, can strike at any age, though it is more common in persons over 40.

Diagnosis:

There are three main tests to detect diabetes.

1. *Random blood sugar test:*

In this test you do not need to be fasting. In this test it is taken at any time. If a doctor thinks you have type 1 diabetes he wants to test on autoantibodies (it is a substance that indicates the person's body is attacking itself) and a another test it is used for type 1 and type 2 diabetes this test on urine for ketones (it is produced when the person body burns fat for energy).[28]

2. *Fasting blood sugar test:*

In this type of test before this test people who are suffering with diabetes do not take any food because the fasting blood glucose level is 99 mg/dl (or) lower than normal. But if the test reports results are 100 to 125 mg/dl it indicates they are suffering from pre-diabetes. If the test reports results show 126 mg/dl (or) higher it indicates they are suffering with diabetes.[29]

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3. *Oral glucose tolerance test:*

It is a type of test that requires fasting overnight before the test, then checking the fasting blood glucose levels and after checking take a drink which contains glucose and take rest for 2 or 3 hours then check the glucose levels. If any alteration is there in reports the person is suffering with diabetes.

Result*: Fasting Glucose Random

Blood tolerance Blood

Sugar Test. sugar Level. test.

Diabetes: 126mg/dl 200mg/dl 200mg/dl

Or or or

Above above above Pre-diabetes:

100-125 140-199 N/A mg/dl mg/dl Normal:

99mg/dl 140mg/dl N/A

Or or

Below below **Precautions:**

- Avoid oily foods, junk foods, carbs and high quality of sucrose or sugar.
- Exercise ng regularly will be helpful to metabolic activity in the body.
- Drink water as a primary source.
- Eat and take leafy green vegetables, fruits like citrus fruits, guava, and unripe papaya.
- Eat and take fiber content food and also eat food within limits.
- Avoid smoking and drinking alcohol.
- And take medication to control the diabetes.
- Consider and take natural herbs.[30]

Prevention of diabetes:

Type 2 diabetes is the most common form condition, can be prevented by making lifestyle modifications. If you have an increased risk of type 2 diabetes due to excess weight or obesity, high cholesterol, or a family history of diabetes, prevention is extremely crucial.[31]

Lose extra weight:

Diabetes is less likely if you lose weight. People in one big research reduced their chance of acquiring diabetes by nearly 60% after decreasing around 7% of their body weight with exercise and dietary changes.[32] Set a weight-loss goal that is proportional to your present body weight. Talk to your doctor about setting realistic short-term goals, such as losing 1 to 2 pounds each week.

Be more physically active:

There are many benefits to regular physical activity. Exercise can help you:

*Aerobic exercise:

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For a total of at least 150 minutes per week, aim for 30 minutes or more of moderate to intense cardiovascular exercise on most days, such as brisk walking, swimming, biking, or running.

*Resistance exercise:

Resistance training, done at least twice a week, improves your strength, balance, and capacity to stay active. Weightlifting, yoga, and calisthenics are all resistance exercises.

*Limited inactivity:

Breaking up long bouts of inactivity, such as sitting at the computer, can help

control blood sugar levels. Take a few minutes to stand, walk around or do some light activity every 30 minutes.

Eat healthy plant foods:

Vitamins, minerals, and carbohydrates are all found in plants. Carbohydrates contain sugars and starches, which provide energy to the body, as well as fiber. Dietary fiber, also known as roughage or bulk, is the indigestible portion of plant foods that you're the body cannot digest or absorb.[33]

Fiber-rich meals help you lose weight and reduce your risk of diabetes. Consume a wide range of nutritious, fiber-rich meals, such as:

-Tomatoes, peppers, and tree fruit are examples of fruits.

-Leafy greens, broccoli, and cauliflower are examples of non-starchy vegetables.

-Beans, chickpeas, and lentils are examples of legumes.

-Whole grains including whole wheat pasta and bread, whole grain rice, whole oats, and quinoa are all good sources of fiber.

Eat healthy fats:

Foods heavy in fat provide a lot of calories and should be consumed in moderation.

Your diet should include a range of foods high in unsaturated fats, sometimes known as "healthy fats," to aid weight loss and management. Monounsaturated and polyunsaturated fats both promote healthy blood cholesterol levels as well as heart and vascular health. Good fats can be found in the following foods:

-Oils from olives, sunflowers, safflowers, cotton seeds, and canola.

-Almonds, peanuts, flaxseed, and pumpkin seeds are examples of nuts and seeds.

-Salmon, mackerel, sardines, tuna, and cod are examples of fatty fish.

