

Introduction to Physiology – Case Study 1: Diabetes

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Written Assignment (Case Study Report)

1. Introduction

Diabetes mellitus is a long-term health condition that affects the amount of glucose (sugar) in the blood. The body uses glucose for energy, but the level must stay within a healthy range. Insulin is a hormone made by the pancreas. It helps glucose move from the blood into cells. Diabetes happens when the body does not make enough insulin or when insulin does not work properly. This can cause high blood glucose, which is also called hyperglycaemia.

There are two main types of diabetes. In type 1 diabetes, the immune system attacks the cells in the pancreas that make insulin. As a result, the body makes very little or no insulin, so the person needs insulin treatment. In type 2 diabetes, the body's cells do not respond to insulin as well as they should. This is called insulin resistance. Over time, the pancreas may also struggle to make enough insulin. Risk factors for type 2 diabetes include family history, age, extra body weight and low levels of physical activity. However, it can affect people with different body shapes and lifestyles (NHS, n.d.-a; NHS, n.d.-b).

Symptoms can include feeling very thirsty, passing urine often, feeling tired, having blurred vision and wounds that take a long time to heal. Type 1 diabetes can start quickly, while type 2 diabetes may develop slowly. If diabetes is not controlled, it can damage the heart, kidneys, nerves and eyes.

This report explains how the body controls blood glucose and how glucose and oxygen help cells make energy. It also looks at ways people can manage diabetes, including healthy eating, exercise, medicines and checking blood glucose. This knowledge can help health and social care workers explain the condition and support people with their care.

2. How Blood Glucose Is Controlled

The body tries to keep its internal conditions stable. This is called homeostasis. After a meal, the body breaks down carbohydrates into simple sugars, including glucose. Glucose is absorbed from the small intestine into the blood, so blood glucose rises. The body then uses hormones to bring the level back towards normal.

The pancreas helps control blood glucose. It contains groups of cells called the islets of Langerhans. Beta cells make insulin, while alpha cells make glucagon. These two hormones have different jobs: insulin usually lowers blood glucose, and glucagon raises it when the level becomes too low.

After eating, beta cells release insulin. Insulin helps glucose enter certain cells, especially muscle and fat cells. It does this by helping glucose transport proteins, including GLUT4, move to the cell surface. Once glucose is inside a cell, it can be used to make energy. Extra glucose can be stored in the liver and muscles as glycogen. This is called glycogenesis. Insulin also tells the liver to release less glucose into the blood.

Between meals, or when a person has not eaten for some time, blood glucose may fall. The pancreas then releases glucagon. Glucagon mainly acts on the liver and tells it to break down stored glycogen into glucose. This is called glycogenolysis. The liver can also make new glucose from other substances; this process is called gluconeogenesis. The glucose is released into the blood and provides energy for the body.

Insulin and glucagon work together to keep blood glucose balanced. Other hormones, such as adrenaline and cortisol, can also affect glucose levels, especially during stress or illness.

In type 1 diabetes, many insulin-producing beta cells are destroyed. Without enough insulin, glucose builds up in the blood and the body cannot use and store energy in the usual way. The body may start breaking down fat, which produces substances called ketones. If too many ketones build up, diabetic ketoacidosis can occur. This is a serious emergency.

In type 2 diabetes, cells do not respond properly to insulin. At first, the pancreas may make extra insulin to help. Later, it may not be able to keep up, so blood glucose stays high. The liver may also continue to release glucose when the blood already contains too much.

High blood glucose over a long period can harm blood vessels and organs. It can increase the risk of heart disease, eye problems, kidney disease and nerve damage. Treatment aims to control glucose and reduce these risks while also avoiding hypoglycaemia, which means blood glucose that is too low. The best target depends on each person and their treatment (NICE, 2026).

3. The Role of Glucose and Oxygen in Making Energy

All cells need energy to work. They use energy for tasks such as muscle movement, moving substances across cell membranes, making proteins and repairing damage. Cells use a molecule called adenosine triphosphate (ATP) as a main source of usable energy. ATP is made through processes that include cellular respiration.

During cellular respiration, cells break down glucose and transfer some of its energy into ATP. When enough oxygen is available, aerobic respiration can release a large amount of energy. The overall process can be written as:



This is a simple summary of the process. Aerobic respiration has several stages: glycolysis, the link reaction, the citric acid cycle and oxidative phosphorylation.

3.1 Glycolysis

Glycolysis takes place in the cytoplasm, the fluid part inside a cell. It does not directly need oxygen. One glucose molecule is split into two smaller molecules called pyruvate. A small amount of ATP is made, as well as reduced NAD, which carries energy-rich electrons to later stages.

If there is not enough oxygen for normal aerobic respiration, pyruvate can be changed into lactate for a short time. This allows glycolysis to continue, but it makes much less ATP than aerobic respiration.

3.2 The Link Reaction and Citric Acid Cycle

When conditions allow aerobic respiration, pyruvate enters the mitochondria, which are structures inside cells. During the link reaction, pyruvate is changed into acetyl coenzyme A. Carbon dioxide is released and reduced NAD is made.

