A NEW SYSTEM FOR SCORING SEVERITY AND MEASURING RECOVERY IN DECOMPRESSION ILLNESS

Simon Mitchell, Tony Holley and Des Gorman

Key Words
Decompression sickness, treatment sequelae.

Introduction

A prerequisite for the investigation of any therapy for a disease is an objective scoring system for both severity at presentation and response to treatment. Decompression illness (DCI) is particularly difficult in this context as the clinical presentations are protean. The conventional practice of describing recoveries as nil, incomplete or complete can be very misleading, as this results in a relative weighting for a complete recovery of paraesthesiae in a left ring finger over a 95% recovery in a tetraplegic. The overall effect is to introduce a potentially significant bias.

Several classification or scoring systems for DCI severity have been proposed. These systems either classify DCI patients into prognostic groups or score disease severity in individual patients.

For example, Dutka[1] proposed a modification to the currently popular descriptive classification of DCI.[2] The modified system classifies DCI according to the latency of onset; the "tempo" of disease evolution after symptoms appear; and the organ systems affected. This modification separates DCI patients into more clearly defined groups and may have more prognostic value than the original system, although this has not been established. In addition, while this novel system will enable group selection, it will not provide a means of tracking patient progress during and after treatment.

An easily calculated severity score, derived from the sum of a sensory symptom grade and a motor symptom grade, was proposed for neurological DCI by Dick and Massey.[3] Ball subsequently reported this system to have prognostic value and used the percentage change in scores to track patient progress during treatment.[4] However, the system is insensitive to those divers with primarily dorsal column spinal lesions and populations of patients who do not have objective neurological findings; as such it would therefore not be applicable to approximately 50% of patients presenting to Australasian hyperbaric units.[5]

Boussuges et al.[6] have proposed a "gravity score" for DCI which is derived from a summation of sub-scores allocated on the basis of: the presence of repetitive diving; the clinical course of the disease before treatment; and the presence of selected neurological findings. Selection of these criteria and the weighting of the sub-scores allocated to them was based on an analysis of 96 DCI cases. The scoring system itself was then validated on another population of 66 divers. This system has prognostic validity and is promoted as useful for "assessing the gravity of a population with a view to comparing the efficiency of different therapeutic protocols". However, the system is not designed to track a patient's progress during treatment nor to quantify recovery. Also, the system is not applicable to populations of patients who do not have objective neurological findings.

Kelleher and his colleagues[7] have developed a system to predict the probability of incomplete resolution after the first recompression treatment. They reviewed 214 cases of neurological DCI and recorded the type of deficit (for example sensory or motor), the number and anatomical location of sites involved, and outcome after the first treatment. They analysed these data to determine the prognostic significance of: the type of deficit; combinations of deficit types and the number of sites involved; and combinations of deficit types and the anatomical sites involved. While this valuable work allows some assessment of prognosis, it cannot be used to track patient progress or recovery.

The Slark Hyperbaric Unit at the Royal New Zealand Navy Hospital has initiated a randomised, prospective, controlled double blind trial of lignocaine (lidocaine) as a adjuvant to recompression therapy in the treatment of DCI. For the purposes of this trial we required a scoring system for DCI severity which provided:

1. applicability to "all" patients presenting with DCI (not just those with spinal syndromes);
2. a numerical index of severity at presentation;
3. quantitative tracking of patient progress during treatment; and
4. an index of recovery to allow comparison between patient groups.

None of the DCI severity scoring systems currently proposed or in place meets these requirements. Therefore we have designed the system described in this paper.

Methods

The fundamental premise upon which the RNZN scoring system is based is that each symptom or sign of DCI will be scored. The scores for any symptoms or signs present will then be summed to give an overall DCI severity score. This score can be calculated at any point during a patient's treatment and the degree of any recovery (recovery score) determined by subtracting the current from the initial severity score.

The initial step in the design of this system was to produce a scoring algorithm which accounted for the severity of each symptom or sign of DCI, but with no attempt to define relative significance or importance. A four point scale, from 0 (symptom or sign absent) to 3 (maximum manifestation) was adopted and a descriptive guide to the allocation of these scores was designed for each symptom and sign (see Table 1 pages 86-91). Scores derived at admission are referred to as "admission scores" and scores derived at follow up assessments are referred to as "progress scores".

