Review article

Recreational diving in persons with type 1 and type 2 diabetes: Advancing capabilities and recommendations

Johan H Jendle[1,2], Peter Adolfsson[2,3,4], Neal W Pollock[5,6]

[1] *School of Medicine, Institution of Medical Sciences, Örebro University, Örebro, Sweden*
[2] *Diabetes Endocrinology and Metabolism Research Center, Örebro University, Örebro, Sweden*
[3] *Department of Pediatrics, The Hospital of Halland, Kungsbacka, Sweden*
[4] *Institute of Clinical Sciences, Sahlgrenska Academy at University of Gothenburg, Gothenburg, Sweden*
[5] *Department of Kinesiology, Université Laval, Quebec, Canada*
[6] *Centre de médecine de plongée du Québec, CISSS Chaudière-Appalaches (CHAU-Hôtel-Dieu de Lévis) Levis, Québec, Canada*

Corresponding author: *Professor Johan H Jendle, Institution of Medical Sciences, Örebro University, Campus USÖ, SE-70182 Örebro, Sweden*
johan.jendle@oru.se

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Abstract

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Diving by persons with diabetes has long been conducted, with formal guidelines published in the early 1990s. Subsequent consensus guidelines produced following a 2005 workshop helped to advance the recognition of relevant issues and promote discussion. The guidelines were intended as an interim step in guidance, with the expectation that revisions should follow the gathering of additional data and experience. Recent and ongoing developments in pharmacology and technology can further aid in reducing the risk of hypoglycemia, a critical acute concern of diving with diabetes. Careful and periodic evaluation remains crucial to ensure that participation in diving activity is appropriate. Close self-monitoring, thoughtful adjustments of medications and meals, and careful review of the individual response to diving can assist in optimising control and ensuring safety. Open communication with diving partners, support personnel, and medical monitors is important to ensure that all are prepared to effectively assist in case of need. Ongoing vigilance, best practice, including graduated clearance for diving exposures and adverse event reporting, are all required to ensure the safety of diving with diabetes and to promote community understanding and acceptance.

Introduction

Diabetes has the potential to promote acute changes in consciousness, making it at least a relative contraindication for many activities. While the non-breathable medium does increase the risk of scuba diving for all participants, and even more for persons susceptible to altered levels of consciousness, there is also a long history of persons with diabetes participating in scuba diving activities with a reasonable record of safety. Societal pressure to eliminate unnecessary barriers to participation has led to expanded consideration of risk and risk mitigation.

Healthy individuals maintain plasma glucose in a range from 4–8 mmol·L^{-1} (72–144 mg·dL^{-1}), relying in large part on endogenous insulin to regulate the movement of glucose into cells. Diabetes mellitus is a chronic disease characterised by insufficient insulin production (type 1 diabetes; T1D) or ineffective response to this hormone (insulin resistance; type 2 diabetes; T2D). Combinations of insulin resistance and reduced insulin production are also possible. It is currently estimated that there are 420 million people suffering from diabetes worldwide, with the number expected to exceed 500 million by 2030. Approximately 90% of the individuals are diagnosed with T2D and 10% with T1D, however, there are regional differences in the prevalence of diabetes.[1] Diabetes management involves the individualised application of diet, physical activity, and medical treatment to promote good glucose control, intended to avoid both acute and chronic complications.

T1D is treated with multiple daily injections, a mixture of basal and prandial insulin boluses, or through continuous subcutaneous insulin infusion (CSII) with insulin pumps. Most individuals with T1D benefit from rapid-acting insulin analogs in combination with basal insulin analogs to reduce the risk of hypoglycaemia.[2] Education and awareness are important to help patients manage ongoing challenges of variable meal content, physical activity, sickness, stress, and for women, menstrual cycle effects. Dose adjustments may be needed to manage the variables, and the delay between subcutaneous injections and the glucose lowering effect requires individuals to both understand the physiological relationships and plan ahead to effectively maintain glucose control.[3]

