



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Introduction to Physiology

(BMHP5003_LON)

Assessment Component 1

Poster Presentation

Student name: Justyna Cichocka

Student number: 1916227

Group: 2

Lecturer name: Noura Mohamed

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DIABETES

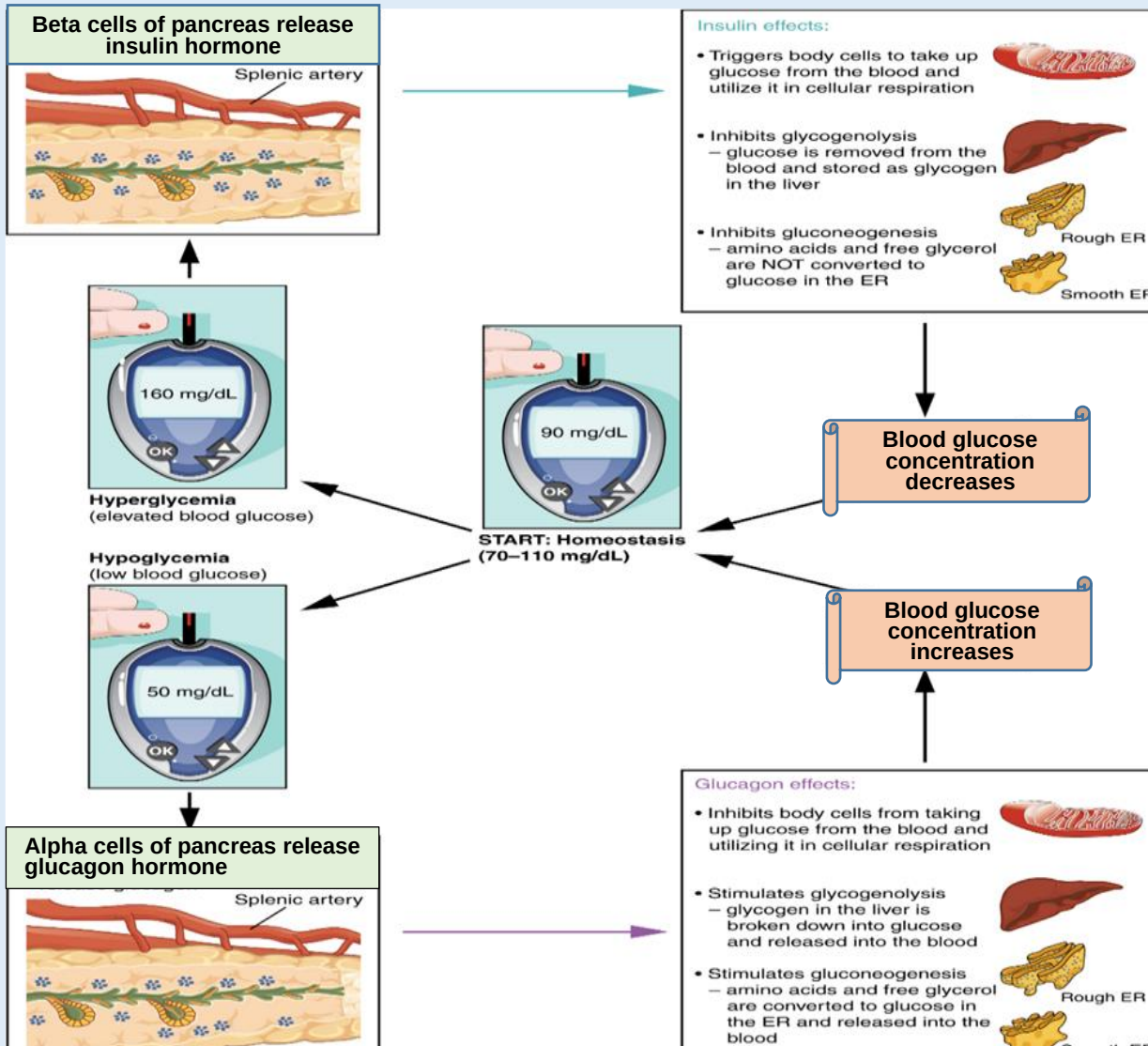


Figure 1. Shows the principle of homeostasis in the regulation of blood glucose levels controlled by hormones insulin and glucagon [Gordon Betts et al., 2013].

Prevalence
About 422 million patients are diagnosed worldwide [WHO, 2020].

About 4.7 million people suffered with the diseases in UK and 4 million in England which is 1 in 15 patients [Diabetes U.K, 2019].

By 2030 it is anticipated the diagnosis will reach 5.5 million in UK [Diabetes U.K, 2019].

Risk factors contributing for Patient A to develop type 2 diabetes are inactivity, unhealthy diet, high blood pressure, age [Nesti et al., 2020].

