

Diabetes and diving: where to now for SPUMS?

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Key words

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

Abstract

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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.ymascuba.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

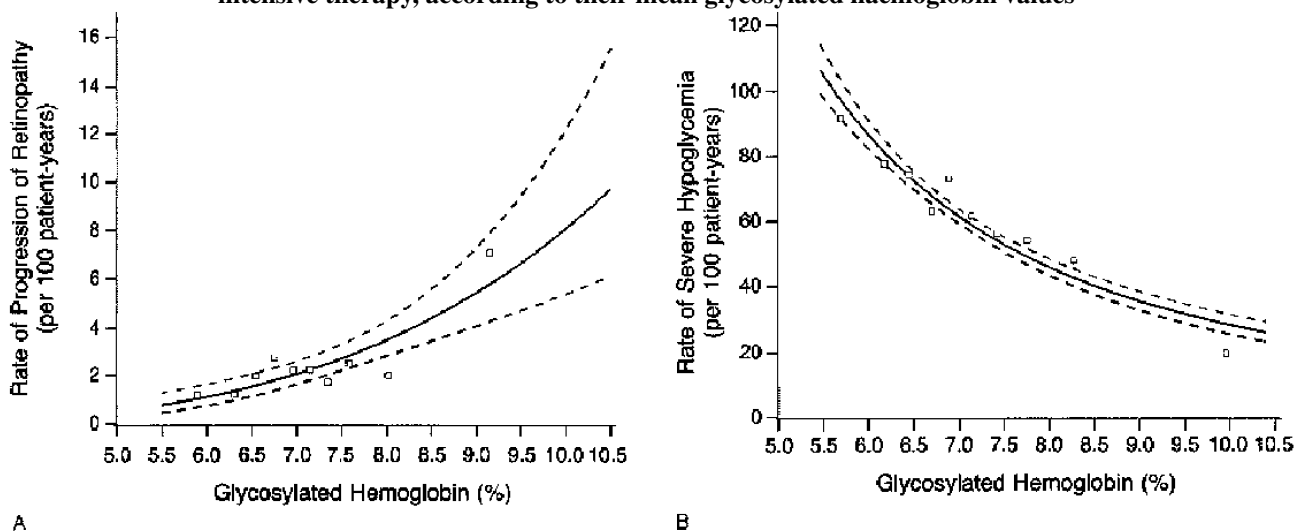
must carry a glucose source. Their ideas were based on those of medical advisors in the diabetic field, which in turn were based largely on data from the Diabetes Control and Complications Trial Research Group in 1993.⁶ In essence, the tighter you run your control, the lower your HbA_{1c}, the greater 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 1¹) 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 values⁶



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
- $HbA_{1c} \leq 9\%$ 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."

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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

very much you follow the guidelines; the dive instructor or the dive team leader does need to know they're diabetic and does need to have training in how to look after those divers, and the diver has to have their own buddy who knows how to look after them. Are there any PADI schools in Australia who are going to teach dive instructors and divers to dive effectively with diabetes?

Richardson, PADI Worldwide: I don't believe so. Mike, you have laid down the gauntlet here as you normally do, and I see an opportunity here for the Society. This is a closeted issue, just like asthma. I understand that there is an increasing problem with both asthma and latent diabetes in the developed world, obesity and lots of allergens and so on. So there is a likelihood of more people doing their own web search, and the diving instructional community really does not have first-hand expertise. There's certainly a call for educational seminars. I am positive that our operators would love to attend if they were led by informed physicians; Dr Chris Edge has demonstrated that in the UK.

I was just thinking that a useful tool for the individual diver would be some sort of work slate. We developed one for dive accident management some years ago. If SPUMS wanted to it could develop an algorithm, the world might applaud that. I think this is food for thought. Alternatively you could simply say do not dive, which would save a lot of trouble! However, there is a growing clientele of sport divers and diving instructors who might be very interested in algorithm flow charts for both asthma and for diabetes. Right now people are doing that on their own. You might make a very relevant impact on the recreational diving community.

Fulton, New Zealand: As a GP, if I had a patient whose HbA_{1c} was consistently up around 9%, I would think that that patient was very poorly controlled. Should it not be tightened up more than that?

Bennett, Sydney: There were certainly plenty of people at the Workshop who would agree with you. The people who actually work most with divers with diabetes suggested that making it much tighter than that would unreasonably limit the number of people who could get into the water. They have had that group diving quite successfully and did not see why they should be excluded. Everyone agreed that poorly controlled diabetics shouldn't be in the water, so we came out with this compromise number of [HbA_{1c}] 9%, but it is absolutely open to debate and interpretation. I actually started off by suggesting less than 6%, which was shouted down with howls of derision as being far too tight, too restrictive.