T2D is characterized by insulin resistance in combination with a progressive loss of β-cell insulin secretion. Metformin is the preferred initial pharmacologic treatment agent. Once initiated, metformin therapy should be continued as long as it is tolerated and effective. Other agents, including insulin, can be added to a metformin regimen as required. Early introduction of insulin is considered if there is evidence of ongoing catabolism (weight loss), frequent symptoms of hyperglycaemia, or frequent periods of plasma glucose ≥ 16.7 $mmol{\cdot}L^{-1}$ (300 $mg{\cdot}dL^{-1}$) or HbA_{1C} levels > 86 $mmol{\cdot}mol^{-1}$ (10%).[2] Patients with newly diagnosed T2D with poor glycaemic control, evidenced by HbA_{1C} ≥ 113 $mmol{\cdot}mol^{-1}$ (12.5%) or 5 $mmol{\cdot}mol^{-1}$ (1.5%) above their target, may benefit from initiated treatment with metformin in combination with insulin.[3]

A patient-centered approach guides the individual prescription of glucose lowering agents. Considerations include different comorbidities. Patients with T2D who have established cardiovascular or chronic kidney disease may benefit from modern glucose lowering agents such as sodium glucose cotransporter-2 inhibitors (SGLT-2 inh) or glucagon-like peptide-1 receptor agonists (GLP-1 RA). GLP-1 RAs are preferred to insulin for most patients with T2D who need the greater glucose-lowering effect of an injectable medication while avoiding an elevated risk of hypoglycaemia.[4]

The obvious primary acute concern regarding physical activity of persons with diabetes who require glucose lowering agents for control is hypoglycaemia, which can impair cognitive function and consciousness. Hyperglycaemia can also impair cognitive function, and persistent hyperglycemia can lead to an increase the risk of long-term diabetes complications, including cardiovascular disease, renal failure, and vision impairment.

The risk of cardiovascular events must also be taken under consideration as a critical component of surveillance and screening in persons with diabetes. Candidates with significant co-morbidities or secondary complications should not be cleared to participate in diving activities. This applies to those with either T1D or T2D. Discussion of selection and surveillance is beyond the scope of this paper.

Improving glycaemic control in patients with T1D substantially reduces the risk of microvascular complications and cardiovascular disease.[5,6] Weight loss and exercise or, in more extreme cases, bariatric surgery will assist in achieving better glycaemic control in patients with T2D.

Diabetes treatment guidelines emphasise the value of good glycaemic control to mitigate the risk of cardiovascular complications.[7] Good glycaemic control is also important for T2D individuals to reduce the risk of cardiovascular disease.[8] It has been shown in persons with T2D that despite a mean glycated hemoglobin level of 7% or less (≤ 52 $mmol{\cdot}mol^{-1}$) and an age of less than 55 years, the excess risk of death was still approximately twice as high as the risk among controls.[9]

The risk of cardiovascular events should be evaluated in both T1D and T2D subjects, weighing the separate risk factors for cardiovascular disease, in the overall fitness to dive assessment in divers with diabetes.

Innovations in diabetes care

The last two decades have seen an increase in pharmacological options, particularly new insulin formulations that are less likely to result in hypoglycaemia. Examples include insulin Glargine U300, insulin degludec, oral SGLT-2 inh, and injectable GLP-1 RAs. In parallel, technological innovations include downloadable insulin pens and insulin pumps paired with continuous glucose monitoring (CGM). Reducing the frequency and severity of hypoglycaemic events can reduce the development of hormonal regulation impairment and thereby lead to more stable glucose levels.[10]

A transition from direct blood glucose monitoring to sensor-based glucose monitoring of the interstitial fluid with CGM is ongoing. In many countries, CGM, either real-time (rtCGM) or intermittent scanning (isCGM), is now considered standard of care. In addition to current glucose values, CGM can provide profiles on past and recent glucose trends and rates of change.[11] Thus, a more comprehensive picture is available for the individual with diabetes. Practically, rtCGM can incorporate user-adjusted alerts, alarms and follower notification functions to aid in glucose management. CGM can be used either as a stand-alone system with multiple daily injection therapy or with an insulin pump/CSII.

