Original articles

Analysis of two datasets of divers with actual or suspected decompression illness

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Key words
Clinical audit, decompression illness, decompression sickness, diving, recompression, treatment, hyperbaric oxygen therapy, outcome

Abstract
(Sayer MDJ, Ross JAS, Wilson CM. Analysis of two datasets of divers with actual or suspected decompression illness. *Diving and Hyperbaric Medicine*. 2009;39(3):126-32.)
Introduction: We examined national and single-centre datasets in Scotland to determine any trends in the treatment of diving-related disease and to assess how the choice of first treatment may be linked to the divers' condition on referral and on discharge.
Method: Two datasets were analysed: (1) 300 divers treated for actual or suspected decompression illness by the Dunstaffnage Hyperbaric Unit (Oban) between 1972 and 2007; and (2) 536 divers treated by the Scottish recompression chamber network between 1991 and 2003 (some data were common to both sets). The type and frequency of initial and any subsequent hyperbaric treatment used were examined. Any trends in demographics, reasons for diving, dive series profiles and condition on admission were examined.
Results: Ninety to 92 per cent of treated divers received standard or modified Royal Navy treatment table 62 (RN 62) or US Navy table 6 (USN 6) for their primary treatment. Nearly a third of the divers (32%) were rated as having a severe condition on admission; only 4% had a severe condition on discharge. Analysis of outcome versus treatment type was complicated by divers with more severe symptoms on referral tending to have a worse outcome (concomitant with their referral condition) while receiving more prolonged and complex treatments.
Conclusions: Shorter and shallower treatment tables (e.g., US Navy table 5, Royal Navy table 61), when used as first treatment, may result in poorer outcomes compared with RN 62/USN 6 treatment. Although subject to ongoing analysis, the shorter and/or shallower treatments have been discouraged as a first treatment in Scotland.

Introduction

The treatment of decompression illness (DCI) has been reviewed extensively and consists almost entirely of therapies based on re-pressurisation combined with breathing oxygen-rich gas mixtures over varying pressure/time schedules.[1–4] Recompression reduces bubble size with concomitant increase of internal bubble pressure (promoting spontaneous resolution and/or enhanced outward gas diffusion) with associated effects on adjacent tissues and secondary inflammation.[1–4] Oxygen-rich breathing gases increase inert-gas pressure differences between bubbles and external tissues while promoting recovery of hypoxic tissue damage and normal tissue function.[1–4]

Present-day therapeutic regimes for treating DCI are based mainly on treatment algorithms devised for military divers (e.g., US Navy, UK Royal Navy).[5,6] Therapeutic procedures developed in support of commercial diving operations are also sometimes employed, and modifications to standard recompression tables have been created for location-specific use.[7–9] The lack of definitive guidance for recompression therapy, coupled with ongoing changes in diving populations and their diving practices, means that periodic analysis of treatment practices may be beneficial.[10] Participants in a national registration service for emergency recompression in Scotland are required to contribute to a process of clinical audit.[11] This present account examines national and single-centre datasets being generated in Scotland to determine any trends in the treatment of diving-related disease. An initial attempt is made to assess how the choice of first treatment may be linked to the condition of the divers on referral and their subsequent condition on discharge.

Methods

The present study adheres to the procedures of implied consent operated by the UK National Health Service for clinical audit. The opinion of the Chairman of the North of Scotland Research Ethics Service was that ethical approval was not necessary for the conduct of clinical audit.

Two datasets were available to this study:

- A national dataset consisting of the audit records of 536 consecutive cases of DCI treated almost entirely by four Scottish recompression chambers (Aberdeen, Oban (Dunstaffnage), Orkney, and Cumbrae) from October 1991 to December 2003;
- A single-centre dataset made up of a summary of the clinical records of 300 consecutive cases of DCI treated at the Dunstaffnage Hyperbaric Unit near Oban from May 1972 to September 2007.