Skip fad diets and make healthier choices:

Many fad diets can help you lose weight, including the glycemic index, paleo, and keto diets. However, there is little evidence of the long-term advantages of these diets or their effectiveness in preventing diabetes. Your nutritional objective should be to reduce weight and then keep that weight off in the future.[34] Healthy eating habits must consequently involve a method that you can stick to for the rest of your life. Making healthy choices that match some of your personal cuisine and tradition preferences might be beneficial over time. Divide up your plate as a simple method to help you make excellent meal choices and consume proper portion sizes. These three divisions on your plate promote healthy eating:

-One-half: fruit and non-starchy vegetables.

-One-quarter: whole grains.

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-One-quarter: protein-rich foods, such as legumes, fish or lean meats.

Artificial pancreas:

Researchers are working on three different artificial pancreas systems:

-Artificial pancreas using a closed-loop system

Pancreas bionic

-An artificial pancreas has been implanted.

-Artificial pancreas using a closed-loop system

-A 'closed-loop insulin delivery device,' often known as a closed loop artificial pancreas, is the most commonly tested artificial pancreas.

Cambridge University has long been a leader in closed-loop research, and their gadget is currently being tested on humans in both controlled and uncontrolled environments. It consists of an insulin pump worn on the outside that communicates wirelessly with a CGM worn as a patch on the skin.[35] The CGM monitors blood sugar levels and feeds the information to a small computer, which determines how much insulin (if any) the insulin pump should give. After that, the dose is administered into the body, which completes the cycle. The European Commission stated in 2016 that it would sponsor a trial at Cambridge University to see if an artificial pancreas may assist young children manage type 1 diabetes.

Medtronic is one of the companies working on closed-loop insulin administration. In September 2016, the biopharmaceutical business revealed data demonstrating positive results from their hybrid closed-loop device; the MiniMed 640G artificial pancreas was launched in the UK in March 2015. Pancreas bionic the iLet, a prosthetic pancreas that could assist persons with type

1 diabetes manage their disease completely through the device, was unveiled to the public in 2015. The bionic pancreas, invented by Dr. Edward Damiano's Beta Bionics company, uses two insulin pumps to inject insulin and glucagon, respectively, to autonomously control blood glucose levels. The pumps communicate with an iPhone app through Bluetooth, allowing the devices to communicate and calculate the necessary doses. Every five minutes, based on updated continuous glucose monitor (CGM) readings, automated dosing decisions for insulin and glucagon are made. Damiano and his team hope to get an insulin-only version approved by the US FDA in 2018 and the whole system was approved soon after. More about the bionic pancreas can be found here. Artificial pancreas that has been implanted. The gel in the implantable insulin delivery device reacts to fluctuations in blood glucose levels. Researchers at De Montfort University are working on the project.

An artificial pancreas has been implanted.[36]

A gel in the implantable insulin delivery device reacts to changes in blood glucose levels. Researchers from De Montfort University are working on it. When blood glucose levels are high, the gel allows more insulin to be released; when sugar

levels are low, the gel reduces the quantity of insulin released. The insulin might be refilled on a regular basis in the implanted system. The most recent developments in artificial pancreas systems in recent years, artificial pancreas devices have become a prominent topic of discussion. Take a look at some of the most important stories in the field of diabetes therapy. The International Diabetes Closed Loop Trial is a research project that aims to find a cure for the disease. The International

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Diabetes Closed Loop (IDCL) experiment, which began in 2016, is a noteworthy study. "Clinical staff will gain experience utilizing the proposed artificial pancreas system named in Control and the in-Control Cloud and assess 24/7 in-home usability prior to commencing a big randomized controlled trial," according to the study's goal. The Type Zero in Control artificial pancreas, which is used in conjunction with Tandem's t: slim insulin pump, will be compared to a regular insulin pump and CGM (known as an open loop). Other firms whose products will be tested in this research include Cell NoVo and Dexcom. Artificial pancreases manufactured at home. Homemade artificial pancreases are becoming more popular among families that don't want to wait for them to come from a pharmaceutical company. However, this is only recommended for experienced engineers who are also well-versed in diabetes care. [208]. Tech-savvy people all over the world are developing their own equipment, including artificial pancreases, as part of the #WeAreNotWaiting effort to improve their health.[37] The device is still being tested for safety and effectiveness, and as of 2016, home and clinical trials in persons with both type 1 and type 2 diabetes have been completed. Research is being carried out all around the world, and each team's expertise in their individual products are assisting in the development of devices. The researchers' next step is to put the technology to the test on a bigger group of people.

