

Diving with diabetes

Definition Diabetes mellitus

Diabetes mellitus is a metabolic disease that occurs either because of an insulin resistance or an insulin deficiency and is characterised by a chronically elevated blood glucose level. This disease is associated with a significantly higher risk of serious comorbidities and secondary diseases.

Etiology

Diabetes mellitus is always caused by a disruption or a defect of the glucose metabolism. A disruption can either occur because the pancreas does not produce enough hormones (such as insulin) or because the cells do not absorb enough sugar (resistance to cellular insulin receptors). Standard value: 70 – 120 mg/dl

ICD-10 classification

E10: Primarily insulin-dependent diabetes mellitus (type 1 diabetes)

E11: Non insulin-dependent diabetes mellitus (type 2 diabetes)

Symptoms

Hypoglycaemia (< 50mg/dl): anxiety, shakiness, pale skin, sweating, loss of concentration, fatigue, adynamia, unconsciousness, fainting – coma – death

Hypoglycaemia (> 200mg/dl): elevated thirst, increased urination, dehydration, dizziness, nausea, vomiting, abdominal pain, stupor, fainting – coma – death → more relevant with regard to long-term complications

Treatment

1. Intensive insulinotherapy

Basic needs not tied to meals are covered by the long-acting basal insulin. Short-acting insulins on the other hand help to increase the blood glucose level after meals and also correct higher blood glucose levels. The insulin agents are administered via a so-called "pen".

2. Conventional insulinotherapy

A set mixture of long- and short-acting insulin at set times of the day (nowadays a seldom approach).

3. Insulin pump therapy

Similar to the intensive insulinotherapy involving a basal-bolus insulin regimen.

Criteria for fitness to dive

Who is not allowed to dive? Diabetics who:

- follow a therapy with a fixed dose of insulin
- have had hypo- or hyperglycaemia in the past year
- have severe secondary diseases as a result of their diabetes (heart, kidney, eyes)
- have not exercised at all in the past year
- got their diagnosis < 6 months ago
- started taking oral antihyperglycaemic agents < 6 months ago
- started their insulin therapy < 12 months ago
- have bad diabetes management (HbA1c > 8,5)

Who is allowed to dive? Diabetics who:

- do not have secondary diseases
- have been exercising regularly for a while
- have an inconspicuous exercise ECG
- measure their blood glucose level at least 4 times a day
- are able to adjust their carbohydrate intake and drug dose to their physical demands
- have had a stable insulin regimen for at least 1 year (HbA1c: 5,5-8,5 %)
- have not had hypo- or hyperglycaemia during physical exertion for 1 year

Normal range			
Hypoglycaemia	Before a meal	After a meal	Hyperglycaemia
< 70 mg/dl < 3,9 mmol/l	60 - 100 mg/dl 3,3 - 5,5 mmol/l	90 - 140 mg/dl 5,0 - 7,8 mmol/l	> 160 mg/dl > 8,8 mmol/l

Blood glucose levels in mg/dl and mmol/L

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Diving fitness examinations

In addition to the normal examination spectre recommended by the Society for Diving and Hyperbaric Medicine (GTÜM), you need to have the following values available: blood glucose levels of the past 6 months, current HbA1c level, results of the screening for secondary diseases and an obligatory exercise ECG, no matter your age.

It is important to know whether a diabetic wants to learn how to dive or if a diver has become diabetic.

Restrictions to the fitness to dive

- **Maximum diving depth = 30 m** (hypoglycaemia and nitrogen narcosis can be confused too easily)
- **Maximum diving time = 60 minutes** (when being physically active for more than 60 minutes, a diabetic needs carbohydrates)
- **Avoid decompression dives**
- **Avoid cave dives** (in case problems occur, especially when there are signs of hypoglycaemia, going back to the surface has to be possible at any time)
- **Avoid extremely arduous or cold dives** (the risk of hypoglycaemia is too high)
- **Take glucose gel or fluids with glucose with you** (to treat hypoglycaemia)

Children

- How independent are they in treating their diabetes?
- Pool dives are preferable, because it is always possible to get help

Practical advice

- The diving school and the dive guide should be informed
- Talk about emergency management under water beforehand
- Make sure your dive group knows the sign for hypoglycaemia („L“ sign)
- Choose a non-diabetic dive buddy
- Do not carry your insulin pump with you
- Your buddy should carry a second source of glucose gel
- Practice taking glucose gel or SCUDA (self contained underwater drinking apparatus) beforehand
- Maybe fill your SCUDA with a liquid containing glucose
- Dive in small groups
- Stay hydrated!
- If you are in danger of fainting at the surface, always inflate your BCD first and only then take glucose



After a dive, you should repeatedly **check your blood glucose levels** over a certain period of time, because hypoglycaemia can occur for up to 12 hours afterwards when the muscles replenish their glycogen stores. You have to make sure to drink enough, have emergency medication (for instance a glucagon injection kit) with you and have the possibility of getting help.

Summary

- **Hypoglycaemia** is the worst-case scenario
- **Hyperglycaemia** under water is rarely an emergency
- Clear **rules for changing the dose-response relationship** in case of anti-diabetic medication and exercise
- **Intensive theoretical and practical education** that covers all of the above-mentioned topics is a must for every **diabetic** who wants to dive
- **Intensive theoretical and practical education** that covers all of the above-mentioned topics is a must for every **diving school and diving instructor** taking a diabetic on a dive