Both datasets adhered to the standardised data collection format detailed by Ross and Sayer; there was some duplication between datasets (n = 150).[11] Data entry was retrospective into both datasets prior to 1996; all entries were quality-assured at national and single-centre levels by authors of this account (JASR and CMW respectively). The total Dunstaffnage dataset (DHU_{total}) was divided into three subsets to assess any temporal variation (DHU_{100}: patients 1–100, 1972–1996; DHU_{200}: patients 101–200, 1996–2001; DHU_{300}: patients 201–300, 2001–2007).

The two databases were assessed initially for any trends in demographics, reasons for diving, dive history and clinical condition on admission. Analyses of treatments examined initial patient management such as surface oxygen, time from symptom onset to treatment, primary and secondary hyperbaric treatments, and condition on discharge.

It was expected that, in general, clinicians would choose more aggressive recompression schedules for the more severe disease states and that any analysis of the efficacy of treatment tables would be confounded by this. In addition, the predominant use of the Royal Navy treatment table 62 (US Navy treatment table 6 equivalent; RN 62/USN 6) in standard or modified forms produced a highly skewed population denominator. Nevertheless, the efficacy of the tables used in the first instance apart from the predominant RN 62/USN 6 and saturation treatment regimes was worthy of investigation. Treatment outcome was studied by comparing the recompression table groupings RN 62/USN 6, RN 62/USN 6 with extension, air or helium oxygen saturation and either hyperbaric oxygen (HBO) or RN 61/USN 5. A single US Navy treatment table 4 (USN 4) was omitted from the analysis since it was atypical. Clinical condition on referral was assessed for each treatment.

STATISTICAL ANALYSIS

Statistical analysis followed preliminary examination for normality using modified (Lilliefors) Kolmogorov-Smirnov tests with transformation where necessary; no assumptions were made for common data.[12–14] Definition of severity at presentation and outcome followed Ross and Sayer, where the most serious symptom defined patient condition.[11]

To compare treatment outcome, condition on discharge category was collapsed to 'good' outcome (no symptoms or minor pain or sensory symptoms only) and 'poor' outcome (any ataxia, any motor weakness, cerebral dysfunction or presence of a urinary catheter). The association between poor outcome and treatment method was assessed using a binary logistic regression model adjusted for time from onset of symptoms to recompression, age, the year in which the treatment took place, the condition of the patient on referral at two levels – 'mild' (pain only, sensory or ataxic symptoms) or 'severe' (motor weakness, nausea/vertigo or cerebral dysfunction) – and whether the patient's condition relapsed after treatment. Treatment efficacy was also assessed by the clinician's assessment of the immediate response to treatment.

The predictive power of the logistic regression model was assessed using receiver operating characteristic (ROC) curve analysis whereby the area under the ROC curve equates to the c-statistic. Acceptable discrimination within the model would be where c-statistic values were between 0.7 and 0.8; a value of 1.0 would be perfect discrimination.[15]

Results

Of the 536 patients examined in the Scottish dataset, 238

Table 1
Demographic and diving data for divers treated for actual or suspected decompression illness in Scotland (1991-2003) and Dunstaffnage Hyperbaric Unit (DHU; 1972-2007) (* age data: square root transformed; † depth-of-last-dive data did not conform to normality; ‡ data not collected).

	Scotland (1991–2003)	**DHU_{total}** (1972–2007)	**DHU_{100}** (1972–1996)	**DHU_{200}** (1996–2001)	**DHU_{300}** (2001–2007)
Male (%)	84	81	83	84	76
Age (y) mean*	34.4	35.0	33.4	34.7	36.7
95% CI*	+0.83, -0.82	+1.25, -1.23	+1.97, -1.92	+1.96, -1.89	+2.50, -2.42
median	34.0	34.0	33.0	35.0	34.5
range	14–73	16–77	17–66	18–62	16–77
Recreational (%)	85	84	86	86	79
Depth of last dive (m)†					
median	32	30	30	28	30
range	5–115	6–91	12–58	10–59	6–91
number (%) over 50 msw	30 (5.9)	16 (5.8)	2 (2.9)	8 (8.3)	5 (5.0)
Mean # of dives in last 48 h	‡	2.99	2.83	2.87	3.27
Sample size (n)	511–535	267–286	74–86	100	100