Allopathic medication for diabetes:

The Allopathic system was introduced in India by Britishers before independence in India. The drugs or medicines are used for diagnosis, mitigation, analysis, treatment, cure and prevention from the disease.[38] These are synthetic drugs for medication. In diabetes the allopathic medication of drugs is[39]

Metformin:

Metformin was first discovered in the year 1922.It is administered orally; the drug is in solid dosage form and this drug is available in tablet form. It is helpful to control blood glucose levels with diet and exercise.[40] Metformin is commonly used to treat type 2 diabetes patients in maintaining their blood sugar levels. Standard metformin is taken two (or) three times per day. Metformin is available in generic form and is also economically low in price. Metformin can also be used in the treatment of gestational diabetes and polycystic ovary syndrome.

Mode of action:

The medicine does not increase insulin levels in the body. But instead reduces the amount of sugar produced by the body and absorbs it.[41] It lowers glucose production in the liver. Metformin also lowers blood sugar by increasing the body's sensitivity to insulin. It also decreases the amount of glucose that our bodies absorb from the foods we eat.

Side effects:

For people who are taking it for the first time, nausea, gastric distress, gas bloating and diarrhea are common.[42] The most serious side effects are, lactic acidosis, kidney problems, severe acute heart failure, liver problems and lactate imbalance. Metformin can also increase the risk of hypoglycemia (particular for those who take insulin).

Sulfonylureas:

These are in tablet dosage forms. These drugs work on increasing levels of insulin in blood from the pancreas gland. This drug controls blood glucose levels through diet and also with exercise.

Ex: Glucotrol(glipizide), Tolbutamide, Tolinase (tolazamide) etc.

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Sulfonylureas are a group of medicines used for treating type 2 diabetes. These will lower blood glucose levels by stimulating insulin release from Beta cells. Sulfonylureas stimulate insulin release by blocking A.T.P potassium channels in Beta cells.[43]

***Mode of action*:**

Sulfonylureas bind to & close ATP sensitive potassium channels on the cell membranes of pancreatic beta cells, where depolarization takes place, this will cause opening of voltage gated calcium channels, rise in intracellular calcium tends to increase fusion of insulin granules. And therefore, increased secretion of mature insulin, sulfonylureas also sensitize beta cells to glucose, which limits glucose production in the liver.[44]

***Side effects*:**

Signs of low blood sugar, like sweating, dizziness, confusion or nervousness, Dark colored urine in some cases, Skin reactions, weight gain in some other cases, Upset stomach. These are some of the major side effects.[45]

Meglitinides:

It is administered orally and this drug is used to treat type 2 diabetes. They work to activate the secretion of insulin.[46]

Ex: Prandini (repaglinide)and Starlix (Nate glinide) etc. ***Mode of action***:

They bind to ATP dependent potassium channels on the cell membrane of pancreatic beta cells. Have a weaker binding affinity and faster dissociation from the SUR-1 binding site. This will increase the concentration of intracellular potassium. This depolarization opens voltage-gated calcium channels.[46] The rise in intracellular calcium leads to increased fusion of insulin granules in the cell membrane. Therefore, increased secretion of insulin.

***Side effects*:**

Low blood sugar (hypoglycemia) is the most common side effects of meglitinides symptoms of hypoglycemia include sweating, shakiness, lightheadedness and confusion.[46]

Thiazolidinediones:

It is administered through orally. It is an antidiabetic drug to improve the metabolic activity in patients and also improve the insulin sensitivity and it is used to treat type 2 diabetes.[47]

Mode of action:

Thiazolidinediones are selective agonists of

PPAR gamma. When activated by a ligand such as a thiazolidinedione. PPAR gamma binds to the 9- CIS retinoic acid receptor.[48] Retinoid x receptor to form a 9 heterodimer. This binds to DNA to regulate the genetic transcription and translation.

Side effects:

The common side effects of thiazolidinediones are water retention, weight gain, eyesight problems, reduced sense of touch, chest pain, infections and allergic skin reactions.[49]

DPP-4 inhibitors:

These are taken along with diet and exercise to reduce the blood glucose levels in patients, especially in adults who are suffering with type 2 diabetes. Ex: Sitagliptin, Linagliptin and Al gliptin etc.[50]

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Mode of action:

DPP-4 inhibitors lower blood glucose and glucagon levels. DPP-4 inhibitors work by increasing incretin levels (GLP-1 and GIP), which inhibit glucagon release, increasing insulin secretion, decreasing stomach emptying, and lowering blood glucose levels.[51]

Side effects:

Nausea, diarrhea, and stomach pain are all symptoms of gastrointestinal issues. Headache, runny nose, and sore throat are flu-like symptoms. Skin responses - itchy, inflamed skin with a red or purple rash.[52]

GLP-1 Receptor agonists:

It is used to treat type 2 diabetes. It lowers the glucose levels in blood along with diet and exercise.[53] It is administered orally and it is available in tablet form.