Recommendations for Patient A are physical activity and healthy balanced diet, it must be implemented to prevent diabetes type 2 [Diabetes U.K, 2021; Pan et al., 2018].

TYPE 1 vs TYPE 2 DIABETES

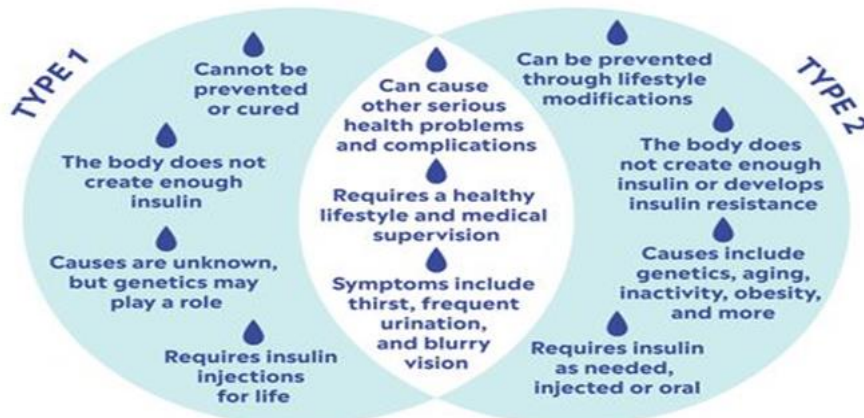


Figure 2. Present differences and similarities between type 1 and type 2 diabetes [Prevention, 2018].



Figure 3. Shows the gangrene, the late stage of diabetes [NHS U.K, 2018].

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Speakers Notes

Introduction

The pancreas is predominant gland in human physiology and the endocrine function taken place in “islets of Langerhans”, where each islet contains 4 different types of cells (alpha, beta, delta, PP cells) and each cell produce different hormone [Tucker, 2015]. Diabetes is a chronic disease that affects how the body turns food into energy, most of the food we eat is broken down into glucose and released into the bloodstream. In diabetes the pancreas does not make enough insulin, or the produced insulin is not use properly by the cells in the human body or cells stop responding to insulin, as a result too much blood sugar stays in the bloodstream [Gordon Betts et al., 2013].

The pancreas is ductless organ and secrete hormones directly to bloodstream. The mechanism of signal hormone release is known as endocrine. Hormones are transported via bloodstream through the body, where target cells with specific receptor react to the hormone which means the target cells which have receptor for glucagon will not react to insulin [Gordon Betts et. al., 2013].

The Diabetes UK [2019] published dramatic facts and statistics, 4 million people are suffered with the diseases in England which is 1in 15 patients and 4.7 million people across the country, with an estimated service cost of £10 billion a year which is 10% of its allocated budget for health services. The diabetics is progressive diseases, the number of diagnosis is constantly increasing and could reach 5.5 million before 2030 in United Kingdom [Diabetes U.K, 2019].

Normal and Abnormal Physiology

Figure 1 present the principal of homeostasis. It is tendency to maintain constant internal environment at many levels in human body, in this case is blood glucose which should be at optimum level so we can function as human being in stable environment [Gordon Betts et al., 2013]. As we can see on the picture there is ideal conditions where blood glucose should be remains within certain range between 70-110 mg/dl. Homeostasis involves negative feedback loops; it is counteractive responses to keep homeostasis and in this

case is normal blood glucose level. There can be also fluctuations, any range above 110mg/dl is a hyperglycemia, it is abnormal conditions, for example, when you drink a glass of fruit juice or we have a meal, our blood glucose rises [Gordon Betts et al., 2013]. In healthy person high blood glucose level is controlled by insulin which is produce by beta cells of the pancreas [Peate & Nair, 2011]. Insulin act as a signal that stimulate the body's cells like muscle, fat cells to take up glucose and utilize in the cellular respiration in mitochondria [Gordon Betts et al., 2013], also glucose is removed from blood and store as glycogen molecule in liver [Peate & Nair, 2011]. The process removed sugar from blood, decreasing blood glucose level and returning the system to homeostasis [Gordon Betts et al., 2013].

Any range below 70 mg/dl it is abnormal conditions, for example if you don't eat for a while blood glucose level drops causing hypoglycemia [Gordon Betts et al., 2013]. Glucagon hormone is released from alpha cells to normalize blood glucose [Peate & Nair, 2011]. Glucagon stops the body cells from taking up the glucose from blood and utilizing in cellular respiration in mitochondria [Gordon Betts et al., 2013]. Glucagon acts on the liver by breaking down glycogen molecule into glucose and releasing into bloodstream causing blood glucose level increase [Peate & Nair, 2011]. This is call glycogenolysis process, however glucagon also stimulates gluconeogenesis process which is formation of new glucose from amino acids and free glycerol in ER and release into bloodstream, increasing glucose level [Gordon Betts et al., 2013]. When blood glucose is normalizing the secretion of glucagon is reduce and system returns to homeostasis, so negative feedback brings the body to equilibrium which is optimum level [Peate & Nair, 2011].