Emerging technologies include insulin pumps with autonomous insulin infusion stops, low and predicted low glucose suspension (LGS and PLGS, respectively) functions, and hybrid closed loop (HCL) pumps. LGS and PLGS functions can reduce glucose variability and minimise hypoglycaemic events.[12,13] HCL pumps adjust the insulin dose based on glucose sensor readings to further reduce glucose variability and the risk of hypoglycaemia.[14]

Diabetes and diving

Diabetes is at least a relative contraindication for diving since impaired consciousness affects the diver's ability to take care of himself/herself or a diving partner and potentially confer a significant risk to health or life. The risk can be increased if the condition contributes to a lack of cardiovascular fitness. It has historically been described as an absolute contraindication prompting blanket bans, but more recent experience has moved it into the relative contraindication class for those without significant co-morbidities or secondary complications.

Diving with diabetes was banned in the UK after an unfortunate case of misdiagnosis ultimately led to a diver committing suicide.[15] Similar prohibitions existed internationally, with the timeline varying based on when it was flagged as an area of concern. Despite the existence of the general prohibition, it became clear that many individuals were diving, and that they were often hiding their condition to avoid disqualification, potentially increasing risks through a lack of group preparedness. The ban on diving by persons with diabetes was reversed in the UK in 1991, but this did not reflect a common pattern of relaxation internationally. A workshop was organized by the Undersea and Hyperbaric Medical Society (UHMS) in 1996 to discuss the possibility of liberalizing guidance on diving with diabetes. The weakness of the evidence base made it impossible for agreement to be reached, but the meeting was successful in promoting international efforts to gather relevant data. The substantial body of evidence produced over the following decade suggested that diving by persons with diabetes could be conducted with notably few adverse events related to the condition.[15–18]

The research evidence provided the foundation for a 2005 UHMS-Divers Alert Network (DAN) workshop.[19] Consensus guidelines for recreational diving with diabetes were generated, primarily focusing on T1D cases. There were three discrete components to the guidance: selection and surveillance, scope of diving, and glucose management on the day of diving.[19,20]

Selection and surveillance play a critical role in determining if candidates should be allowed to dive. Problematic co-morbidities, serious secondary complications, and poor physical fitness can all serve to disqualify candidates (see 'Medical clearance'). Our focus in this review is largely on individuals who are generally healthy, with well managed diabetes as the primary health issue.

The scope of diving guidance was intentionally conservative as a starting point: a maximum depth limit of 30 metres; all dives within no-decompression limits; no overhead environments; and duration no longer than 60 minutes. There are concerns, primarily related to hypoglycaemia, that justified a conservative starting point. Symptoms associated with hypoglycemia could be confused with those arising from other factors related to diving. For example, fatigue could result from effort expended during a dive; reduced cognitive focus or lethargy could result from cold stress; confusion or mental absence could result from nitrogen narcosis; and malaise or other physical compromise could result from decompression illness.[21] An erroneous assessment could lead to delays in securing the correct treatment, be it carbohydrate or glucagon administration or hyperbaric oxygen therapy. Concerns that hyperbaric exposure would specifically alter glucose utilization was set aside following a chamber study of exercising divers with and without T1D,[22] but there remains a concern that the distractions of diving could increase the risk of hypoglycaemic unawareness. The diving environment changes many normal stimuli; altering sensations due to immersion, buoyancy, wetsuit and/or hood use; compromised verbal and auditory communication; and creating unusual visual effects and physical demands. Symptoms might be more easily missed. Cautious experience could help to minimise the risk of complications.

Medical clearance for recreational divers with T1D and T2D

Diving can be physically demanding, and individuals with diabetes who want to start this activity must demonstrate sufficient knowledge and control over their condition in addition to meeting requirements for diving and medical fitness. This includes a cardiology screening[23–26] and medical clearance regarding glucose control.

CARDIOLOGY SCREENING TO EVALUATE IF THE INDIVIDUAL IS 'FIT TO DIVE'

The goals are to:

- Identify individuals with serious cardiac conditions that could pose a danger during diving, for example, hypertrophic cardiomyopathy or aortic stenosis.
- Identify individuals with cardiovascular disease that could cause disablement during diving, for example, acute myocardial infarction or angina pectoris.

Recommendation:

- Screening is recommended of all individuals with T1D or T2D.
- History including information on heredity and symptoms of cardiovascular diseases.
- Clinical examination including monitoring and evaluation of blood pressure, heart rate and heart sounds, and a 12-lead resting ECG.
- In case of abnormal findings, referral to a cardiologist is recommended.