(44%) were treated by the Aberdeen centre, 151 (28%) were from Dunstaffnage (and were common to both datasets), 77 (14%) were from Orkney, 53 (10%) were from Cumbrae and 17 (3%) were from other treatment centres in Scotland or had received primary treatment outside Scotland prior to being transferred for secondary treatment. Overall, 96% of treated divers either made a full recovery or were left with only mild clinical residua.

The sex ratio of treated divers in all datasets was in the range of 76–84% male; 79–86% of patients treated were recreational divers (Table 1); there was no significant difference in sex ratio between the three subsets of DHU data (G-test, $P = 0.789$). Diver age ranged from 16–77 years; mean and median values ranged between 33 and 37 years (Table 1). There were no significant differences in diver age between the Scottish and DHU_{total} groups (Z-test, $P = 0.631$); mean age increased stepwise from DHU_{100} to DHU_{300} (Table 1) but the trend was not significant (Kruskal-Wallis, $P = 0.298$). The median depth of the incident (assumed last) dive in the Scottish data was not significantly different than that of the DHU_{total} group (Mann-Whitney, $P_{(same)} = 0.028$), and there were no significant differences between median depths of last dive in the DHU subsets (Kruskal-Wallis, $P = 0.833$). Nearly 6% of incident dives in the Scottish and DHU_{total} groups were deeper than 50 msw; this value ranged from 2% to 8% in the DHU subsets. The mean number of dives in the 48 h preceding the incident dive was approximately three in all groups where it was recorded (Table 1).

Of divers in DHU_{total}, 75% had received normobaric oxygen on transfer to DHU. However, there was an asymptotic trend with 84–88% receiving oxygen in the DHU_{200} and DHU_{300} groups, compared with 54% in the DHU_{100} group, which included the period prior to the widespread introduction of surface oxygen as a first-aid measure. Median (and interquartile range) time to treatment following onset of symptoms was 5.8 h (0.8–13.5) for Scottish data ($n = 470$) and 3.0 h (2.0–5.0) for DHU_{total} data ($n = 274$).

The Scottish data ($n = 535$) indicated that, on admission, 11.0% of divers had no symptoms, 25.4% had pain-only symptoms, 20.7% had altered sensation, 11.0% were ataxic, 17.8% had motor difficulties, 2.0% had bladder/rectal dysfunction and 12.0% had cerebral disturbances (including vestibular decompression sickness (DCS)). In total, 68% of divers captured in the Scottish dataset were considered to be in a mild to moderate condition on admission; 32% were considered severe. The DHU_{total} data ($n = 286$) were characterised on final diagnosis; the main category groups were 5.1% of divers being treated for omitted decompression, 4.4% for cutaneous DCS, 14.2% for pain-only, 3.6% for vestibular DCS, 59.2% for a neurological component, and 10.8% for an embolism.

In the Scottish dataset, 90% of primary treatments (n = 482/536) were RN 62/USN 6; 176 of those (37%) were extended versions of the table. One USN 4 was used with poor outcome. USN treatment table 5 (USN 5) was used eight times (either as USN 5 or the Royal Navy equivalent treatment table 61, RN 61) and low pressure (range 192–243 kPa) hyperbaric oxygen treatments were used 25 times.