Long, NSW: I'd like to follow up what Fulton said. Recommendations for good diabetic control are now less than 7% and the reason for those recommendations is to avoid end-organ disease. So there is an implication in what you are saying that so these guys can dive it does not matter if they get retinopathy at the end of it all. That is the implication

of bringing the number up, when there has been a big drive to get everybody below 7%.

Christie, Victoria: Obviously people who have diabetes and who meet those guidelines are going to need some kind of extra education and training about their diabetes before they actually dive. I wonder is there any specification in the guidelines, about whether it would be the diving instructor, the diving doctor doing the dive medical or in fact a combination of both who would have that responsibility?

Bennett, Sydney: No, we did not deal with that. At the moment, with these specialised groups, this function is taken on by diving instructors, usually with diabetes, who have developed the strong interest in it and have involved diving doctors and diabetologists to advise them on the details. It is difficult to see how that could work over a whole system where diabetics were going to have free access to every dive school in the country. The suggestion by Simon Mitchell and Lynn Taylor was that you would need to run special courses. However, the industry pointed out how difficult that would be to get off the ground. So I do not think anyone knows the answer to how you are going to integrate into dive training in Australia at least.

Waterson, Narimbula: Just a comment on the HbA_{1c}; the 9% figure seemed to come out of that Virgin Islands project which, from the website you showed, included teenagers. In general, teenagers run with higher HbA_{1c} measurements because they are usually less reliable at that stage of their lives and I guess they are less concerned about retinopathy and nephropathy when they are 16 years old. In my experience, endocrinologists are happy with their teenagers running higher because of hypos being such an issue in the growth period. I wonder if that is where that leniency came from?

Bennett, Sydney: You are probably right. I take your point, but it is a guideline for who should be allowed to dive, not a recommendation for diabetic management. However, if there is a potential for it to be interpreted that way then maybe we should think carefully about how we put it, even if we let that number in.

Acott, Adelaide (President SPUMS): In your recommendations you suggested gathering a few people together to put recommendations to the SPUMS Committee. As President of the Society, I want to know when are you going to start?

Bennett, Sydney: Well, once we've discussed the budget, I'll get underway.

Acott, Adelaide: What budget?

Smart, Hobart: There is a huge logistical issue in the actual medical process for this, and it is likely to be expensive for the diver. That aspect is going to have to be taken

into account. It is certainly going to be a problem for any international divers who are diabetic coming to Australia and their primary physician is back in another country and they want the quick dive medical for their Great Barrier Reef holiday they have paid \$20,000 for.

I like Drew's idea with the slates, but we also need information in terms of a calculation of risk. I believe that in this circumstance family members would need to come in as the risk sharers and understand what is going on. Finally, information for dive buddies is essential. It is okay to release guidelines, but the practical implications of the operation are going to be huge.

Meehan, Cairns: In Cairns there are a couple of dive instructors who are trained through the International Association of Handicapped Divers from Europe, and my understanding is that in that Society they do train instructors to train divers who have diabetes, plus a whole lot of other issues. Does PADI provide courses for certain instructors to train people with certain medical conditions or handicaps?

Richardson, PADI Worldwide: We cooperate with the International Association for Handicapped Divers. What I am suggesting is, it depends whether SPUMS wishes to evolve guidelines and integrate these into the diving community or not. If you wanted to create a model like that, I can assure you that PADI would cooperate fully in getting the word out to divers and diving professionals and try to bring them to educational sessions. The problem now is that there are all these opinions and guidelines floating around the Internet and elsewhere that are not really harmonised and people are taking matters into their own hands. If you feel that you want to evolve guidelines, with Australia as a model, I am sure Henrik [Nimb] and his training department at PADI could do a lot to help you along those lines locally.

Sharp, Perth: In the UK system diabetic divers have both the UK medical form and a diabetic form they must fill out, and which the GP has to fill out, as well as this other diabetic form which the GP and the endocrinologist also complete. That all goes to Dr Chris Edge or Dr Phil Bryson for review. Many of the UK sport-diving medical referees thought that it was all just too much hard work. In England, the Sports Diving Medical Committee medical questionnaire is done every year, so the auditing workload is considerable. After 14 years, Dr Edge said he had had enough, let the diabetics dive, here are our guidelines.

Davis, New Zealand: Thank you everyone who has contributed. I think we do need to set up a group, and the issue of funding for that is a genuine one. Mike's comment about that was not facetious at all. Perhaps through the Diabetes Society is the way to seek at least partial funding for setting up a joint committee to investigate these issues. That would be my feeling. I think Drew's idea of a slate is a very sensible one. Slates like that do work from a practical point of view and that gives us a new path for SPUMS to explore in assessing the data. I don't think there is much doubt that, as a diving medical society, we do have to change our stance. It will be interesting to see how this develops.

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