Diabetes and diving: where to now for SPUMS?

Michael H Bennett

Key words
Diabetes, scuba diving, safety, fitness to dive, medical conditions and problems

Abstract

(Bennett MH. Diabetes and diving: where to now for SPUMS? *Diving and Hyperbaric Medicine*. 2006; 36: 220-5.)
The current guidelines of the Society explicitly preclude insulin-dependent diabetics from undertaking scuba diving. This stance is based on a perception that diabetics are at high risk of serious injury or death as a result of diabetic end-organ complications or unanticipated hypoglycaemia. It is also possible that some symptoms of hypoglycaemia may mimic decompression illness. In reality, however, several dive training organisations have developed programmes that allow some insulin-dependent diabetics to dive. These programmes seem to be highly successful and several formal reports suggest that, when using strict guidelines, there is a low incidence of problematic hypoglycaemia in these divers. This address to the SPUMS ASM in 2006 suggests that we should carefully consider these programmes and critically re-examine our position.

This talk on diving with diabetes largely summarises the recommendations of the DAN/UHMS Workshop held in June 2005, in which Simon Mitchell and I participated.[1] The executive summary and guidelines promulgated from that meeting were reprinted earlier this year in this journal.[2] We are discussing only recreational diving, so nothing in this address has any direct bearing on occupational diving. To begin with, I will discuss briefly the potential problems faced by diabetics who wish to dive.

There are four potentially problematic areas for divers with diabetes. First, the seriousness of hypoglycaemia underwater leading to a reduced level of consciousness and clouding of judgement is obvious to anyone here. Many insulin-dependent diabetics are unaware of impending important hypoglycaemia, and this has been one of the real sticking points for those of us who have been generally against this kind of activity for people with diabetes.

Second, thermal and exercise stress while diving can develop unpredictably, so anticipating needs and modifying insulin doses and/or sugar intake correctly can be difficult. Third, there is also a clear potential for symptomatic hypoglycaemia to be confused with decompression illness and vice versa.

Finally, hyperglycaemia may be a problem, although it seems unlikely that a diver would be getting to that state and still be diving. People with diabetes who run high blood sugar levels (BSLs), many of them non-insulin dependent, are prone to a wide range of complications and end-organ damage that might compromise their ability to dive safely. Dehydration from osmotic diuresis if running at high BSLs, may increase the risk of decompression sickness.

Therefore, there are problems if BSLs are either too low or too high, so if we are going to be positive about diving with diabetes, then this must involve pretty tight control of BSLs. The chronic complications and end-organ damage common in the diabetic population will also impact on their 'fitness to dive'.

The current SPUMS diving medical form states, "*Diabetes requiring medication with insulin is a contra-indication to diving.*"[3] On the SPUMS website there is a statement on diabetes, which contains much of a general nature to non-medical specialists as well as a clear direction to members of the Society regarding diabetes.[4] In parts, this states,

> "*Physicians who are sympathetic…often quote examples of world-class athletes who have diabetes…the diving environment is totally different from the athletic field or tennis court…On the athletic field, the blood glucose level can be easily maintained…consumption of (sugar) in the course of a dive is not as readily achieved.*
> *There are occasions when (diving) becomes exceedingly stressful and there is a need for unplanned, severe, sustained exercise. A diabetic whose blood sugar is controlled either with insulin or other oral agents would be incapable of maintaining such an exercise level and should be guided into less exacting pursuits.*
> *The insulin-dependent diabetic is prone to hypoglycaemia resulting in loss of consciousness and decompression illness and consequently should be advised against diving.*"

It probably will not surprise you to know that there are plenty of people with diabetes out there diving. There are organisations, some such as Camp DAVI (run by the Diabetic Association of the Virgin Islands) in existence for many years, that hold regular diving training for people with diabetes. Other examples on the Web are the Utila Community Clinic in Honduras (<http://www.aboututila.com/ScubaInfo/Diabetic-Scuba-Diver-Protocol.doc>), the YMCA (<http://www.ymcascuba.org/ymcascub/diabetic.

html>) and the British Sub-Aqua Club, where Dr Chris Edge has been an active promoter (<http://www.ukdiving.co.uk/information/medicine/diabetes.htm>).