RN 62 was used as the primary treatment table in 276 (92%) of cases in DHU_{total} and was modified (extended) in 127 (46%) of those uses; RN 61 was used in 13 (4%) as the primary treatment. Other tables employed for primary treatment were US Navy treatment table 7 (USN 7; $n = 3$), Comex 12 ($n = 3$), USN 6A ($n = 2$), USN 5A ($n = 2$) and Royal Navy table 66 ($n = 1$); on three occasions a RN 62 was converted to RN 51, 53 or 54. In DHU_{total} there were 158 secondary treatments of which 109 were Comex 12, 15 were RN 66, 12 were extended RN 62, nine were unmodified RN 62, two were RN 61 and one was a USN 7. Total treatment times per patient in the DHU_{200} and DHU_{300} groups were significantly longer than DHU_{100} values (Kruskal-Wallis, $P = 0.007$) although there were no significant differences in the numbers of treatments (Kruskal-Wallis, $P = 0.543$; Figures 1 and 2).

Table 2
First recompression treatment (as a percentage (rounded) of patients within their respective condition grading group assigned on referral) and days spent under care in relation to the severity of the patients' condition on first contact with medical services for all-Scotland dataset

Condition on referral	USN 6 RN 62	USN 6ext RN 62ext	Helium Saturation	USN 4	HBO Low pressure	USN 7	USN 5 RN 61	Total cases (*n*)
Pain only	67	26	1	0	6	0	1	161
Sensory	61	30	0	0	7	0	2	152
Ataxia	56	36	3	0	0	4	6	36
Motor	49	38	4	0	4	0	0	71
Nausea or vertigo	38	47	11	0	0	0	4	47
Cerebral	46	39	7	1	3	3	0	69
Total cases	57	33	3	1	1	1	2	536
Days in care								
(median IQR)	2 (2–3)	3 (2–4)	8 (6–12)		2 (1–3)	12 (6–27)	2 (1–3)	

Figure 1
Total hyperbaric treatment time per patient (h) at the 10, 25 and 50 percentiles for divers treated at Dunstaffnage Hyperbaric Unit 1972–2007 (n = 300; DHU_{total}), 1972–1996 (n = 100; DHU_{100}), 1996–2001 (n=100; DHU_{200}), and 2001–2007 (n = 100; DHU_{300})

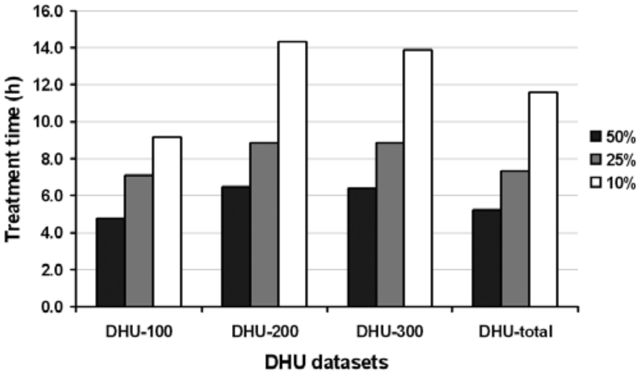
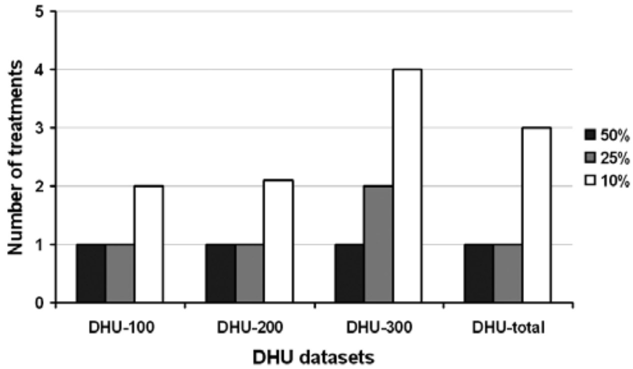


Figure 2
Total number of hyperbaric treatments per patient at the 10, 25 and 50 percentiles for divers treated at Dunstaffnage Hyperbaric Unit 1972–2007 (n = 300; DHU_{total}), 1972–1996 (n = 100; DHU_{100}), 1996–2001 (n=100; DHU_{200}), and 2001–2007 (n = 100; DHU_{300})



Relapses, defined as rapid and clinically significant deterioration or reversal of improvement following initial treatment, with new symptoms in most cases, occurred in equal proportions in both the Scottish and DHU_{total} groups (12%, *n* = 536 and 283, respectively). The time delay for relapse ranged from 0.33 to 6.20 h; although not significant, the relapse rate in the DHU_{300} group was 8% compared with a rate of 15% in DHU_{100}.

