Contemporary practices of blood glucose management in diabetic patients: a survey of hyperbaric medicine units in Australia and New Zealand

Brenda R Laupland[1], Kevin Laupland[2,3], Kenneth Thistlethwaite[1], Robert Webb[1,4]

[1] *Hyperbaric Medicine Unit, Royal Brisbane and Women's Hospital, Brisbane, Australia*
[2] *Queensland University of Technology (QUT), Brisbane, Australia*
[3] *Department of Intensive Care Services, Royal Brisbane and Women's Hospital, Brisbane, Australia*
[4] *Clinical Informatics, Digital Metro North, Metro North Health, Brisbane, Australia*

Corresponding author: *Dr Brenda Laupland, Hyperbaric Medicine Unit, Royal Brisbane and Women's Hospital, Butterfield Street, Herston, Queensland, 4029 Australia*
ORCiD ID: 0009-0005-4883-1932
kbetlaup@gmail.com

Keywords
Blood sugar level; Diabetes; Hyperbaric oxygen treatment; Protocol; Questionnaire

Abstract
(Laupland BR, Laupland K, Thistlethwaite K, Webb R. Contemporary practices of blood glucose management in diabetic patients: a survey of hyperbaric medicine units in Australia and New Zealand. Diving and Hyperbaric Medicine. 2023 September 30;53(3):230–236. doi: 10.28920/dhm53.3.230-236. PMID: 37718297.)
Introduction: Blood glucose levels may be influenced by hyperbaric oxygen treatment (HBOT). Patients with diabetes mellitus commonly receive HBOT but there is a lack of standardised blood glucose management guidelines. We documented relevant contemporary practices applied for patients with diabetes treated in hyperbaric medicine units.
Methods: A survey was administered in 2022 to the directors of all 13 accredited hyperbaric units in Australia and New Zealand to identify policies and practices related to management of patients with diabetes receiving HBOT.
Results: Twelve of the 13 units routinely managed patients with diabetes. Three-quarters (9/12) used < 4 mmol·l^{-1} as their definition of hypoglycaemia, whereas the other three used < 5, < 3.6, and < 3 mmol·l^{-1}. Units reported 26% (range 13–66%) of their patients have a diagnosis of diabetes of which 93% are type 2. Ten (83%) units reported specific written protocols for managing blood glucose. Protocols were more likely to be followed by nursing (73%) than medical staff (45%). Ten (83%) units routinely tested blood glucose levels on all patients with diabetes. Preferred pre-treatment values for treatments in both multiplace and monoplace chambers ranged from ≥ 4 to ≥ 8 mmol·l^{-1}. Seven (58%) units reported continuation of routine testing throughout a treatment course with five (42%) units having criteria-based rules for discontinuing testing for stable patients over multiple treatments. Two-thirds of units were satisfied with their current policy.
Conclusions: This survey highlights the burden of diabetes on patients treated with HBOT and identifies considerable variability in practices which may benefit from further study to optimise management of these patients.

Introduction

Approximately 5.3% of Australians and 5.7% of New Zealanders have diabetes (type 1 and type 2) making it common in the general population.[1,2] In addition, non-healing diabetic ulcers are one of the approved indications for treatment with hyperbaric oxygen.[3] As such, diabetes is a frequent co-morbidity in hyperbaric medicine patients.

Hyperbaric oxygen treatment (HBOT) has been shown to affect blood glucose levels in patients with diabetes by a postulated mechanism of increasing peripheral insulin sensitivity.[4,5] Its specific effect on individual patients, however, has been inconsistent among studies. Within eight papers examining blood glucose fluctuations with HBOT, five show an overall decline in blood glucose levels,[6–10] one shows an increase[11] and two suggest no change.[12,13] As well, individual changes may vary markedly with one study showing a range from +13.3 mmol·l^{-1} to -20.0 mmol·l^{-1} for blood glucose responses during a single treatment.[13] Although the type of diabetes, insulin usage, and control of blood glucose prior to treatment have been investigated, no variable has demonstrated a consistent ability to predict an individuals' blood glucose response.[6,7,11,13]

