

## Suggested assessment for divers with diabetes

(Extract from The SPUMS diving medical 2011)

### Introduction

Diving by individuals with diabetes has been one of the most controversial issues in 'fitness to dive' for several decades. A report from a joint UHMS/DAN workshop in 2005 has summarised the position.

### Diabetes and diving

Selection of appropriate individuals with diabetes (whether insulin-requiring or not) who could be recommended for diving is important because many of the acute and chronic complications of diabetes are potentially profound risks during and after diving. A brief summary of the major concerns is given in Table 1.

Complication	Potential interaction with diving
Hypoglycaemia	<ul style="list-style-type: none"> <li>- May be precipitated by stress, cold and exercise during diving</li> <li>- Potentially catastrophic consequences due to impaired mentation and consciousness underwater</li> <li>- Impending symptoms may be less likely to be noticed during diving</li> <li>- Potential for confusion with symptoms of DCI or other possible problems such as hypothermia or sea sickness</li> </ul>
Hyperglycaemia	<ul style="list-style-type: none"> <li>- May augment dehydration stress; a possible risk factor for DCI</li> <li>- May worsen outcome in neurological DCI</li> </ul>
Coronary artery disease	<ul style="list-style-type: none"> <li>- Impairment of exercise tolerance</li> <li>- Possibility of myocardial ischaemic event</li> </ul>
Resetting of hypothalamic glucose control	<ul style="list-style-type: none"> <li>- Release of adrenaline during hypoglycaemia occurs after neuroglycopenia and patient may become incapacitated before noticing hypoglycaemic symptoms: a phenomenon known as "hypoglycaemia unawareness"</li> </ul>
Autonomic neuropathy	<ul style="list-style-type: none"> <li>- Blunting of adrenaline release expected when blood glucose falls thereby worsening potential for hypoglycaemia</li> </ul>
Peripheral neuropathy	<ul style="list-style-type: none"> <li>- Possible confusion with signs of DCI</li> </ul>
Peripheral vascular disease	<ul style="list-style-type: none"> <li>- Impairment of exercise tolerance</li> </ul>
Renal impairment	<ul style="list-style-type: none"> <li>- Multiple possibilities depending on severity</li> </ul>

**Table 1. Acute and chronic complications or associations recognized in diabetes, and potential interactions with diving**

People with diabetes who are prone to acute complications (such as hypoglycaemia) or suffering chronic complications that might impact significantly on diving safety should be advised against diving. Similarly, the progressive nature of many complications of diabetes suggests there should be longitudinal health surveillance and periodic reassessment of suitability over the period of the individual's participation in diving.

**Divers with diabetes should always have immediate access to the surface and adopt a strategic approach to management of blood glucose during a diving day.**

### **Which people with diabetes may be able to dive?**

The following criteria are appropriate for recreational dive training for a candidate with diabetes:

1. Age 18 years or over.
2. At least six (6) months have passed since the initiation of treatment with oral hypoglycaemic agents (OHAs) or one (1) year since the initiation of treatment with insulin. An appropriate "observation period" must be imposed after introduction or major change of medication.
3. No hypoglycaemic episodes requiring intervention from a third party for at least one year, and no history of "hypoglycaemia unawareness".
4. HbA1c  $\leq 9\%$  when measured no more than one (1) month prior to initial assessment and at each annual review.
5. No admissions or emergency visits to hospital for any complications of diabetes for at least one (1) year.
6. No known retinopathy (worse than "background" level), significant nephropathy, neuropathy (autonomic or peripheral), coronary artery disease or peripheral vascular disease. This requires clinical judgement by both the physician managing the diabetes and the diving physician, on a case-by-case basis.
7. Prior to the first diving medical assessment (see 8) and each annual evaluation, a review must be conducted by the physician managing the candidate's diabetes, who must confirm that:
  - criteria 3–6 are fulfilled
  - the candidate demonstrates accurate use of a personal blood glucose monitoring device and
  - the candidate has a good understanding of the relationship between diet, exercise, stress, temperature and blood glucose levels.