MEDICAL CLEARANCE REGARDING GLUCOSE CONTROL

Candidates must be able to adjust insulin doses and carbohydrate intake prior to dive.[27] Patients with T2D should use an oral glucose lowering agents that best control their diabetes but must bear in mind that some of these medications may increase the risk of hypoglycaemia (Table 1).[4]

Medical clearance to dive requires a consensus between

Table 1
Glucose lowering agents, cardiovascular effects, and risk of promoting hypoglycaemia.[4] CHF = congestive heart failure; CVD = cardiovascular disease; DPP-4 inh = dipeptidyl peptidase inhibitors; GLP-1 RA = glucagon-like peptide-1 receptor agonists; MI = myocardial infarction; SLGT-2 inh = sodium glucose cotransporter-2 inhibitors

Class of glucose lowering agent	Representative agents	Cardiovascular benefit and risk	Risk of hypoglycaemia
Biguanide	Metformin	Reduction MI and coronary deaths	Low
DPP-4 inh	Sitagliptin Saxagliptin Vidagliptin Linagliptin	CV risk neutral, may increase risk of CHF	Low
SLGT-2 inh	Canagliflozin Dapagliflozin Empagliflozin	Reduction CVD risk	Low
GLP-1 RA	Liraglutide Exenatide Dulaglutide Semaglutide	Reduction CVD risk	Low
Thiazolidinediones	Pioglitazone	Increased risk of cardiac failure	Low
Insulin	Human insulin Mealtime analogues NPH insulin Basal analogues	CV risk neutral	High
Sulfonylureas	Glimepiride Glibenclamide Glipizide	CV risk neutral or may be increased	High

clinicians with expertise in diabetology and diving medicine, and the diver. The hypoglycaemia definitions used are in accordance to the American Diabetes Association (ADA) classification.[28] The following simplified criteria for dive qualification have been proposed:[27]

- Glycaemic control, HbA1c < 63 mmol·mol^{-1} (8%), without any symptomatic long-term diabetic complications (cardiovascular, nephropathy, neuropathy, or substantial retinopathy). Mild non-proliferative background diabetic retinopathy is accepted.
- No history of severe hypoglycaemia (defined as that requiring intervention by a third party)[28] during the last year and no evidence of hypoglycaemia unawareness.
- Knowledge on how to manage the diabetes disease, monitor glucose levels, adjust insulin doses effectively, and to gauge carbohydrate intake prior to physical activity.
- CGM is recommended for risk evaluation and hypoglycaemia prevention prior to diving and for subsequent evaluation of outcomes.
- Yearly evaluation should be performed by a specialist in diabetology in consultation with a physician with training in diving medicine.

The focus of the 2005 UHMS-DAN guidelines[19] was on the recreational diver, but the same guidance for selection and surveillance, glucose management on the day of diving and team awareness and readiness could apply if the diver with diabetes was a dive leader or professional diver. One of the areas that would benefit most from refinement is the scope of diving. A concept not included in the 2005 UHMS-DAN guidelines is graduated clearance, which would work well for all divers with diabetes, and particularly well to define the limits for professional divers.

A model for graduated clearance can be found in scientific diving. Divers are initially approved to dive to the shallowest depths with experienced partners. After gaining experience and demonstrating competence at a step they may be cleared for the next depth increment. A recommendation was made to the American Academy of Underwater Sciences to consider formalising the depth clearance of scientific divers with diabetes using a similar graduated scheme,[29] but qualification for this group currently remains solely based on medical clearance. In any case, a practice of formal or informal graduated clearance to dive could provide additional safety buffers, reducing stress and concerns for all. Questions of the duty of care of persons with diabetes responsible for others deserves additional consideration, but it is beyond the scope of this paper. It is important to acknowledge that restrictions on professionals vary and that there is no unified position or solution.