In Type 1 diabetes insulin is not produce and it is caused by an autoimmune reaction which is immune disease where the body mistakenly attacks itself and lead to the destruction of beta cells [NIDDK, 2021]. Our body is not able to get glucose from blood into cells. Glucose outside the cells cannot be used to make energy in cellular respiration. The cells need to take glucose in to make energy to survive. To manage Type 1 diabetes insulin injections are needed for a life to normalized blood sugar, along with dietary and lifestyle interventions [NIDDK, 2021]. Type 1 accounting for 8 % of the total diabetes, mostly young children, teens, young adults are affected. Other causes then family history

is not specified. Symptoms appear quickly and lead to diabetic ketoacidosis. There is an overproduction of ketone compounds, the blood becomes acidic, and ketoacidosis develops [Diabetes U.K, 2021].

Type 2 is metabolic disorder, the pancreas produced not enough insulin or cells become resistant to insulin and ignoring message to absorb glucose, as a result too much glucose is accumulated in the blood rather than be use as a fuel by the cell in cellular respiration [NIDDK, 2021]. Broken feedback loop makes it difficult or impossible for the body to lower high blood sugar to a healthy level. To clear glucose from circulation system the body have technique like excessive urination. Other symptoms are weakness, excessive thirst, blurred vision [NIDDK, 2021]. Type 2 accounting for 90% of the total diagnoses and 1 in 4 are unaware they have diabetes, so over time high blood glucose damage blood vessels which can damage organ and lead to heart disease, vision loss, and kidney disease [Diabetes U.K., 2019]. People usually get in 50s, or late 40s and often they are overweight, have high blood pressure. They eat a lot of calories, they have a lot of sugar in their diet and in that case the pancreas can produce insulin, but amount of insulin is not enough to break down the glucose that the patient is eating and then go for medication [Diabetes U.K., 2019]. Type 2 diabetes can be managed with a combination of lifestyle changes, exercise, and dietary treatment, and often insulin treatments [NHS, 2021].

Case Study: Risk Factors

From the lifestyle questionnaire, I noticed that the patient age is 46, it means is in group with potential high risk of developing diabetes. Increasing age also affects glucose metabolism, as blood glucose levels spike more rapidly and take longer to return to normal in the elderly. The patient A is consuming a lot of carbohydrates which contain glucose and raise blood sugar levels.

The respondent stated that consumption of frozen food takes place 4 times a week. Trans fats in frozen meals can cause a patient to be diagnosed with high cholesterol, known as hyperlipidemia, which can increase the risk of type 2 diabetes, as well as stroke and vascular disease. The results showed that the patient's sister also had high cholesterol, indicating a recurring family history of symptoms.

The respondent said that only exercises once a month, so it is obvious that her lifestyle is sedentary. Studies have shown that a sedentary population poses a high risk of type 2 diabetes, high blood pressure and even cardiovascular disease.

The findings revealed that the patient suffers from hypertension also known as high blood pressure, the blood pressure results are 140/90 mmHg, which is higher than the normal range which should be 120/80 mmHg. It is very likely that the respondent is at risk of diabetes 2 and cardiovascular disease.

The results showed that the patient consumes 3 to 6 units of substances a day, such as alcohol, and this unhealthy daily habit can lead to chronic disease, stroke, and heart problems.

The results showed that smoking was enjoyed by the patient over a wide range, from 1 to 9 a day. Smoking is associated with the premature development of vascular disease and leads to type 2 diabetes. The relationship between smoking and the development of diabetes is not fully understood, but recent studies have shown that quitting smoking is the key to advanced diabetes prevention.

Recommendations

Diabetes type 2 can be prevented through lifestyle modifications. Healthy diet can really help, eat food which is rich in fruits, vegetables, include fish and white meat as a source of protein. The patient should ask GP to refer for nutrition or dietician where actually can have diet balance in professional settings [NHS, 2021; NIDDK, 2021].

The patient needs to be mindful and keep active for at least 0 minutes a day, healthy exercises such as cycling, jogging, or tennis, etc. must be implemented to daily routine [NHS, 2021; NIDDK, 2021].

Self-management education and support will be helpful. Keeping health care appointments can also reduce the impact of diabetes on your life.

The patient needs to reduce the amount of alcohol consumed, perhaps only drinking sporadically or on weekends to start a healthy change.

The patient should use a stop smoking service, which can be contacted through the GP, there are specialized nurses who can help with treatment and provide medications, or recommend like nicotine patches or gum, which can be purchased from a pharmacy.

Conclusion

Maintaining homeostasis is the main key to proper functioning of the body. Insulin and glucagon are involved in the regulation of glucose metabolism. Lifestyle suggestions for a patient A are likely to be affordable, safe, effective, and well tolerated by most diagnosed diabetic patients.

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