Safety for patients and staff in a closed, pressurised hyperbaric chamber is paramount. Symptomatic hypoglycaemia, particularly hypoglycaemia-associated seizures, represent a major safety concern during HBOT. Event rates of symptomatic hypoglycaemia have been reported from 0.19% to 4.6% of treatments depending on patient population studied and definitions of hypoglycaemia applied.[6,11] Seizures due to hypoglycaemia are extremely infrequent during HBOT[14] but represent a medical emergency that is

challenging to manage particularly in monoplace chambers. To prevent these complications, different suggestions have been proposed for testing and targeting specific pre-HBOT glucose levels. Based on a limited body of evidence, recommendations have consistently advised relatively elevated pre-treatment levels[6,8,10,13,15,16] leading to changes in both patient and physician management of diabetes during HBOT.[17]

Although diabetes is among the most common comorbid illnesses observed among patients treated with HBOT and this treatment may result in adverse effects on their glucose management, there is a paucity of information surrounding actual practices. The objective of this study was therefore to conduct a survey of accredited hyperbaric units in Australia and New Zealand to describe contemporary practices of glucose management among patients with diabetes undergoing HBOT.

Methods

This project was submitted to the Royal Brisbane and Women's Hospital Human Research Ethics Committee and was found to be exempt from full ethics review as it was considered negligible risk research (Ref: EX/2022/QRBW/83562).

STUDY DESIGN

The survey utilised a mixed semi-quantitative, semi-qualitative design. A pilot survey was created with questions based on practice principles utilised in the hyperbaric unit at Royal Brisbane and Women's Hospital. It was tested on clinicians at two hyperbaric units within Brisbane, Queensland for the relevance of questions and ease of administration and modified iteratively to form the final version. Respondents were asked to complete the survey within the context of a typical month of treatments. Questions were grouped into themes: determining the proportion of patients with diabetes, definitions of hypoglycaemia, presence of written protocols, and practices surrounding monitoring and management of glucose before, during, and after HBOT.

PARTICIPANTS

The survey was offered to the medical directors of each of the 13 accredited hyperbaric units within Australia and New Zealand. Consent to participate was demonstrated by participation. All survey responses were kept confidential. Respondents were offered the option to be contacted for further detailed discussion of their responses.

DATA ANALYSIS

Data obtained within the survey were collated with unit and director identifiers anonymised. Analysis was descriptive. Categorical values were reported as proportions (%). continuous variables were reported as means with standard deviations or medians with ranges. The post-survey interview responses were grouped into themes.

Results

All 13 eligible units responded to the survey. One unit did not routinely treat patients with diabetes and did not participate further, leaving 12 units in the analysis. All twelve units reported having a multiplace chamber. Five units also had monoplace chambers, with four reporting treating patients with diabetes in that chamber.

DEFINITIONS

Definitions for hypoglycaemia varied between units. Three-quarters (9/12) used < 4 $mmol \cdot l^{-1}$ as their definition, whereas the other three units each used definitions of < 5, < 3.6, and < 3 $mmol \cdot l^{-1}$. One half of the units (6/12) agreed that symptomatic hypoglycaemia was defined by the specific number they had chosen for hypoglycaemia (i.e., < 4 $mmol \cdot l^{-1}$) along with the addition of symptoms. The other one half of units defined symptomatic hypoglycaemia to be subjective or objective symptoms at any blood glucose level.

PREVALENCE OF DIABETES

A total of 210 patients had been treated amongst all units in the month surveyed of which 55 (26%) were diabetic (Figure 1). The median total number of patients treated per unit was 12 (range 3–38), of which a median of 5 (range 1–9) were diabetic. The prevalence of diabetes among the units ranged from 13–66% (Figure 1). Of the 55 patients with diabetes, 5 (7%) and 51 (93%) had types 1 and 2 diabetes, respectively, representing 2% and 24% of patients overall.

