

DIVING WITH DIABETES A CHANGING PERSPECTIVE?

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Medical opinions on diving with diabetes varies widely among diving physicians, from those who would consider diabetes to be an absolute contra-indication to diving, to those who believe that certain well-controlled, well-motivated and well-informed diabetics may be able to manage their diving within acceptable bounds of risk. Not surprisingly, this results in a lot of contradictory advice filtering down to divers. It is very difficult for divers and potential divers to find objective and unbiased accounts of these issues and so our recent review of this topic to the South Pacific Underwater Medicine Society has created a lot of interest¹. We have been asked to write subsequent articles in publications for dive instructors² and the general diving population³. We are pleased to make this available on the NZUA website.

Diabetes is becoming an increasingly common condition in the modern world. The NZ Ministry of Health model conservatively estimates that in 1996 approximately 81,000 were known to have diabetes. The number of people in NZ with diabetes may exceed 145,000 by 2011⁴. Approximately 10-20% of diabetics will require insulin. People with diabetes mellitus, particularly those requiring insulin, are generally considered unfit to scuba dive. The search revealed that a surprising amount of diving is conducted by diabetics. Although the data are far from definitive, there is compelling evidence that focussed, trained and carefully monitored diabetics can dive without a substantial increase in absolute risk. It could therefore be argued that the blanket exclusion of diabetics from diving is more conservative than necessary and some diabetics may be unfairly denied the opportunity to venture into the underwater world. Even worse, diabetics may bypass the system and dive without the necessary information and support from a medical professional and a scuba instructor.

This article is aimed at providing both an understanding of the complexity of the medical and practical issues surrounding diving with diabetes, and a balanced discussion of the arguments for and against diabetic diving. Several important perspectives must immediately be established. First, any arguments made in favour of diving by diabetics are **not** intended to suggest **all** diabetics should be able to dive, or that diabetics should participate in routine open-water training courses. As will be discussed, not all diabetics would be suitable, and those that were should have special training in order to dive within acceptable bounds of risk.

What is diabetes?

Insulin is a natural hormone produced by the pancreas in response to the rise in blood glucose that follows digestion of food. Insulin is responsible for allowing the uptake of glucose into our cells so it can be metabolised to produce energy. In diabetes mellitus either the body does not produce insulin (Type 1 diabetes) or the cells are insensitive or resistant to the insulin that is produced (Type 2 diabetes).

Advice for all diabetics involves modification to diet (reducing sugar and fat intake) and to take regular exercise. In addition, some diabetics (Type 2) can be treated with tablets (called oral hypoglycaemic agents) that lower the blood glucose levels. Whilst other diabetics (Type 1) need to inject insulin several times a day to control their blood glucose. Some Type 2 diabetics will eventually require insulin. Whilst we will focus mainly on those diabetics who do require insulin, Type 1, many of the comments also apply to Type 2 diabetes.

This educational article is written with the intention of making balanced information available to all individuals, particularly those involved in diver training or diver safety. You are free to download this information and print copies for wider distribution. If sections of the articles are used in other publications, they should be fully referenced with acknowledgement being given to the NZUA and the author(s) – www.nzunderwater.org.nz

In the short term, if the pancreas doesn't produce enough insulin, or the insulin doesn't work properly, cells cannot take up glucose from the blood and the blood glucose levels rise beyond normal. Normally the kidneys don't allow glucose from the blood to enter the urine, but at high blood glucose levels some eventually "spills" into the urine. The osmotic effect of the high urine glucose content results in passing a lot of urine, and this may result in dehydration. In addition, when cells cannot take up glucose they use other energy fuels such as fats. Through a complicated series of events, this can result in production of excessive acidic by-products.

In the longer term the constantly elevated blood glucose levels cause a variety of complications such as accelerated atherosclerosis (blockage of arteries) and damage to the kidneys, the peripheral nerves, and the retina of the eyes. It follows that diabetics are more prone to heart attacks and strokes, kidney failure, and progressive deterioration in vision and peripheral sensation. Those diabetics who achieve better control of blood glucose levels are less likely to develop these complications, and many motivated diabetics can lead "near normal" lives.

Concerns about diving with diabetes:

The argument against diving by diabetics is based on 3 concerns: Firstly, hypoglycaemia underwater which could lead to unconsciousness and drowning; hyperglycaemia which could cause dehydration and a theoretically increased risk of decompression illness (DCI); Secondly, the effect of long term complications which might include reduced exercise tolerance; Thirdly practical difficulty in differentiating between symptoms of these complications and symptoms of decompression illness (DCI). These problems are expanded below.

HYPOglycaemia (low blood glucose).

Insulin dependent diabetics are prone to suffering low blood glucose if they administer too much insulin relative to their intake of food. The cells of the brain need a constant supply of glucose. If glucose levels fall significantly, there may be tiredness, lack of concentration, hunger, confusion, sweating, trembling, headache, nervousness and palpitations. If not given glucose, unconsciousness follows. Hypoglycaemia can occur at 3 important times in relation to diving activities. First and most importantly, hypoglycaemia can occur during the dive. Cold, stress and exercise have all been shown to precipitate hypoglycaemia, and the onset may be insidious since the early symptoms can be difficult to recognise underwater. This is potentially catastrophic since unconsciousness is likely to lead to drowning. The possibility of hypoglycaemia underwater is one of the strongest arguments against diving by diabetics. Second, hypoglycaemia may occur after a dive as glucose has been used up during the dive activity, and the symptoms may be difficult to distinguish from symptoms of decompression illness (DCI). Finally, blood glucose levels can fall dramatically during the night following diving. This can result in potentially dangerous hypoglycaemia during the night.