Preventing hypoglycaemia through glucose monitoring

The goal to maintain stable or moderately rising pre-dive glucose levels is to minimise the risk of hypoglycaemic events[28] during dives. Frequent glucose monitoring is

Table 2

Illustration of different continuous glucose monitoring devices: Dexcom G4/G5/G6 (rtCGM); Freestyle Navigator (rtCGM); Abbott Libre (isCGM); Eversense XL (implantable sensor, rtCGM); and Medtronic (rtCGM). These enable automatic frequent measurements of glucose concentration (every 5–15 min) and a simultaneous indication of the direction of changing glucose values and how fast this is happening, indicated by different trend arrows. The table illustrates various combinations (glucose value and type of trend arrow) where the individual can predict a low glucose value during the next 15 minutes, which also allows preventive measures to be taken

Product	Interval $mmol \cdot L^{-1}$ / $mg \cdot dL^{-1}$	Trend arrow	Interval $mmol \cdot L^{-1}$ / $mg \cdot dL^{-1}$	Trend arrow	Interval $mmol \cdot L^{-1}$ / $mg \cdot dL^{-1}$	Trend arrow
Dexcom (G4,G5,G6)	> 6.5 / > 117	↓↓	5.7–6.5 / 103–117	↓	4.8–5.7 / 86–103	↘
Freestyle Navigator; Libre; Eversense (XL)	Not applicable (n/a)	n/a	> 5.7 / > 103	↓	4.8–5.7 / 86–103	↘
Medtronic (Enlite 2,3)	> 6.5 / > 117	↓↓↓	5.7–6.5 / 103–117	↓↓	4.8–5.7 / 86–103	↓

required to be aware of state and changes in state. If a glucometer is used, measurements taken at least 4–8 times per day during 1–2 weeks prior to and throughout periods of diving are recommended.

Use of CGM gives additional information and a monitoring period of at least two weeks is recommended prior to diving. This type of glucose monitoring could be beneficial to identify and address unexpected deviations in glucose management that could potentially increase the risk during subsequent diving. Episodes can be more reliably detected by CGM to warn of unwelcome deviations and the potential need for additional regimen adjustments.

Real-time CGM can help to prevent hypo- and hyperglycaemia day and night and to register possible hypoglycaemia unawareness. In addition to the use of alerts and alarms, trend data can help guide good practice. The beneficial effects of rtCGM on glucose control has been verified with insulin injection therapy[30,31] and CSII treatment.[32] Individuals demonstrating hypoglycaemia unawareness had a lower frequency of hypoglycaemia when using rtCGM in comparison with self-monitored blood glucose.[33] Additionally, rtCGM was associated with decreased frequency of nocturnal hypoglycaemia and improved glycaemic variability.[34] The use of rtCGM in connection to recreational diving has been shown to be beneficial for individuals with T1D.[34] Table 2 lists combinations of glucose levels from CGM systems with the use of trend indicators predicting imminent hypoglycemia hazards.

While CGM and pump technologies provide additional insight and protection for patients, it must be recognized as an important limitation that they cannot currently be used while diving. Pumps are generally described as water-resistant, but only allowing exposures to depths of 2.5–3.5 metres for short periods. Neither the structural integrity nor delivery performance is tested beyond these near-surface conditions. All insulin pumps should be disconnected and removed before dives and then reconnected as soon as possible after diving in order to reinstate insulin delivery, glucose monitoring and control.

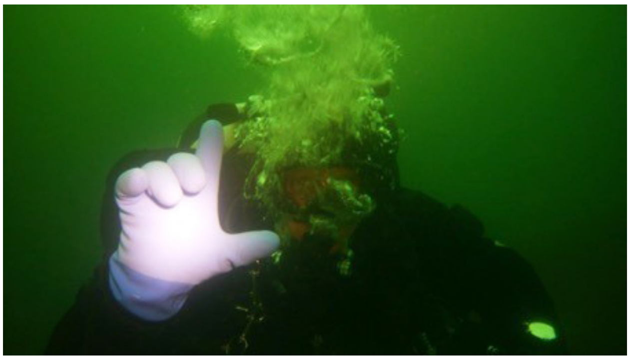
Preventing hypoglycaemia by insulin adjustments and carbohydrate intake

Individuals using multiple daily injection treatment should reduce the long acting (< 24 h effect) insulin dose to minimise the risk of hypoglycaemia during diving. A 20% reduction may be reasonable for moderately long, strenuous, or repetitive dives. Individual response must be assessed, progressing from the most benign conditions, to determine the most appropriate adjustments. When a more pronounced long-acting insulin is used (insulin degludec), a dose reduction results in a postponed effect which may not reduce the risk of hypoglycaemia during the day of the dive. Instead, in these cases, large pre-dive carbohydrate boluses (30 g or more) without additional insulin may be necessary to prevent hypoglycaemia.[35]