PROTOCOLS

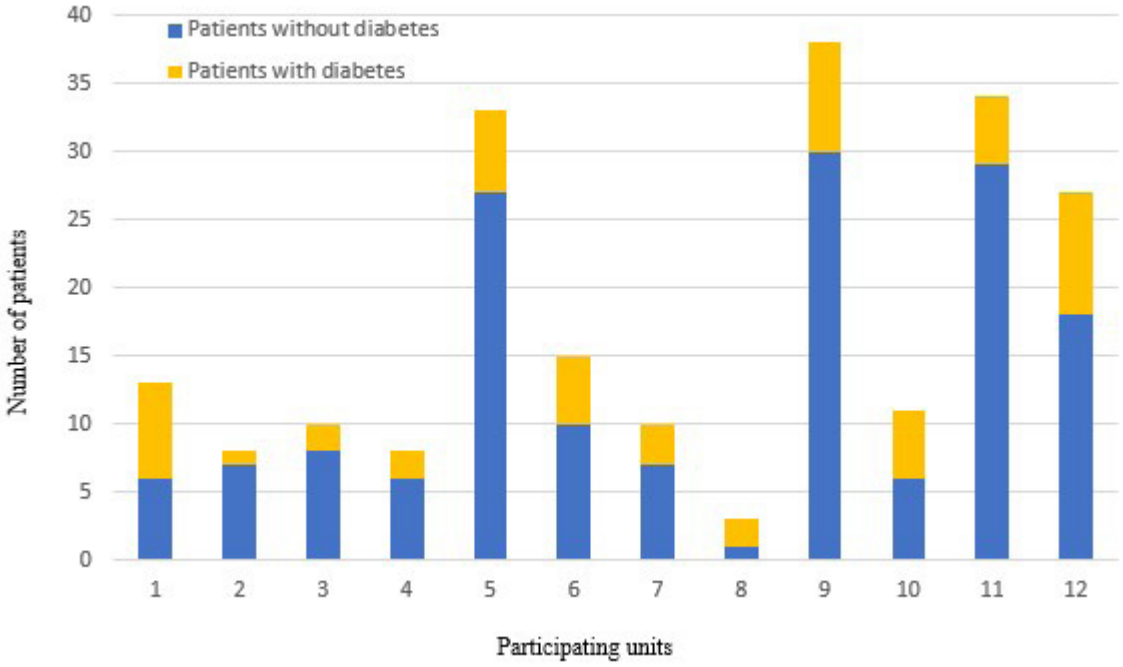
Ten (83%) of the units reported a specific written protocol for management of patients with diabetes in the hyperbaric chamber. Among the other two, one had a strict set of verbally agreed upon guidelines and one reported having no defined protocol. Of the 11 units with protocols, 8 (73%) reported that nursing staff were compliant with that protocol, whereas 5 (45%) responded that medical staff were likely to be compliant.

MULTIPLACE CHAMBER RESPONSES

Pre-chamber testing

Ten (83%) units routinely tested blood sugar levels on all patients with a diagnosis of diabetes regardless of type (1 or 2) or treatment (diet, oral tablets, or insulin). In the other two units testing was not initiated on those who were diet controlled. One of these also did not test those taking metformin as a sole oral agent.

Figure 1
Number of patients with and without diabetes treated in the month surveyed per hyperbaric medicine unit (numbered 1–12)



Seven units (58%) continued testing on all patients with diabetes prior to every treatment, whereas five (42%) discontinued testing under certain criteria. Two units ended if values were considered stable for diet-controlled patients. One unit stopped testing on all patients with diabetes after multiple treatments if blood glucose levels had been stable over an undefined time period. One unit discontinued testing on all patients with diabetes once blood glucose levels had been stable for one week. One unit ended testing if patients were considered stable, hypoglycaemia aware, and not on insulin.

Pre-treatment values

Five units (42%) target pre-treatment blood glucose was ≥ 8 mmol·l^{-1}. For four units (33%) this value was ≥ 6 mmol·l^{-1}. Two units (17%) targeted ≥ 5 mmol·l^{-1}. One unit described a range of acceptable values between of 4–10 mmol·l^{-1} (Figure 2). The pre-treatment levels were an absolute requirement for two units with the other 10 relying on clinical judgement if values were: close to the desired level, trending upward, if patients had recently eaten, or if no insulin had been given.

Patients were considered not suitable for treatment on a given day for several reasons. Four units deferred treatment if a patient's blood glucose level was less than the desired pre-treatment level. Two units did not treat patients if their blood glucose levels were unstable or trending downward. Six units used criteria to determine eligibility of patients when pre-test values were lower than the desired initial level. These criteria included: symptoms, blood glucose not rising after the patient was given a carbohydrate, fasting patients with type 1 diabetes, blood glucose trending downward, and recent dose of short acting insulin. One unit also deferred treatment for elevated blood glucose levels > 25 mmol·l^{-1} with no insulin given.