As a Society we last reviewed the subject of diving with diabetes at the 2000 ASM.[5] It was pointed out that there are many people with diabetes who dive, apparently with a low risk of adverse events. Mitchell and Taylor in their paper advocated a review of the Society's absolute medical edict against diving with diabetes. The Diabetes Australia statement in 1994 on diving and diabetes was consistent with the SPUMS position. Recently, however, Diabetes Australia asked Simon Mitchell and me to provide them with a summary of the current thinking and data in the field. Their medical advisory panel is now considering the DAN/UHMS recommendations and guidelines, which (in a slightly modified form) is what we submitted rather than the SPUMS statement.

Let us review what is happening around the world. In the USA, there are several organisations actively promoting diving in insulin-dependent diabetes; the YMCA has a published protocol for divers with diabetes and there is an SSI programme available. Camp DAVI has been operating since the late 1980s with about 700 dives reported, and has developed some very detailed protocols (<http://www.diabetesnet.com/visle.php>). Participants must have an HbA_{1c} running at less than 9% and no symptomatic hypoglycaemic events requiring treatment or requiring third-party intervention for one year.

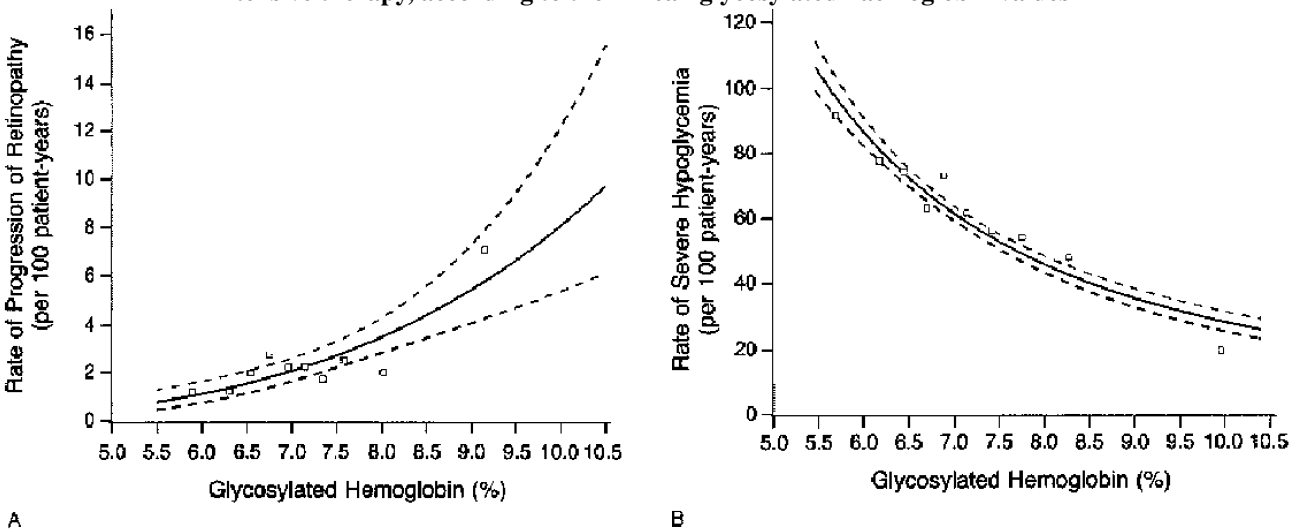
The goal BSL they are looking for is 8 to 10 $mmol.l^{-1}$ immediately prior to diving. BSLs are measured at 60 and 30 minutes and immediately pre-dive, and the BSL must have been rising or stable across that time. All diving is restricted to no-decompression diving, and participants must carry a glucose source. Their ideas were based on those of medical advisors in the diabetic field, which in turn were based largely on data from the Diabetes Control and Complications Trial Research Group in 1993.[6] In essence, the tighter you run your control, the lower your HbA_{1c}, the greater chance you have of a symptomatic hypoglycaemic event. On the other hand, retinopathy and most of the other complications of diabetes are much less common when you have tight glycaemic control. So, this is a balance between two differing needs, one short-term and one long-term.