Employing CSII treatment, the risk of hypoglycaemia during diving may be reduced by adjusting the basal rate (90–120 min before diving) and/or the intake of carbohydrates prior to diving.[27,34] During a series of relatively modest dives (maximum depth 18–22 metres; 42–52 min duration), the glucose level was reduced by 1.7 (SD 3.8) $mmol \cdot L^{-1}$ (31 (68) $mg \cdot dL^{-1}$) when the insulin dose was reduced prior to dive and a carbohydrate bolus was ingested with no extra insulin 10 min pre-dive.[29] Using CSII with an autonomous insulin infusion stop and PLGS function before and after diving could further improve safe management,[12,13,36] but this has not been studied during diving conditions.

In order to lower the glucose variability during diving a meal should be consumed at least 1.5 to 2 hours, and preferably 3 hours, prior to the dive. The insulin concentration levels will then be lower at start of diving and thus reduce the risk of hypoglycaemia during the dive. The insulin dose prior

Figure 1
The 'L-signal' – sign of hypoglycaemia – posed as a question or offered as a statement. Photo by Peter Adolfsson



to a meal may need to be reduced, especially when diving is conducted 1.5–2 hours after a meal. The glucose target prior to diving should be 7–12 mmol·L^{-1} (126–216 mg·dL^{-1}). The pre-dive intake of a modest carbohydrate bolus, 15–30 g per 70 kg body weight (depending on glucose value), is recommended just before diving with no accompanying insulin.

When repeated dives are planned, insulin dose adjustment may be needed before meals to compensate for the increased insulin sensitivity seen during repeated physical activity comparable to the planned scuba diving.

Detailed personal logbooks should be maintained, recording multiple pre- and post-dive glucose levels, carbohydrate boluses, insulin dose, and description of dives (depth, duration, thermal stress, levels of physical exertion, and any adverse events). When rtCGM is used, calibration or confirmation of readings is recommended before and after each dive. The records and downloads can be used to understand the individual glucose response to multiple factors to optimise future glucose regulation.

Managing suspected hypoglycaemia during a dive

It is important for all divers and dive support personnel to be familiar with the needs of persons with diabetes, to be informed of protocols for monitoring and managing blood glucose deviations, and to be able to recognize acute signs and symptoms. Dive teams should practice signaling and treating hypoglycaemia. The 'L-signal', with the index finger and thumb forming the letter L, is used to ask a diver about his or her glycaemic status or to alert the partner of concerns regarding hypoglycaemia (Figure 1).[19,20,33] If a problem is suspected, the protocol based on the 2005 UHMS-DAN guidelines[19] is for both diver and partner to immediately surface and end the dive. No-decompression and no overhead diving is recommended to allow direct ascent to the surface at least until divers with diabetes gain substantial experience and are fully in control of their condition. Obligatory decompression and dives in overhead environments make surfacing more complicated. The default advice for divers concerned with possible hypoglycaemia is to surface with safe but expeditious dispatch. Once on the surface, affected divers should establish positive buoyancy and then ingest a modest carbohydrate bolus (as gel or glucose/fructose solution).

Carbohydrate formulations should be carried by both divers with diabetes and their partners on all dives. Divers should practice buddy procedures: communicating with the 'L-signal' and ingesting gel, first on the surface and then underwater for advanced practice if appropriate. A high level of comfort and competence in underwater ingestion of carbohydrate is required before divers conduct dives that do not allow direct access to the surface, either as decompression ceilings or overhead obstructions. Dive partners, divemasters, instructors, and surface support staff should understand both the concerns and management strategies for acute problems linked to diabetes. All should be sufficiently informed to be able to appropriately assess potential issues and have access to carbohydrate and glucagon to assist divers in need.

Protocols for underwater management of suspected hypoglycaemia have been developed and implemented by divers, primarily relying on the ingestion of glucose paste. Individuals with additional experience and the inability to surface directly and immediately in a safe manner would have to ingest carbohydrate before surfacing. Discussion of specific protocols for underwater ingestion of glucose is beyond the scope of this paper.