In-chamber testing

In-chamber glucose checks were able to be performed in all twelve units. One half of the units tested blood within the chamber with the other half transferring blood out for testing. There was significant variability in the protocols for testing during treatments. Three (25%) units tested all patients with diabetes. One unit stopped routine testing after three stable treatments. The remainder (67%) tested based on criteria that included symptoms, staff concerns, lower than usual pre-test levels, and whether insulin had been given prior to entering the chamber.

Post-treatment testing

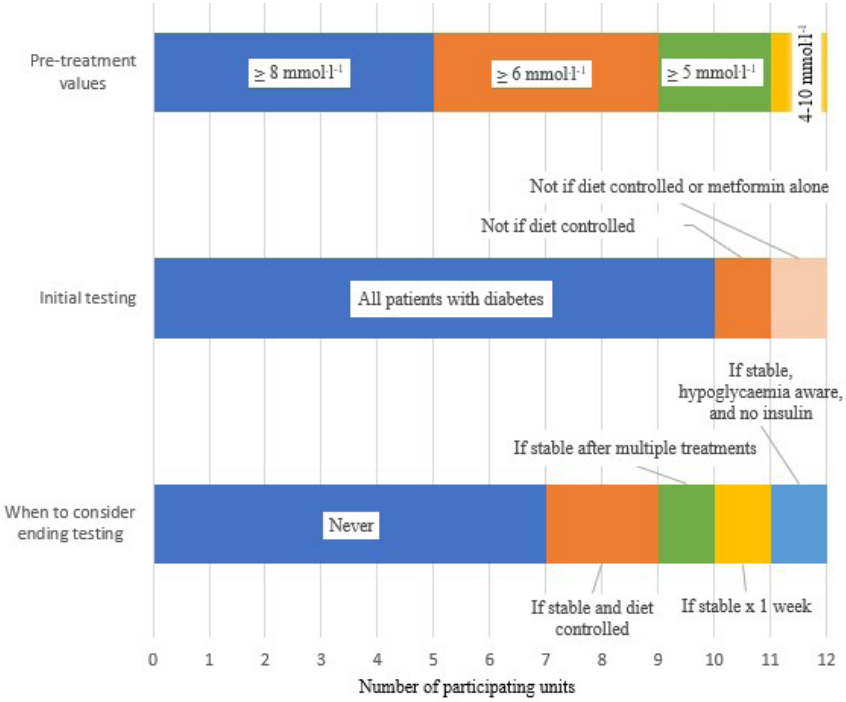
Post-treatment testing was reported as routine by two (17%) units while three (25%) reported no prescribed testing. Criteria-based testing was employed in the remaining seven (58%) units with indications including in-chamber events, stability of blood glucose during previous runs, type 1 diabetics, and hospital inpatients.

Carbohydrate usage

Prior to treatment, eleven (92%) units gave carbohydrate if blood glucose levels were lower than their pre-treatment

Figure 2

Multiplace chamber responses to survey questions (12 hyperbaric units); 'pre-treatment values' refers to target blood glucose prior to HBOT; 'intial testing' refers to conducting blood glucose measurement prior to each HBOT treatment



desired level. One unit gave carbohydrate regardless of level if patients had not eaten or were symptomatic.

Once a carbohydrate had been given, all units reported conditional treatment if glucose was rising on subsequent testing. If a carbohydrate had been given and blood sugars were stable, four (33%) units allowed treatment, two (17%) would not, and six (50%) used criteria such as absolute level of blood glucose or other factors (no recent insulin, recently eaten, previously stable blood glucose level in chamber) to determine eligibility for treatment. Carbohydrates were given during treatment in the multiplace chamber by all twelve (100%) units with reasons for this being directed by in-chamber blood glucose levels in one half and symptoms in the other half of units.

MONOPLACE CHAMBER RESPONSES

Among the four units that treated diabetic patients in their monoplace chambers, pre-treatment blood glucose requirements were ≥ 8 mmol·l^{-1} for three units and a range of 4–10 mmol·l^{-1} for one (Figure 3). Units reported a tendency for stricter adherence to specific blood glucose thresholds with monoplace as compared to multiplace treatments. If a patient's initial blood glucose level was below the pre-treatment threshold in three of the four units, treatment was conditional on a carbohydrate being given and subsequent blood glucose levels being higher than the pre-treatment threshold. One unit required three stable multiplace treatments to be eligible for monoplace treatment. Two units specified that monoplace patients had sugary drinks available within the chamber.