The second step was to derive a series of conversion factors which would modify the admission or progress scores for each symptom or sign to better indicate its relative prognostic and functional significance. Because of the general lack of objective prognostic data for individual symptoms and signs of DCI, these draft conversion factors were obtained by the independent rating of each symptom and sign by three experienced diving physicians. The scales used in this process were: specificity for DCI; natural history if untreated; and potential for incapacity (Table 2). The natural history scale was numerically emphasised since a symptom or sign which is likely to resolve spontaneously, even if untreated, was considered to be unimportant. A fourth scale, the co-dependence compensation (Table 2), was added to increase the importance of symptoms or signs whose presence would prevent or invalidate both the assessment of certain other manifestations and any contribution by the latter to the DCI severity score. Co-dependent symptom relationships that were recognised are listed in Table 3 (page 91).

For each symptom or sign, the ratings on the four scales were summed to derive an importance index (maximum 20) which was assumed to reflect relative importance (Table 4 page 92). Next, the importance index for each symptom or sign was divided by 3 (the maximum score for any manifestation on the unweighted scales in Table 1) in order to derive a conversion factor. For example, the conversion factor for lower limb weakness is derived from its importance index of 20, divided by 3, to give 6.67.

The third step was to add a second conversion factor to allow for the progression of disease before recompression, as this has been shown to be prognostically important.[6] The four disease progression categories previously used in the descriptive classification for DCI[2] were adopted for use in this scoring system. The conversion factors were arbitrarily allocated as follows: symptom static 1.0; symptom remitting 0.75; symptom progressive 1.25; symptom relapsing 1.25. The "progressive category" would include the group of "abrupt" onset patients considered prognostically important by Dutka.[1] Treatment of lignocaine trial patients is stopped when all symptoms have either resolved or the rate of change over two consecutive treatments approaches zero. It follows that the "static" conversion factor (1.0) is assumed at discharge and subsequent reviews.

TABLE 2

FOUR IMPORTANCE WEIGHTING SCALES FOR A SYMPTOM OF DCI

1 The **specificity** of the symptom in the context of a diver presenting with possible DCI
- 0 = often not related to DCI
- 1 = attribution to DCI sometimes doubtful
- 2 = almost always related to DCI

2 The **natural history** of the symptom if the diver was untreated.
- 0 = almost certain to resolve spontaneously
- 2 = very likely to resolve spontaneously
- 4 = sometimes resolves spontaneously
- 6 = very likely to persist
- 8 = almost certain to persist

3 The **incapacity potential** of the symptom assuming it persists at a moderate severity
- 0 = almost no potential to incapacitate
- 1 = annoyance potential with no effect on activities of daily living / social / employment
- 2 = potential to cause disruption to work but unlikely to cause loss of job, may affect socially but not activities of daily living
- 3 = potential for profound effect on employability, possible loss of job, but unlikely to effect independence
- 4 = likely to cause loss of job and dependence in activities of daily living

4 The **co-dependence compensation** loading for the symptom
- 0 = no co-dependent symptoms
- 2 = 1 co-dependent symptom
- 4 = 2 co-dependent symptoms
- 6 = 3 or more co-dependent symptoms

The DCI severity score can be calculated by:
1. scoring each symptom or sign using the unweighted scoring system (Table 1);
2. multiplying the unweighted score for each symptom or sign score by its importance and progression conversion factors (CFs); and
3. summing the products of these calculations (excluding co-dependent symptoms).

A DCI recovery score can be calculated by subtracting a current severity score from the initial severity

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TABLE 1.

UNWEIGHTED SCORING SYSTEM FOR INITIAL ASSESSMENT OF EACH SYMPTOM OF DCI
(Admission scores are calculated at admission. Progress scores are calculated at later reviews)

1 LETHARGY / FATIGUE / MALAISE / FEELING "OFF COLOUR"
(Note: this group of non specific "constitutional" symptoms is treated as a single entity. There is a separate scale for mood changes and for cognitive changes)

Admission score

The patient is asked to grade symptoms as: **0** = nil; **1**= mild; **2** = moderate; **3** = severe. As a guide, score 1 would correlate with comments such as "I feel more tired / demotivated / "off colour" than usual but I'm coping easily"; score 2 would correlate with comments such as "I feel more tired / demotivated / "off colour" than usual and I'm having trouble getting on with normal daily activities"; score 3 would correlate with comments such as "I feel more tired / demotivated / "off colour" than usual and I just want to stay in bed / can't cope with normal daily activities".