From the Scottish dataset, the type of treatment table employed for initial hyperbaric therapy was related to the severity of the presenting illness. Severe disease accounted for 28% of unmodified RN 62/USN 6 treatments, 43% of modified (extended) RN 62/USN 6 and 90% of the saturation treatments (Table 2). Only 21% of the other types of table used were associated with severe presentations and these were instead used predominantly to treat mild disease (Table 2). Longer and more aggressive forms of treatment tended to be related to a poorer patient outcome in the cases where condition on referral was more severe (Table 3).

In comparison with outcome after an unmodified RN 62/USN 6 treatment the odds for poor outcome when employing an extended RN 62/USN 6 treatment were 5.2 (95% CI 1.9, 14.1, $P = 0.001$) and 87.5 (95% CI 20.0, 382.3, $P < 0.001$) for a saturation treatment. The odds for a poor outcome for the other treatments were 9.0 (95% CI 1.3, 61.9, $P = 0.016$). Other significant factors in the analysis were age, severity on referral and relapse after treatment. The c-statistic for the regression model was 0.94 indicating a high predictive power. The initial employment of RN 61/USN 5 or low pressure hyperbaric oxygen treatments produced a much poorer response than the RN 62/USN 6 treatments (extended and non-extended; Table 4) but this does not necessarily relate to the clinical outcome at discharge.

Discussion

The data need to be considered in terms of both the general and particular approaches to handling a diving accident taken by the Scottish service. In general, first contact was rapidly

Table 3
Condition on discharge (as a percentage, rounded) and days spent in care in relation to the severity of the patients' condition on first contact with the medical services for all-Scotland database.

Days in care median (IQR)	Condition on referral	Complete resolution	Mild pain/ sensory	Motor or ataxia	Severe motor or ataxia/catheterised	Cerebral	Dead	Total cases (*n*)
2 (2–3)	Pain only	68	32	0	0	0	0	161
2 (2–3)	Sensory	71	28	1	0	0	0	152
2 (2–3)	Ataxia	72	22	6	0	0	0	36
3 (2–4)	Motor	59	23	7	7	4	0	71
3 (2–5)	Nausea or vertigo	60	13	23	0	4	0	47
3 (2–5)	Cerebral	61	10	10	4	13	1	69
2 (2–3)	Total cases	66	24	5	2	3	0	536
Days in care, median (IQR)		2 (2−3)	2 (2−3)	5 (4−7)	14 (8−17)	9 (4−14)		

Table 4
Response to treatment (as % rounded) against the initial treatment table; 'response to treatment' is the change in the patient's relative condition as a result of recompression treatment (i.e., a 'good' response can still be associated with a 'poor' condition on discharge)

Treatment	No symptoms at start and no change	Complete resolution	Major improvement	Moderate improvement	Slight/no improvement
RN62/USN6 (unmodified) (*n* = 306)	16	55	21	5	3
RN62/USN6 (extended) (*n* = 176)	3	42	44	7	4
Saturation Tx (*n* = 20)	0	15	60	15	10
RN61/USN5 or HBO (*n* = 33)	12	15	42	18	12

followed by a medical assessment of the victim's condition, ideally by the duty diving doctor talking to the patient or the patient's immediate carers at the scene of the accident. The available options, in order of priority and in relation to the patient's condition, were then:

- transfer to the nearest accident and emergency or trauma unit for resuscitation and stabilisation prior to assessment of the need for recompression;
- transfer to the nearest approved chamber for assessment and recompression if required;
- transfer to an accident and emergency unit or general practitioner for examination, emergency treatment if required and assessment of the need for recompression in collaboration with the duty diving doctor in Aberdeen.