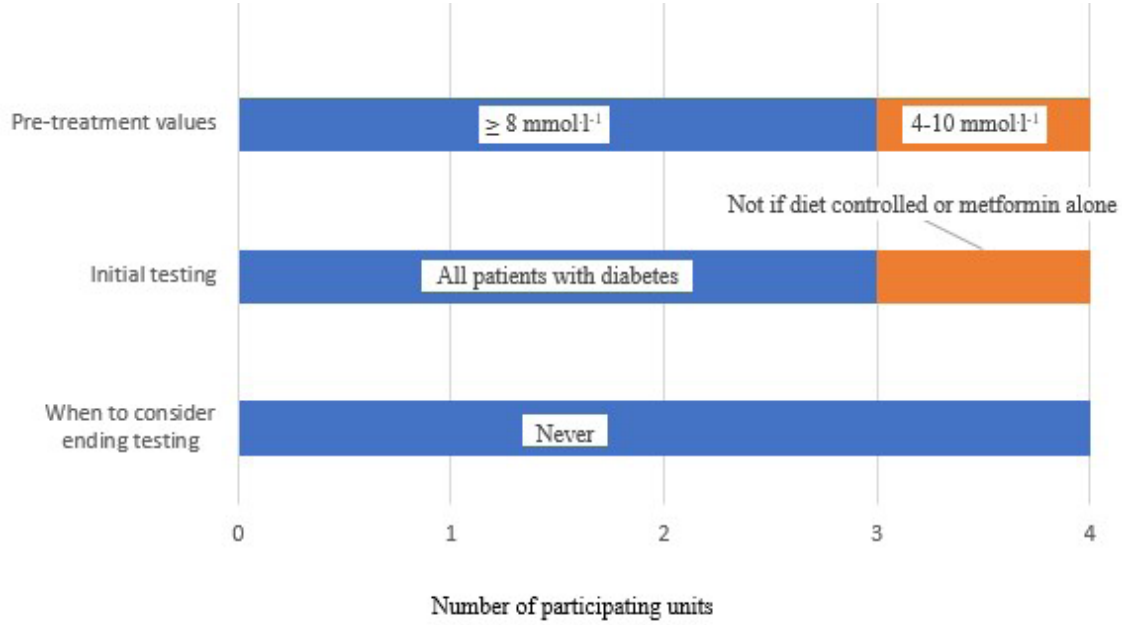
Post-treatment testing was performed routinely by two of the four units, and all four maintained regular testing on patients using the monoplace chamber even if stable over ongoing treatments (Figure 3).

If patients experienced a hypoglycaemic event in the monoplace chamber, three units transferred that patient back to the multiplace chamber for the remainder of their treatments, and one unit allowed ongoing monoplace treatments but with a higher pre-treatment blood glucose requirement.

SATISFACTION

Overall, eight (67%) units indicated they were satisfied with their current policy. The two units without written policies each mentioned they would like to formalise a policy. Potential changes suggested for improvement among existing protocols included: more detail regarding reasons to test pre-treatment and mid-treatment, specifying dose of carbohydrate to be used, having different criteria for patients with type 1 and 2 diabetes, and expanding opportunity for patients with type 2 diabetes to treat in a monoplace chamber.

Figure 3
Monoplace chamber responses to survey questions (4 units); 'pre-treatment values' refers to target blood glucose prior to HBOT; 'intial testing' refers to conducting blood glucose measurement prior to each HBOT treatment



Discussion

This study identifies that patients with diabetes are commonly treated with HBOT, they are treated in both monoplace and multiplace chambers, and most units have a protocol to help guide management of blood glucose levels. A majority of units reported routine and ongoing blood glucose testing of patients both prior to and during HBOT. There was marked heterogeneity in practice related to defining safe pre-chamber glucose levels and how these were subsequently managed, including indications for deferring HBOT. This survey highlights the burden of diabetes on patients treated with HBOT and identifies variability in practices which may benefit from further study to optimise management of these patients.