At reviews the patient completes a 0-10 visual analogue scale (VAS) which compares the current severity with that *just prior to initiation of treatment.*

Progress score = admission score x (current VAS score ÷ 10)

2 MOOD CHANGE
(Note: be careful not to confuse this with lethargy etc above)

Admission score

The patient is asked to grade any mood change as: **0** = nil; **1** = minimal change; **2** = marked change; **3** = severe change. As a guide: score 1 might correspond to comments like "I feel a bit down / irritable more often than I used to"; score 2 might correspond to comments like "I feel quite depressed / angry a lot of the time"; and score 3 might be indicated by suicidal ideation or violent behaviour.

At reviews the patient completes a 0-10 visual analogue scale which compares the current severity with that *just prior to initiation of treatment.*

Progress score is given by admission score x (current VAS score ÷ 10)

3 HEADACHE

Admission score

The patient is asked to grade headache as: **0** = nil; **1** = mild; **2** = moderate; **3** = severe. As a guide, score 1 would correlate with comments such as "It's there but I only notice it if I think about it"; score 2 would correlate with comments such as "I am aware of it all the time but it doesn't affect my normal activities; score 3 would correlate with comments such as "It's so bad that I can't concentrate on anything else".

At reviews the patient completes a 0-10 visual analogue scale which compares the current severity with that *just prior to initiation of treatment.*

Progress score = admission score x (current VAS score ÷ 10).

4 NAUSEA

Admission score

The patient is asked to grade nausea as: **0** = nil; **1** = mild; **2** = moderate; **3** = severe. As a guide, score 1 implies that the patient feels "queasy" but not frankly nauseated or near to vomiting; score 2 implies that the patient is constantly aware of nausea and feels they may vomit; score 3 implies that the patient is incapacitated with nausea or is vomiting.

At reviews the patient completes a 0-10 visual analogue scale which compares the current severity with that *just prior to initiation of treatment*.

Progress score = admission score x (current VAS score ÷ 10).

5 TINNITUS

Note: Tinnitus is only scored greater than 0 if it is suspected as arising secondary to DCI. Barotrauma is not considered.

Admission score

The patient is asked to grade tinnitus as: **0** = nil; **1** = one ear; **2** = both ears; **3** = tinnitus in either ear can be heard over normal conversation.

At reviews the patient completes a 0-10 visual analogue scale which compares the current severity with that *just prior to initiation of treatment*.

Progress score = admission score x (current VAS score ÷ 10)

6 PARAESTHESIAE (TINGLING) AND OTHER SUBJECTIVE SENSORY ALTERATIONS

Two separate sub-scores are used to derive both the admission score and the progress score.

Intensity score

The patient is asked to grade paraesthesiae or another subjective sensory alteration as: **0** = nil; **1** = mild; **2** = moderate; **3** = severe, at the *worst location*. As a guide to paraesthesiae, score 1 implies equivocal and perhaps intermittent tingling; score 2 implies definite constant tingling; and score 3 implies uncomfortable prominent pins and needles. Where other subjective sensory alterations exist, or coexist with paraesthesiae, grade the most prominent alteration. For alterations other than paraesthesiae no guidelines are presented and the patient's subjective grading of mild, moderate, or severe will determine the score.

Distribution score

Consider each limb and girdle, the chest, the back, and the head as a "region": **0** = nil; **1** = one region; **2** = two regions; **3** = more than two regions.

Admission score = (intensity score + distribution score) ÷ 2

At reviews, as at admission, paraesthesiae (and / or other subjective sensory alterations) are evaluated with respect to both intensity and distribution.

Intensity

The patient completes a 0-10 visual analogue scale which compares the current intensity of the worst site and modality with those *just prior to initiation of treatment* (do not worry if the worst site and modality have changed).

Distribution score

Consider each limb and girdle, the chest, the back, and the head as a "region": **0** = nil; **1** = one region; **2** = two regions; **3** = more than two regions.

Progress score = [(admission intensity score x (current VAS score ÷ 10)) + current distribution score] ÷ 2

7 MUSCULOSKELETAL PAIN (INCLUDING GIRDLE PAIN)

Two separate sub-scores are used to derive both the admission score and the progress score.