HYPERglycaemia (high blood glucose).

Hyperglycaemia can affect the diabetic diver in two ways. Firstly, the spill-over of glucose into the urine causes loss of larger volumes of water, and can lead to dehydration, a theoretical risk factor in DCI. Secondly, as with all insulin-dependent diabetics deprived of insulin, the production of acidic by-products of fat metabolism can cause a dangerous state known as ketoacidosis. It must be said that a diabetic in this state would be unlikely to present him or herself to go diving.

Complications.

Chronic complications of diabetes such as arterial disease in the heart may reduce the diver's ability to exercise effectively. In addition, other chronic effects such as changes in sensation and visual changes may complicate assessment of the diver in the event that they are suspected of suffering DCI. Perhaps not surprisingly, the weight of medical opinion during the 1980's and 1990's has inclined to the view that diabetics should be advised against diving.

The current (1992) South Pacific Underwater Medicine Society (SPUMS) policy states “Diabetes requiring medication with insulin is a contraindication to diving”⁵. Most diving fitness policies issued by underwater medical organisations around the world concur with this stance.

Has the problem been over stated?

Many of the concerns described above are based on theory and a small number of case reports in which dives by diabetics have ended adversely. In contrast, there is a growing body of evidence suggesting that despite the apparent risks, some diabetics do dive, and are diving with similar rates of adverse events to those of the general diving population.

- A questionnaire by Divers Alert Network (DAN) published in Alert Diver was completed by 110 diabetics, 79 of whom were using insulin⁶. The respondents had a history of 48,663 dives between them. 15 % had experienced hypoglycaemia whilst diving but no episodes had ended adversely. There was only one reported case of DCI, which was an air embolism.
- The British Sub Aqua Club (BSAC) Medical Committee decided in 1991 that certain diabetics may be allowed to dive in controlled circumstances provided that they are able to pass the standard BSAC medical examination and satisfy additional criteria relating to their diabetes⁷. Up to the year 2000 the BSAC register contained 230 diabetic divers⁸, with 5348 recorded dives and only 11 cases of reported hypoglycaemia (7 not related to diving)⁹. All cases of hypoglycaemia were recognised and managed without incident.
- Customised training courses have been developed for diabetic divers, such as that described by Lerch et al¹⁰. The emphasis is on the management of blood sugar levels pre and post dive with adjustments to carbohydrate intake and insulin doses being made as appropriate. In 77 dives on Lerch’s course, conducted in tropical waters, there were no cases of in-water hypoglycaemia.
- A study of 16 diabetic divers using insulin on a tropical diving holiday revealed no cases of hypoglycaemia in the 131 dives monitored (Ugiccioni et al¹¹).

While some of these data are potentially subject to significant bias, they do indicate that properly focussed diabetics can and do dive with an apparently acceptable level of risk.

The way ahead

Any suggestion that all diabetics should be allowed to dive, or that a standard open water course is sufficient training is **not** supported by the data available. If some diabetics are to dive, the focus must be on development of appropriate selection and training protocols. Unfortunately, this is not going to happen overnight, but what follows is our “vision” for a system that would select appropriate diabetics and provide them with the training they need to dive with an acceptable level of risk.

Selection: A thorough medical assessment from a diving physician would be essential so that the risks of diving can be assessed and fully explained. The assessing diving physician would require a detailed report from the candidate’s diabetologist or endocrinologist describing their level of glycaemic control and the status of any diabetic complications. The degree of risk will vary considerably between diabetics. Those with poor glucose control, recurrent hypoglycaemia, or prominent complications will not be suitable for diving, irrespective of appropriate training. Equally, those with excellent control, no recent hypoglycaemia, and no obvious complications will have a risk level that could be considered “acceptable” (given proper training) and they may choose to accept those risks.

The BSAC considers any approval to undertake diving to be valid for only one year, due to the need for re-evaluation of potentially progressive diabetic complications. This system of annual medicals would seem sensible for all diabetic divers.

Training: We believe that the currently available data does support diving by selected diabetics who complete diver training specifically tailored to diabetics, conducted by an Instructor who has a special knowledge and interest in diabetic diving, and perhaps augmented by several sessions with a medical professional with knowledge of diving medicine. The blueprint for such a course already exists¹⁰ with the priority focus on blood glucose monitoring and reactive adjustments of insulin, carbohydrate and fluid intake.

Summary:

The data available suggests that some diabetics may dive without a substantial increase in absolute risk. As well as strict selection criteria and specialised training, ongoing monitoring of the diver's activities and any problems, coupled with a regular medical reassessment of their diabetes would be essential if the risks of diving with diabetes are to be contained within acceptable boundaries.

If you are a diabetic who does dive, we invite you to complete a confidential questionnaire, or make contact with the authors, via the NZUA website www.nzunderwater.org.nz

Further information:

For individual professional medical advice contact a doctor who has the appropriate knowledge and training in diving medicine. A list of doctors who have additional training in diving medicine can be found on the SPUMS website¹².

References

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