Diabetic protocols centre around optimal pre-treatment levels of blood glucose. On one hand, pre-HBOT levels that are too low may be exacerbated by treatment with a risk for hypoglycaemic symptoms and seizures. On the other hand, requirement of levels that are too high may lead to cancellation of treatments or exacerbation of diabetic complications associated with poor control. Glycaemic control, and in particular a haemoglobin A1c of < 8% has been shown to improve wound healing during the treatment of diabetic foot ulcers and to decrease amputation rates.[18,19] If criteria for HBOT require elevated glucose levels to enter treatments, then patients may be encouraged to maintain higher levels than normal so as not to be excluded from treatment.[17] In addition, the multiple glucose checks often required during a treatment may augment this concern without improving management.[15]

Units in our study targeted pre-HBOT levels from ≥ 4 mmol·l^{-1} to ≥ 8 mmol·l^{-1}. The marked heterogeneity and lack of consensus between units mirrors the literature which offers pre-treatment suggestions from > 6 mmol·l^{-1} to ≥ 9.4 mmol·l^{-1}, with multiple values in-between.[8,10] Interestingly, 3/12 of units in our survey use numbers lower than these. These units each expressed satisfaction with their protocols suggesting few adverse events. It could be postulated that use of lower numbers would encourage glycaemic control and decrease exclusions without significantly increasing risk compared to higher entry criteria, but further evidence is required.

Comments and criteria included in the survey indicate a focus on insulin use to determine initial and ongoing testing, with stability of blood glucose being used to determine termination of testing. While two studies conclude that any patients with diabetes using insulin are at higher risk for hypoglycaemic events,[6,20] other authors found that that this risk is related to those patients with type 1 diabetes and not those on insulin therapy *per se*.[11] This is further supported by another group who observed that patients with type 2 diabetes had more treatments with a drop in blood glucose than those with type 1, but of patients with lower post treatment levels (< 5 mmol·l^{-1}), 70% were on insulin alone.[13] Interestingly, one study found that when patients had a standardised meal and medications prior to treatment, non-insulin dependent patients had a significant decrease in their blood glucose level, but insulin-dependent patients did not.[7] When considering the postulated mechanism of HBOT increasing peripheral insulin sensitivity,[4,5] it would make most sense that patients with type 2 diabetes should

have a more consistent, but predictable decrease in their blood glucose levels during treatments. Patients requiring insulin, would have more variable drops that would be more dependent on their diabetic control overall. This is further supported by the observations that patients with good diabetic control over their course of treatments, evidenced by a change of < 2.8 mmol·l^{-1} in all of their blood glucose readings, experienced no hypoglycaemia.[13]

Only two studies have prospectively examined interventions to minimise hypoglycaemia during hyperbaric treatments. One group created a protocol based on blood glucose changes from 3,136 HBOT sessions in their hyperbaric unit.[15] They examined outcomes before and after introduction of this protocol which excluded patients on an intravenous insulin infusion and who could not communicate hypoglycaemia. Utilising the protocol criteria of not continuing to test patients with a pre-chamber blood glucose of > 8.3 mmol·l^{-1} and specifically defining testing and carbohydrate dosage for those with blood glucose between 3.9 and 8.2 mmol·l^{-1}, they noted the incidence of hypoglycaemia decreased from 1.5% to 0 in the short time frame studied and the number of finger prick tests done decreased by 33%. A second group examined a scoring system incorporating pre-treatment teaching, a risk analysis profile (diabetic control and complications), and pre-treatment glucose.[21] This score was modified daily based on timing of food and medications. Their incidence of hypoglycaemic events using this system decreased from 1.3/100 diabetic patients to 0.16/100. Interestingly, none of the units in our survey utilised either protocol. All units, however, used criteria closer to the second of the above approaches to routinely modify their own protocols. This multifactorial approach, with more specific criteria on who to test, and when to end testing, could be incorporated into a more comprehensive protocol to maintain glycaemic control and maximise patients included in treatment.