8. Prior to commencing diving for the first time and at each annual review, a diving medical examination must be performed by a doctor who has completed a post-graduate diving medical examiners course (see Appendix A). This examination will include appropriate assessment of exercise tolerance, and for candidates over 40 years old should include an exercise ECG. The focussed report from the physician managing the diver's diabetes must be available at the time of diving medical assessment.
9. As part of the assessment by the diving medical examiner, the candidate must acknowledge (in writing):
  - receipt of and intention to use the recommended diabetic diving protocol (see below)
  - the need to seek further guidance if there is any material that is incompletely Understood
  - the need to cease diving and seek review if there are any adverse events in relation to diving suspected of being related to diabetes.
10. Steps 2–9 of this protocol must be fulfilled on an annual basis. Where possible the same diabetic physician and diving medical officer are used for these annual reviews.

### **Scope of diving**

The following restrictions are appropriate for recreational divers with diabetes:

1. Divers with diabetes should undergo training within a programme designed specifically for them.
2. Divers with diabetes are unsuitable for occupational diving, which involves focus on a task or purpose that demands attention and concentration. This will inevitably detract from self-monitoring and is not recommended.
3. Divers with diabetes should not undertake dives deeper than thirty (30) metres of seawater, dives longer than one (1) hour, dives that mandate compulsory decompression stops, or dives in overhead environments. These practices all hamper rapid access to surface support.
4. Divers with diabetes **do not undertake more than two (2) dives per day and use minimum surface interval of 2 hours.**
5. Divers with diabetes must dive with a buddy who is informed of their condition and aware of the appropriate response in the event of a hypoglycaemic episode.
6. Divers with diabetes should avoid combinations of circumstances that might be provocative for hypoglycaemic episodes such as prolonged, cold dives involving hard work.

## **Blood glucose management on the day of diving**

The following protocol is taken from the Divers Alert Network guidelines for divers with diabetes and is reproduced with permission.

Divers with diabetes (whether insulin-dependent or otherwise) should use this protocol to manage their health on the day of diving:

1. On every day on which diving is contemplated, the diver must assess him or herself in a general sense. If he or she is uncomfortable, unduly anxious, unwell in any way (including sea sickness), or blood glucose control is not in its normal stable pattern – **DIVING MUST NOT BE UNDERTAKEN.**
2. The diver should establish a blood glucose level (BSL) of at least 9 mmol.L-1, and ensure that this level is either stable or rising before entering the water. Measurements should be taken 3 times before diving: at 60 minutes, 30 minutes and immediately prior to gearing up. Diving should be postponed if blood glucose is <9 mmol.L-1, or there is a fall between any two measurements.
3. Attempts to comply with the requirements at 2 (above) should not result in a blood glucose level greater than 14 mmol.L-1, and diving should be cancelled for the day if levels are higher than 16 mmol.L-1 at any stage.
4. Divers must carry oral glucose in a readily accessible and ingestible form at the surface and during all dives. We strongly recommend that these divers also have parenteral glucagon available at the surface. If premonitory symptoms of hypoglycaemia are noticed underwater, the diver must surface, establish positive buoyancy, ingest glucose and leave the water. An informed buddy should be in a position to assist with or initiate this process.
5. Blood glucose levels must be checked at the end of every dive. The requirements for blood glucose status outlined at point 2 remain the same for any subsequent dive. In view of the recognized potential for late decrements in blood glucose levels following diving, BSL should be checked 12-15 hours after diving.
6. Divers are strongly recommended to drink between 1000 and 1500 ml of extra water over a period of several hours prior to their first dive of the day.
7. Divers must log all dives, associated diabetic interventions, and results of all blood glucose level tests conducted in association with diving.

This protocol should be combined into an information package to be given to the diabetic by the examining doctor on completion of their diving medical examination.

For more detailed information please consult the SPUMS “Guidelines on medical risk assessment for recreational diving”.

<http://www.spums.org.au/public-file-download/full-spums-medical>