***Mode of action*:**

The GLP-1 receptor is found in -cells, and its activation is thought to produce a variety of shorthand long-term effects. In terms of -cell function, GLP-1 promotes insulin secretion quickly and effectively,[54] which is a well-known action that will be covered further down.GLP-1, on the other hand, increases insulin gene transcription, islet cell proliferation, and neogenesis, all of which are potentially essential activities in the treatment of diabetes.

***Side effects*:**

GLP-1 receptor agonists are most commonly associated with gastrointestinal symptoms, particularly nausea.[55] Injection site responses, headaches, and nasopharyngitis are other common side effects.

SGLT-2 Inhibitors:

It is administered in an oral route in tablet form. It is an anti- hyperglycemic agent and it is used to treat diabetes mellitus.[56]

Ex: Canagliflozin (Invokana), Dapagliflozin (Farxiga) and Empagliflozin (Jardiance) etc.

***Mode of action*:**

SGLT2 inhibitors work by lowering renal tubular glucose reabsorption, resulting in a decrease in blood glucose levels without triggering insulin release.[57] Other advantages could include lower blood pressure and weight loss.

Side effects:

Vaginal yeast infections, yeast infections of the penis, stuffy or runny nose, and changes in urine are the most prevalent SGLT2 side effects. Two percent or more of clinical trial participants experienced these typical adverse effects.[58]

Insulin:

Insulin is a hormone which regulates the blood glucose level and sets it to normal levels.[59] It is a liquid dosage form. It is administered through a subcutaneous route. It is available in insulin injection form and it is used to control blood glucose levels in patients who are suffering with type 1 and type 2 diabetes.

***Mode of action*:**

Insulin works by attaching to a glycoprotein receptor on a cell's surface. An alpha subunit binds the hormone, while the beta subunit is an insulin-stimulated, tyrosine-specific protein kinase.[60] It is helpful in the energy process.

Side effects:

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The following are some of the more prevalent insulins regular (human) adverse effects. Your arms and legs are swollen.[60]gaining weight. Blood sugar levels are low (hypoglycemia). This must be addressed.

Traditional medication for diabetics:

Traditional medicinal system is an ancient medicinal system in India. In India before independence, we used plant, animal and mineral source of drugs to treat the disease and also, we used these products in food stuff to make food. For diabetes we are using herbal drugs nowadays.[61] Some people who are suffering with diabetes but they do not like allopathic medication because allopathic medication has therapeutic properties along with that side effects are also there. So those people mostly prefer herbal drugs for treating diabetes.[62] The natural drugs which have anti-diabetic property are:

Aloe Vera, Berberine, Bilberry extract, Bitter melon, Cinnamon, Curry, Eugenia jambolana, Fenugreek, Ginger, Ginkgo, Okra, Phyllanthus amarus, Pterocarpus marsupium, Solanum torvum and Vinca rosea etc. Some other traditional drugs for anti-diabetes:[63]

Allium:

Allium sativum is commonly called garlic, allium may decrease blood glucose and it increases the secretion and slows down the degradation of insulin in the body. The spice plant Allium cepa, also known as onion, is a member of the Liliaceae family. It has been utilized for the treatment of a variety of ailments since ancient times.[64] Among the many activities of Allium cepa, one of the most important effects in DM is the modulation of hypoglycemic activity. The hypoglycemic activity of Allium cepa is mostly attributed to Sulphur compounds such as S-methyl cysteine and flavonoids such as quercetin. S-methyl cysteine and flavonoids reduce blood glucose, serum lipids, oxidative stress, and lipid peroxidation while also enhancing antioxidant enzyme activity and insulin secretion.[65] By normalizing the activity of liver hexokinase, glucose 6-phosphatase, and HMG coenzyme-A reductase, onion extracts have also been demonstrated to have hypoglycemic and hypolipidemic effects. Patients with diabetes who consumed slices of Allium cepa showed sufficient hypoglycemic effect in preliminary clinical studies. Further research is needed to examine and confirm the hypoglycemic properties of Allium cepa, its components, and/or their synthetic analogues in the future.[66]

Bauhinia forficate and Myrcia uniflora:

The plant derivative drug is also called vegetable insulin. This herb has hypoglycemic activity. Kaempferol, a flavonoid found in Bauhinia forficata leaves, has hypoglycemic and antioxidant properties.[67] In humans, a mixture containing B. forficata extracts and other medicinal plants had a hypoglycemic effect. In diabetic patients, an infusion of Bauhinia forficata leaves produced a hypoglycemic effect. Myrcia may decrease the amount of sugar absorbed by the stomach.[68] This could help diabetics lower their post-meal blood sugar levels. Thyroid hormone synthesis is also reduced by Myrcia.[69]

Coccinia indica:

Coccinia indica is also called "ivy gourd". It is used mainly to control the glycemic. It is a traditional remedy to control the insulin and it mimics the insulin in the body.[70] Coccinia indica leaf extract had a substantial hypoglycemic and antihyperglycemic impact in normal and streptozotocin diabetic rats, as well as reversing biochemical problems.[71] After 45 days of oral treatment of 200 mg/kg ethanol extract of Coccinia indica leaves (CLEt) to diabetic mice, blood glucose, glycosylated hemoglobin, total hemoglobin, and plasma insulin levels were significantly lower.[72]

Ficus Carica:

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Ficus Carica is also called fig-leaf. It is used as a natural remedy in Spain and south-western European countries to treat diabetes.[73]The levels of blood glucose, total cholesterol (TC), triglycerides (TG), body weight, and hepatic glycogen were significantly affected (p 0.005) by the ethyl acetate extract (250 and 500 mg/kg) of n F. carica leaves.F. carica was used in the treatment.[74] The cytoprotective impact on pancreatic -Beta cells was confirmed by immunohistochemical examinations of islets.[75]

Gymnema Sylvestre:

Gymnema Sylvestre is also used in ayurvedic medicine. It is used in diabetes treatment to control or to decrease blood glucose levels. Gymnema's potential to reduce blood sugar is insufficiently supported by scientific evidence to propose it as a stand-alone diabetic treatment. However, study indicates that there is a lot of promise.[76] According to the findings, lowering blood sugar levels after a meal resulted in lower average blood sugar levels over time. This may aid in the reduction of long-term diabetes problems. Gymnema sylvestre can help lower fasting, post-meal, and long-term blood sugar levels in persons who have high blood sugar or a high HbA1c. Consult your doctor first if you're on blood sugar-lowering medication.[77]

Ocimum Sanctum:

Ocimum Sanctum is a natural drug used in the ayurvedic system of medicine. It is also called "holy basil". It is used to treat diabetes.[78] The leaves of the Ocimum sanctum tree have long been used to treat diabetes. The test group's blood glucose levels were significantly reduced after 30 days of dietary supplementation with fresh tulasi leaves at a dose of 2 gm/kg BW. The current findings show that the antioxidant property of Ocimum sanctum leaves is primarily responsible for the hypoglycemic effect.[79]

Opuntia strep acantha:

Opuntia strep acantha is also called Prickly-pear cactus.[80] It is used to control the glucose in blood. Opuntia strep acantha is a species of opuntia that grows in the United States. When intact animals were given Lemaire sap orally in generated states of considerably elevated blood glucose, hypoglycemic effects were observed.[81]

Silybum marianum:

Silybum marianum is called "milk thistle". Silymarin increases the concentration of flavonoids and antioxidants.[82] It is used to control the glycemic condition in the body. Diabetes problems are exacerbated by inflammation and oxidative stress. Silymarin, an antioxidant and anti-inflammatory herbal medicine, may help with glycemic management and prevent problems from worsening.[83]

Trigonella foenum graecum:

Trigonella foenum graecum is also called Fenugreek and it is used in food preparation. It is widely grown in India and North Africa.[84] It is used to control the glycemic condition in the body. Soluble fiber in fenugreek seeds (trigonella foenum graecum) helps reduce blood sugar by slowing carbohydrate digestion and absorption.[85] This shows that they could be useful in the treatment of diabetes patients. Several studies have been conducted to look into the anti-diabetic properties of fenugreek. Several clinical investigations have shown that fenugreek seeds can reduce blood glucose levels and improve glucose tolerance in people, which can help with most metabolic symptoms associated with type 1 and type 2 diabetes.[86]

Conclusion:

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Diabetes is a disorder controlled by anti-diabetic agents with herbal and allopathic medicines. Diabetes is a chronic condition. We cannot reduce the diabetes disease in the patient but we can control the insulin in normal levels in the patient by taking anti-diabetic agents in the proper manner then only we control the diabetes in the patient.

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