In our survey, approaches to glucose management in monoplace chambers tended to be more conservative than the literature. In a series of 1,825 monoplace HBOT treatments in 77 patients the authors required a pre-treatment level of > 6.7 mmol·l^{-1} and gave glucose to those with lower numbers, with an incidence of hypoglycaemia of 0.2%.[13] Another group[10] examined 700 HBOT sessions in a monoplace chamber, administering glucose to those with a blood glucose level of < 5.5 mmol·l^{-1} before the session and having an incidence of symptomatic hypoglycaemia of 0.29%.[10] Neither series reported any serious adverse outcomes. Of those units using the monoplace chamber in our survey, three of four required a pre-treatment blood glucose level of ≥ 8 mmol·l^{-1} (including following the administration of carbohydrate) to allow treatment. It may be that our survey respondents were more conservative than the literature because a multiplace chamber is available at each site meaning there is little need to incur any risk of hypoglycaemia within a monoplace unit.

Although it provides insight into contemporary practices related to glucose management in hyperbaric units in Australia and New Zealand, our study does have some limitations that merit discussion. As a survey we were only able to obtain reported practice which may differ from actual practice. We only surveyed one individual at each centre, and it is possible that responses may not be fully reflective of all staff at those centres. As patient data included in the survey was only collected over one month there may be bias in terms of numbers of diabetic patients treated due to natural fluctuation. Additionally, carbohydrate was not specifically defined in the questionnaire. Those responding units who contributed their protocols generally utilised 15 g of carbohydrate, however this may not be true of all units. As well, the use of rapid versus longer acting carbohydrate may have impacted decisions on further patient testing. Finally, our study is limited in that we did not ask for outcome data in terms of frequency of hypoglycaemic events, hypoglycaemic seizures, or numbers of cancelled treatments, as our aim was to keep the survey brief to encourage full participation by all sites. Given the significant variability in reported practice demonstrated by this survey, the potential influence of that variability on these outcomes would be an interesting area for further study.

Conclusions

Patients with diabetes are common in hyperbaric medicine units in Australia and New Zealand, accounting for 26% of all patients treated during the month surveyed. Survey responses indicate that blood glucose management protocols utilise similar principles to the satisfaction of most units. There is considerable variability in reported practice however, suggesting opportunities exist to enhance glycaemic control and facilitate patient treatment.

References

1 Australian Bureau of Statistics. Diabetes. ABS; 2020-21. [cited 2023 Mar 1]. Available from: https://www.abs.gov.au/statistics/health/health-conditions-and-risks/diabetes/2020-21.

2 Health New Zealand. Virtual diabetes register web tool; 2021. [cited 2022 Nov 30]. Available from: https://minhealthnz.shinyapps.io/virtual-diabetes-register-web-tool.

3 Moon RE, editor. Undersea and Hyperbaric Medical Society – hyperbaric oxygen therapy indications. 14th ed. North Palm Beach (FL): Best Publishing Company; 2019.

4 Wilkinson D, Chapman IM, Heilbronn LK. Hyperbaric oxygen therapy improves peripheral insulin sensitivity in humans. Diabet Med. 2012;29:986–9. doi: 10.1111/j.1464-5491.2012.03587.x. PMID: 22269009.

5 Xu Q, Wei YT, Fan SB, Wang L, Zhou XP. Repetitive hyperbaric oxygen treatment increases insulin sensitivity in diabetes patients with acute intracerebral hemorrhage. Neuropsychiatr Dis Treat. 2017;13:421–6. doi: 10.2147/NDT.S126288. PMID: 28228657. PMCID: PMC5312693.