The concept that rapid recompression is paramount, even in the absence of general supportive care, has never been accepted; in spite of more rapid treatment at Oban, outcomes were similar across all chambers.

Between 90 and 92% of all primary treatments delivered in the present study were standard or modified (extended) RN 62/USN 6. The other 8–10% ranged from longer or deeper tables that treated extremely severe presentation to shorter, shallower tables used mainly as precautionary treatments.

The rate of poor clinical outcome at discharge was 4% but patients who responded badly to treatment were more likely to have presented in a severe condition and, therefore, would tend to be treated by the deeper, longer therapies.[11] Subtracting that fraction of the treated population from the diving presentations in Scotland rated as 'severe' (32% of the total) shows that a considerable number of severe presentations were treated successfully with RN 62/USN 6 therapeutic tables. These oxygen tables have been highly predominant as primary treatments for DCS for well over 40 years and have replaced the previous use of single RN 61/USN 5 tables for all but precautionary or secondary therapy.[1–2] The level of satisfactory patient outcome in these data (96%) was high compared with previous similar studies.[3] However, although the major recompression schedule employed was the RN 62/USN 6 and overall outcome was good, these tables were used in the context of a recompression service with a wider capability since it was recognised that this recompression regime can be of limited efficacy in severe illness.[8,16]

During the course of this audit, a helium:oxygen Comex 30 table became available at all Scottish chambers. Throughout the audit period, intensive care at pressure and a helium:oxygen saturation capability to any required depth were available at the Aberdeen centre. If the initial condition of a patient exceeded the capability of the nearest chamber or the recompression treatment applied locally did not have a satisfactory outcome, then air transport to Aberdeen was used. Data for inter-unit transfers in the present study were too few to analyse (for example three of the last 200 DHU treatments resulted in transfer to Aberdeen; two of the last 200 DHU patients were transferred from Cumbrae). Helicopter transfers were used because other transport between treatment units is compromised by slow mountain roads and inter-island ferries (helicopter air transfer times are estimated at 16–22% of land-based times). Helicopter transfers occurred at a maximum altitude of 230 m above sea level compared with some roads having altitudes in excess of 305 m above sea level; clinically significant deteriorations were not observed in the patients undergoing transfer.

The predominance of the RN 62/USN 6 as the primary treatment table in the present study differs little from the recent accounts of Mitchell[17] and Müller et al.[18] However, this predominant use differs markedly from a review of treatment of 129 DCI cases in Italy.[19] Although that study showed that most treatments (87%) employed short oxygen/air tables, nearly 55% of that 87% were USN 5 tables or equivalents and 13% of patients were scored with residua one week post-treatment. The Scottish data show a highly infrequent employment of RN 61/USN 5 treatments with poor final outcome in only 4% of patients. However, direct comparison is inappropriate considering the lack of equivalent information on respective severity of clinical presentation or matching of the type of treatment to the severity of presentation.

In the present study, extended RN 62/USN 6 and saturation treatments were associated with poorer outcomes on discharge from care. Those treatments, however, were used proactively with regard to the patients' response to treatment. Where a patient did not respond to an unextended RN 62/USN 6 then the treatment was extended; if patients did not respond to the RN 62/USN 6 regime (with or without extension, but usually with) then a saturation treatment was used. In this context, the immediate response to treatment is relevant (Table 4). The favourable responses to treatment for saturation and extended RN 62/USN 6 can be taken in relation to a failure to achieve an acceptable response with unextended RN 62/USN 6 treatments. If the unextended RN 62/USN 6 had not been converted, the response to treatment for that regime would have appeared worse. The same argument does not apply to the shorter and/or shallower treatments (RN 61/USN 5 and low pressure HBO) where there is doubt about their acceptability as a first-line treatment for possible DCI; their use as initial hyperbaric therapies is now discouraged in Scotland.