Patient obligations

- Consult a physician and diabetes/diving specialist to ensure medical and physical fitness to dive before making an attempt to dive.
- Inform dive partners and support personnel of the condition and the ways to provide aid in case of emergent need.
- Ensure that both diver with diabetes and partner carry appropriate and accessible carbohydrate formulations on all dives.
- Ingest a modest bolus of carbohydrate immediately pre-dive to minimise the risk of hypoglycaemia.
- Measure plasma glucose levels repeatedly in the hour pre-dive and immediately post-dive or consider using a CGM system to monitor glucose levels in real-time outside of diving.
- Ensure a stable or rising pre-dive glucose level (SMBG or CGM) of ≥ 7 mmol·L^{-1} (127 mg·dL^{-1}).
- Be aware of conditions that may be confused with symptoms of hypoglycaemia. Dive depth should be limited to 30 metres until diving competence, diabetes control, and emergency management capabilities are well established. Any subsequent increase in exposure depth should be thoughtful and graduated.
- Avoid dives longer than 60 minutes until glucose

response under realistic conditions is fully understood and can be well managed. Any subsequent increase in dive time should be thoughtful and incremental.
- All dives should be logged, including glucose monitoring results, carbohydrate ingestion, medication use, and any adverse events. This information should be used for dive planning and shared with medical advisors to ensure optimal practices.
- Stay well hydrated in conjunction with diving.

Considerations for youths

A small group of inexperienced but motivated teenage drivers with diabetes was shown to be able to maintain plasma glucose levels and avoid hypoglycemia associated with diving,[37] but diving by youths with diabetes must be carefully considered. Appropriate medical evaluation and clearance is necessary prior to participation. Candidates must have the physical ability, mental maturity, and motivation to manage all the hazards of diving with diabetes and the assessing physician should take into account possible parental or peer pressure to dive. Divers with diabetes must have a thorough understanding of their disease, reliably demonstrate good management practice and risk assessment, and be sufficiently mature to take personal responsibility for their safety, fully understand the risk that they may pose to themselves and other divers and demonstrate appropriate diving skill. As recommended in the 2005 UHMS-DAN guidelines,[19] a minimum age of 16 years is likely reasonable, and only then for individuals who have been well oriented in training programs that incorporate both dive training and diabetes management.

International aspects of diving

Divers often travel widely to dive, and it is important to comply with local regulations and requirements for diving and diabetes. Responsible practice is important to protect the safety and freedom of all divers. Relevant training materials and guidelines are available for review and to share with local authorities.[19,38–40]

Limitations

It is understood that the availability of treatment options and medical care is not consistent. Direct consultation with experts in either diving medicine or diabetes may not be practical. The expense associated with scuba diving may limit the pool of candidates who are in a better position for optimised care, but it is unclear that all who may wish to participate can be appropriately evaluated. A conservative approach, in lieu of comprehensive medical support, is warranted.

Where possible, candidates for diving with diabetes would be best trained through organised programs dedicated to providing this familiarisation. Unfortunately, such programs are not widely available currently. Additional effort is needed to develop training materials and programs to facilitate dissemination of critical information to divers, diving leaders, and medical monitors. Resource materials made available to community-based groups could minimise the background work required by such groups and ensure a higher standard for consistent and best practice. Clearance to dive professionally for persons with diabetes must be established through consultation that includes medical monitoring and professional oversight involving various authorities as well as based on national rules and regulations.

Conclusions

Diving, even in the absence of diabetes, is a potentially dangerous activity. Mindful and safe practice is required for all divers, particularly for those who have additional medical challenges. There is a substantial evidence base indicating the diving with diabetes can be conducted safely by qualified individuals but ongoing vigilance and best practice is required. Recent and ongoing developments in pharmacology and technology can aid in reducing the risk of hypoglycaemia, the critical acute hazard in diving with diabetes. Open communication with diving partners, support personnel, and medical monitors is important to ensure that all are prepared to effectively assist in case of need. Ongoing vigilance, best practice, including graduated clearance for diving exposures and adverse event reporting, are all required to ensure the safety of diving with diabetes and to promote community understanding and acceptance.

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