Acetyl coenzyme A then enters the citric acid cycle, also known as the Krebs cycle. This takes place in the mitochondrial matrix. A series of reactions releases carbon dioxide and produces reduced NAD and reduced FAD. These carry electrons to the next stage, where more ATP can be made.

3.3 Oxidative Phosphorylation

Oxidative phosphorylation takes place on the inner membrane of the mitochondria. Electrons move through a set of proteins called the electron transport chain. The energy released moves protons across the membrane and creates a difference in their concentration.

Protons then move back through an enzyme called ATP synthase. This helps the cell make ATP from ADP and phosphate. Oxygen is needed at the end of the electron transport chain. It joins with electrons and protons to form water. Without enough oxygen, this stage cannot work normally and much less ATP is produced.

Aerobic respiration makes far more ATP from each glucose molecule than glycolysis alone. The energy supports movement, growth, normal body functions and tissue repair (Clark et al., 2018).

3.4 Diabetes and Cell Energy

Diabetes affects how the body controls glucose, but high blood glucose does not mean that every cell is unable to take in glucose. In type 1 diabetes, there is not enough insulin to support normal glucose uptake in tissues that depend on insulin. In type 2 diabetes, insulin resistance makes the body's normal use of glucose less effective.

Some cells, including red blood cells, can take in glucose without insulin. Other tissues respond to insulin in different ways. Therefore, it is not correct to say that glucose cannot enter any cells in a person with diabetes.

When insulin is missing or does not work well, the body may break down more fat and protein to use as fuel or to make other substances. In type 1 diabetes, a severe lack of insulin can lead to too many ketones. Long-term high blood glucose in either type can also damage cells and tissues.

Oxygen is important for aerobic respiration, but diabetes is not mainly caused by a lack of oxygen. It is mainly a problem with insulin and blood glucose control. This is why treatment focuses on managing glucose and lowering the risk of complications.

4. Lifestyle, Monitoring and Diabetes Care

Managing diabetes usually involves medical treatment, information and support with everyday habits. Health and social care workers should explain the condition in clear language and consider the person's needs, choices and circumstances.

A balanced diet can help with blood glucose control. People may be advised to eat more vegetables, whole grains and high-fibre foods, and to choose suitable sources of protein. It can also help to reduce sugary drinks and highly processed foods. The amount and timing of carbohydrates can affect glucose levels, especially for people who use insulin or certain medicines. Food advice should suit the individual, because one plan will not work for everyone.

Regular physical activity can help the body respond better to insulin, support heart health and help with weight management when needed. When muscles move, they can take in more glucose. People should choose activities that are safe for their ability and health. Those taking insulin or medicines that can cause low blood glucose may need advice about checking their levels and planning food or treatment around exercise.

Stopping smoking is important because smoking raises the risk of heart and blood vessel problems. People with diabetes already have a higher risk of these problems. Healthcare workers can give support and explain how to access smoking cessation services.

Medicine depends on the type of diabetes and the person's needs. People with type 1 diabetes need insulin. People with type 2 diabetes may use lifestyle changes, tablets, injectable medicines or insulin. Patients should know what their medicines do, how to take them and which side effects or warning signs to report. They should not stop or change medication without advice from a healthcare professional.

Monitoring helps show how well diabetes is being managed. HbA1c is a blood test that gives an idea of the average blood glucose level over about two to three months. It helps the healthcare team review glucose control and treatment. How often it is checked and the target level depend on the person's situation.

Some people check their blood glucose using a finger-prick meter or a continuous glucose monitor. This may be especially useful for people who use insulin or are at risk of hypoglycaemia. However, not every adult with type 2 diabetes needs regular finger-prick testing. Monitoring should be based on treatment and individual needs (NICE, 2026).

Keeping a record of readings, meals, exercise and symptoms can help a person notice patterns. For example, high readings after meals may mean that the care plan needs to be reviewed. Low readings can be a sign of hypoglycaemia. Patients need to understand their results and know when to ask for medical advice.

Some warning signs need urgent help. Severe hypoglycaemia may cause confusion, seizures or unconsciousness. Vomiting, stomach pain, deep or fast breathing, dehydration or breath that smells fruity may be signs of diabetic ketoacidosis. These symptoms need emergency medical care.

Care should be based on the individual person. Clear information, regular reviews and support with healthy habits can help people understand their condition, follow their treatment and lower the chance of complications (NICE, 2026).

5. Conclusion

Diabetes is a long-term condition that affects the way the body controls blood glucose. It happens when the body does not make enough insulin, cannot use insulin properly, or both. The pancreas, insulin and glucagon normally work together to keep glucose levels balanced. In diabetes, this process does not work as it should.

Glucose and oxygen help cells make ATP through aerobic respiration. This energy is needed for normal body functions. Diabetes mainly affects insulin and glucose control, not the amount of oxygen in the body. If blood glucose stays high for a long time, it can damage blood vessels, nerves, kidneys and eyes.

Health and social care professionals can help people understand diabetes and make choices about their care. Advice about food, physical activity, stopping smoking, medicines and blood glucose checks should match each person's needs. Clear communication and support can help people manage diabetes more safely and protect their long-term health.

References

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