DAN published guidelines in 2005 that are very similar to those of the DAN/UHMS Workshop (Table 1[1]) and Camp DAVI. From 1997 DAN has been running an observational study of 83 divers: 43 well-controlled insulin-dependent diabetic divers having a total of 555 dives and a control group of 40 divers having 504 dives.[7] No symptomatic hypoglycaemic events were recorded, but 7% of the divers with diabetes had a blood sugar of less than 4 $mmol.l^{-1}$ at some stage. Interestingly 1% of the non-diabetic divers also recorded BSLs of less than 4 $mmol.l^{-1}$.

Both the French and British have published guidelines as have a number of other countries. A British database going back to 1991 documented 447 divers, with a median HbA_{1c} of 7.6%, who recorded 14,000 dives.[8] There were two deaths reported, both in non-insulin-dependent diabetics. One was a middle-aged man who suffered a myocardial infarction. The other death in a fit, young person remains unexplained, and so is worrying. There was only one symptomatic hypoglycaemic episode during a dive, which was treated underwater with ingestion of glucose paste.

It is fair to point out that SPUMS has taken no action since 2000. Now the word is out on the street, there are literally dozens of websites where diabetics are saying "Now we

Figure 1
Risk of sustained progression of retinopathy (A) and rate of severe hypoglycaemia (B) in the patients receiving intensive therapy, according to their mean glycosylated haemoglobin values[6]



can go diving". One increasingly important issue will become the application of the anti-discrimination and equal-opportunities legislation to our refusing to entertain people with diabetes diving. Clearly the current SPUMS position on diabetes and diving has become very different to that of much of the rest of the world. The question arises as to what the Society should do?

The sensible course would be to have an appropriate group of interested people, knowledgeable in the area, review all

Table 1
Guidelines for recreational diving with diabetes - summary form*

Selection and surveillance
- Age >=18 years (>=16 years if in special training program)
- Delay diving after start/change in medication
  - 3 months with oral hypoglycaemic agents (OHA)
  - 1 year after initiation of insulin therapy
- No episodes of hypoglycaemia or hyperglycaemia requiring intervention from a third party for at least one year
- No history of hypoglycaemia unawareness
- HbA_{1c} <= 9% no more than one month prior to initial assessment and at each annual review
  - values > 9% indicate the need for further evaluation and possible modification of therapy
- No significant secondary complications from diabetes
- Physician/Diabetologist should carry out annual review and determine that diver has good understanding of disease and effect of exercise
  - in consultation with an expert in diving medicine, as required
- Evaluation for silent ischaemia for candidates > 40 years of age
  - after initial evaluation, periodic surveillance for silent ischaemia can be in accordance with accepted local/national guidelines for the evaluation of diabetics
- Candidate documents intent to follow protocol for divers with diabetes and to cease diving and seek medical review for any adverse events during diving possibly related to diabetes

Scope of diving
- Diving should be planned to avoid
  - depths > 100 fsw (30 msw)
  - durations > 60 min
  - compulsory decompression stops
  - overhead environments (e.g., cave, wreck penetration)
  - situations that may exacerbate hypoglycaemia (e.g., prolonged cold and arduous dives)
- Dive buddy/leader informed of diver's condition and steps to follow in case of problem
- Dive buddy should not have diabetes

Glucose management on the day of diving
- General self-assessment of fitness to dive
- Blood glucose (BG) >=150 $mg.dl^{-1}$ (8.3 $mmol.l^{-1}$), stable or rising, before entering the water
  - complete a minimum of three pre-dive BG tests to evaluate trends
    - 60 min, 30 min and immediately prior to diving
  - alterations in dosage of OHA or insulin on evening prior or day of diving may help
- Delay dive if BG
  - < 150 $mg.dl^{-1}$ (8.3 $mmol.l^{-1}$)
  - > 300 $mg.dl^{-1}$ (16.7 $mmol.l^{-1}$)
- Rescue medications
  - carry readily accessible oral glucose during all dives
  - have parenteral glucagon available at the surface
- If hypoglycaemia noticed underwater, the diver should surface (with buddy), establish positive buoyancy, ingest glucose and leave the water
- Check blood sugar frequently for 12-15 hours after diving
- Ensure adequate hydration on days of diving
- Log all dives (include BG test results and all information pertinent to diabetes management)

* For full text see: Pollock NW, Uguccioni DM, Dear GdeL, editors. *Diabetes and recreational diving: guidelines for the future*. Proceedings of the UHMS/DAN 2005 June 19 Workshop. Durham, NC: DAN; 2005.

the implications of adopting some or all of the guidelines and recommendations of the DAN/UHMS Workshop. Such a group would consist of diving physicians and diabetologists. I was convinced by the legal experts and the patient pressure groups at the DAN/UHMS Workshop that it would be very sensible to involve them in this process too. This fits best into a risk-assessment framework, which would move the Society, in Des Gorman's words, "from policeman to health adviser."