6 Trytko B, Bennett MH. Blood sugar changes in diabetic patients undergoing hyperbaric oxygen therapy. SPUMS

Journal. 2003;33:62–9. [cited 2023 Jul 27]. Available from: https://dhmjournal.com/images/IndividArticles/33June/Trytko_dhm.33.2.62-69.pdf.
7 Peleg RK, Fishlev G, Bechor Y, Bergan J, Friedman M, Koren S, et al. Effects of hyperbaric oxygen on blood glucose levels in patients with diabetes mellitus, stroke or traumatic brain injury and healthy volunteers: a prospective, crossover, controlled trial. Diving Hyperb Med. 2013;43:218–21. PMID: 24510327. [cited 2023 Jul 27]. Available from: https://dhmjournal.com/images/IndividArticles/43Dec/Peleg_dhm.43.4.218-221.pdf.
8 Ekanayake L, Doolette DJ. Effects of hyperbaric oxygen treatment on blood sugar levels and insulin levels in diabetics. SPUMS Journal. 2001;31:16–20. [cited 2023 Jul 27]. Available from: https://dhmjournal.com/images/IndividArticles/31March/Ekanayake_SPUMSJ.31.1.16-20.pdf.
9 George K, Ross D, Rowe L. Integration of data to establish a standard operating procedure for the diabetic patient undergoing hyperbaric oxygen therapy. J Wound Ostomy Continence Nurs. 2017;44:546–9. doi: 10.1097/WON.0000000000000377. PMID: 29117079.
10 Al-Waili NS, Butler GJ, Beale J, Abdullah MS, Finkelstein M, Merrow M, et al. Influences of hyperbaric oxygen on blood pressure, heart rate and blood glucose levels in patients with diabetes mellitus and hypertension. Arch Med Res. 2006;37:991–7. doi: 10.1016/j.arcmed.2006.05.009. PMID: 17045116.
11 Stevens SL, Narr AJ, Claus PL, Millman MP, Steinkraus LW, Shields RC, et al. The incidence of hypoglycemia during HBO_2 therapy: a retrospective review. Undersea Hyperb Med. 2015;42:191–6. PMID: 26152103.
12 Lo T, Delamora N, Daher N, Moore P. Glucose fluctuations in diabetic versus nondiabetic patients with chronic wounds undergoing hyperbaric oxygen therapy. J Wound Ostomy Continence Nurs. 2009;36(3). [cited 2023 Jul 27]. Available from: https://www.researchgate.net/publication/268106142_Glucose_Fluctuations_in_Diabetic_Versus_Non-Diabetic_Patients_with_Chronic_Wounds_Undergoing_Hyperbaric_Oxygen_Therapy.
13 Heyboer III M, Wojcik SM, Swaby J, Boes T. Blood glucose levels in diabetic patients undergoing hyperbaric oxygen therapy. Undersea Hyperb Med. 2019;46:437–45. PMID: 31509900.
14 Foley K, Banham N, Bonnington S, Gawthrope I. Oxygen toxicity seizure mimics. Diving Hyperb Med. 2021;51:161–6. doi: 10.28920/dhm51.2.161-166. PMID: 34157731. PMCID: PMC8426116.
15 Stevens SL, Sorita A, Narr AJ, Claus PL, Tescher A, Millman MP, et al. Applying quality improvement methods in a hyperbaric oxygen program: reducing unnecessary glucose testing. Undersea Hyperb Med. 2016;43:427–35. PMID: 28763172.
16 Nwafor TS, Collins N. Managing low blood glucose levels in patients undergoing hyperbaric oxygen therapy. Ostomy Wound Manage. 2014;60(4):12–5. PMID: 24706399.
17 Baines C, O'Rourke G, Miller C, Ford K, McGuiness W. Patient reported experience of blood glucose management when undergoing hyperbaric oxygen treatment. Collegian. 2019;26:428–34. doi: 10.1016/j.colegn.2018.11.004.
18 Xiang J, Wang S, He Y, Xu L, Zhang S, Tang Z. Reasonable glycemic control would help wound healing during the treatment of diabetic foot ulcers. Diabetes Ther. 2019;10:95–105. doi: 10.1007/s13300-018-0536-8. PMID: 30465160. PMCID: PMC6349287.
19 Lane KL, Abusamaan MS, Voss BF, Thurber EG, Al-Hajri N, Gopakumar S, et al. Glycemic control and diabetic foot ulcer outcomes: a systematic review and meta-analysis of observational studies. J Diabetes Complications. 2020;34(10):107638. doi: 10.1016/j.jdiacomp.2020.107638. PMID: 32527671. PMCID: PMC7721205.
20 O'Malley E, Otto G, Berkowicz L, Suttle K, Kulikovsky M, Sparlin S, et al. Blood glucose screening in diabetics undergoing hyperbaric oxygen therapy [Abstract]. Undersea Hyperb Med. 1998;25(Supp):49.
21 Pontani B, Warriner R, Ricken K, Cetina S. A Comprehensive intervention program to eliminate hypoglycemia as a complication of HBO therapy; preliminary report of an ongoing study [Abstract]. Undersea Hyperb Med. 1994;21(Suppl):79–80.

Acknowledgements

Thank you to the Royal Brisbane and Women's Hospital Hyperbaric Medicine Unit for their support.

Conflicts of interest and funding: nil

Submitted: 30 April 2023
Accepted after revision: 25 July 2023