Both USN and RN tables are part of a recompression therapy algorithm that is pro-active and treatments should not be prescribed without knowledge of the response of the patient to recompression treatment. The algorithms also describe options to be taken in the event of failure of the patient's condition to respond to recompression. At the time of this audit, these options were largely to compress to greater depths, in air, in an attempt to get a better response. Our experience is that not only has this approach failed to produce any further response to treatment, but it also exceeded the logistic capabilities of a local unit and put attendant staff at risk of a number of factors including nitrogen narcosis, oxygen toxicity and decompression illness, and could be followed by psychological issues.

In the event of recompression failure with the RN 62/USN 6, and if the patient's condition warranted it, the table was either converted into a helium:oxygen saturation at the depth of maximum clinical response (in Aberdeen), extended into a USN 7 at 283 kPa or completed and the patient transferred to Aberdeen for further treatment with helium:oxygen saturation.[20] Although a helium:oxygen Comex 30 capability has recently become available at all Scottish chambers, it has not yet been used. While response to treatment was poorer for saturation treatments, this should be considered in relation to how the treatment was used. Saturation treatment was only initiated if an initial RN 62/USN 6 treatment had failed to produce a major response or better. Had saturation treatment not been initiated, all 20 cases in this present study would probably have been associated with only a moderate to poor response to treatment. Similar considerations apply to where RN 62/USN 6 treatments are extended.

Examining the DHU data over three sequential time periods has shown some trends in treatment patterns. On a per patient basis, total treatment time increased. However, the lack of any increase in the number of treatments given tends to suggest that this is probably caused by an increased employment of extended RN 62/USN 6 treatments. Part of the reason for extending primary tables more routinely may have been as a response to the numbers of relapses in earlier datasets.[21,22] Based on the immediate dive history, types of presentation and/or reason for diving (e.g., shellfish diving), treatments were extended more frequently. At DHU, relapse rates were halved between the DHU_{100} and DHU_{300} groups although there was a concomitant decrease in clinical severity on presentation.

Increased treatment times per patient may have been influenced by a higher prevalence of vestibular decompression sickness but also by changes in treatment practice; more secondary treatments were provided per patient at DHU from 1996 onwards. Treatment for severe vestibular DCS at DHU is based on RN 62/USN 6 tables but has evolved to minimise exposure to 283 kPa oxygen if the patient is stable, while fully extending treatment at 191 kPa. The primary treatment is then followed with a series of Comex 12 treatments, twice daily until no significant improvement is measured. Comex 12 (223 kPa air/oxygen table) replaced RN 66 (243 kPa air/oxygen table) primarily because of safety concerns to the internal attendants although, subjectively, patients appeared to recover better breathing 223 kPa oxygen compared with 243 kPa possibly because O_2 delivery may be improved where pO_2 vaso-constriction is less. Typically, therefore, treatment of vestibular DCI at DHU consists of an initial modified RN 62/USN 6 followed over about two to four days by a series of approximately 3–8 Comex 12 treatments, with treatment continuing until no improvement is measured. A recent review of diving-related inner ear problems noted that, over the past 10–15 years, the incidence of inner ear DCS as a form of DCI has changed from rare to common with a much higher awareness of its symptomatology.[23]

Although agreeing with Mitchell about the lack of substantive evidence for any particular treatment regime, changes can be made to how the treatment is administered in general and how standard treatments can be modified to anticipate the condition and reaction of certain groups of diver.[17,21,22] Although clinical outcome with an initial RN 62/USN 6 approach was associated with good outcome statistics it cannot be said that the same standard would be achieved using these tables in isolation. Accordingly, there is no plan to limit the therapeutic capability of the Scottish service on the basis of these audit results since it is recognised that decompression illness has potentially fatal consequences, can require an intensive care approach to treatment and does not always respond to the initial RN 62/USN 6 recompression treatment.

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