References

1 Pollock NW, Uguccioni DM, Dear G de L, editors. Undersea and Hyperbaric Medical Society and Divers Alert Network. Diabetes and recreational diving: guidelines for the future. *Workshop Proceedings June 19 2005*. Durham, NC: DAN Publications; 2005.

2 Pollock NW, Uguccioni DM, Dear G de L, eds. Diabetes and recreational diving: guidelines for the future. Guidelines and executive summary reprinted in: *Diving and Hyperbaric Medicine*. 2006; 36: 29-34.

3 The SPUMS diving medical. <www.SPUMS.org.au> South Pacific Underwater Medicine Society; 1991, revised 1999. (last accessed 15 December 2006).

4 SPUMS statement on diabetes. <www.SPUMS.org.au> South Pacific Underwater Medicine Society. (last accessed 15 December 2006).

5 Mitchell S, Taylor L. Should old dogma give way to new evidence. *SPUMS J*. 2001; 31: 44-50.

6 The Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Engl J Med. 1993; 329: 977-86.

7 Dear G de L, Pollock NW, Uguccioni DM, Dovenberger J, Feinglos MN, Moon RE. Plasma glucose responses in recreational divers with insulin-requiring diabetes. *Undersea Hyperb Med*. 2004; 31: 291-301.

8 Edge CJ, St Leger Dowse M, Bryson P. Scuba diving with diabetes mellitus – the UK experience 1991-2001. *Undersea Hyperb Med*. 2005 ; 32: 27-37.

Associate Professor Michael Bennett, MD, FANZCA, MM(Clin Epi), is Senior Staff Specialist,
Department of Diving and Hyperbaric Medicine,
Prince of Wales Hospital,
Barker St, Randwick, NSW 2031,
Australia
Phone: *+61-(0)2-9382-3880*
Fax: *+61-(0)2-9382-3882*
E-mail: *<m.bennett@unsw.edu.au>*

Audience participation

Haller, Victoria: I think it is a great idea putting some of the onus back onto the diver, rather than on the medical practitioner and the diving instructing people. If a diabetic diver from, say, Europe comes to Australia, who then takes the onus if they run into any diving problems and in looking after their diabetes?

Bennett, Sydney: I don't have the answer to that, I don't know if someone else in the room does?

Standon, Australia: As a dive-shop operator, as long as they have a certification card, I assume that they have been trained appropriately and they have the appropriate awareness and I take them diving.

Bennett, Sydney: What would you do if they came in and said here's my insulin, here's my dive card?

Standon, Australia: I would then have issues with whether or not my staff are trained to look after these people and, taking that on board, telling them that I either do or do not have the staff trained appropriately. Most of them have a basic awareness, but certainly trying to give insulin injections or anything like that…All they could do is shove a few jellybeans down their throat. Apart from insurance and duty-of-care considerations, it's not really a problem. Once again, they have been trained, they have their certification card, they should be aware of their condition and its ramifications and we will do whatever we can to help them.

Bennett, Sydney: It should be said, though, that someone doing that would clearly be diving outside those guidelines, because they would be concealing it from the dive leader, the dive group organiser.

Henderson, USA: One thing that came to mind for me as far as the discrimination issue is concerned, is what does Australia, New Zealand and the States do for pilots who are diabetic? It would seem to me that if these countries have imposed limitations for pilots who are diabetic one could adopt those guidelines, or parts of those guidelines, and hopefully avoid some of the discrimination issues that might arise.

Bennett, Sydney: You are absolutely right and there was a representative from the aviation authorities, who was a specialist in that area, at the Workshop. A lot of the recommendations were based on criteria for holding a private pilot's licence. I am not sure about professional pilots.

Meehan, Cairns: In Queensland, all certified divers have to fill out a declaration form, declaring if they have any medical illness or condition, or if they are on medications. So anyone who is an insulin-dependent diabetic is identified and the situation there is that we are regularly called for advice. It is