Intensity score

The patient is asked to identify the location of greatest pain and mark a 0 - 10 visual analogue scale according to

how the pain compares to the worst pain they have ever felt. The intensity score is then derived as follows: VAS 0 = score **0**; VAS 1 - 3 = score **1**; VAS 4 - 7 = score **2**; VAS 8 - 10 = score **3**.

Distribution score

Consider each arm / shoulder; leg / hip; the back; the neck; and the chest as a"region": **0** = nil; **1** = one region; **2** = two regions; **3** = more than two regions.

Admission score = (intensity score + distribution score) ÷ 2

At review, as at admission, musculoskeletal pain is evaluated with respect to both intensity and distribution.

Intensity

The patient identifies the *current* worst site and completes a 0 - 10 visual analogue scale which compares the current severity at that site with the pain at the worst site *just prior to initiation of treatment*, **not** against the worst pain ever felt (do not worry if the worst site has changed).

Distribution score

Consider each arm / shoulder, leg / hip, the back, the neck, and the chest as a"region": **0** = nil; **1** = one region; **2** = two regions; **3** = more than two regions.

Progress score = [(admission intensity score x (current VAS score ÷ 10)) + current distribution score] ÷ 2

8 WEAKNESS

Two separate sub-scores are used to derive both the admission score and the progress score.

Intensity score

Grade the power in the weakest muscle group using the standard system, viz: **5** = normal; **4** = less than normal but able to resist gravity plus some extra force; **3** = able to resist gravity only; **2** = unable to resist gravity, but movement around a supported joint; **1**= flicker of movement only; **0** = no movement. The intensity score is then derived as follows: Power 0-2 = score **3**; Power 3 = score **2**; Power 4 = score **1**; Power 5 = score **0**.

Distribution score

Score the number of locations at which objective weakness is detected as follows: **0** = nil; **1** = one muscle group; **2** = more than one muscle group on same limb; **3** = weakness in more than one limb.

Admission score = (intensity score + distribution score) ÷ 2

Progress score is derived exactly as for admission score.

9 COGNITIVE DISTURBANCE

(*Note: includes problems with memory, attention, concentration)*

Admission score

Perform an MMSE and elicit the degree to which the patient feels they are impaired with respect to functions such as concentration, memory, attention. Score as follows: **0** = no impairment; **1** = mild impairment with no significant difficulty working; **2** = moderate impairment such that work would be difficult; **3** = essentially unable to work because of cognitive difficulty or MMSE score < 25. Note: if there is a clear explanation for a poor MMSE score such as poor educational level, do not consider the MMSE result in allocating a score.

Progress score is calculated exactly as for admission score.

10 OBJECTIVE SENSORY ALTERATION

These scores grade objective changes to touch, pain, temperature, vibration, proprioception. *(Note, the pairings of*

pain and temperature, and vibration and proprioception, are each considered as one modality.)

Two separate sub-scores are used to derive both the admission score and the progress score.

Intensity score

Score **0** = no abnormality; Score **1** = single modality affected; Score **2** = two modalities affected; Score **3** = three modalities affected.

Distribution score

Score **0** = no abnormality; Score **1** = one limb only affected; Score **2** = greater involvement than one limb but changes unilateral; Score **3** = greater involvement than one limb and changes bilateral (includes saddle area deficits).

Admission score = (intensity score + distribution score) ÷ 2

Progress score is calculated exactly as for admission score.

11 VISUAL DISTURBANCE

Admission score

A visual disturbance is scored as follows: **0** = nil; **1** = subjective deficit but no signs; **2** = visual field defect to confrontation or other signs on examination; **3** = blindness (less than 6/60 vision in either or both eyes).

Progress score is calculated exactly as for admission score.

12 CO-ORDINATION

Admission score

Assessed by finger-nose-finger, rapid alternating movement, and heel-knee-shin tests. **0** = no deficit; **1** = subtle difficulty, for example, occasional past pointing or tremor; **2** = clear evidence of past pointing, tremor, dysdiadochokinesis, **3** = frank inability to perform any one test.

Progress score is calculated exactly as for admission score.

13 GAIT

Admission score

A gait disturbance is scored as follows: **0** = no deficit; **1** = walks unaided at normal pace but gait abnormal; **2** = walks unaided but pace and gait abnormal; **3** = cannot walk without support or cannot walk at all.

Progress score is calculated exactly as for admission score.

14 BALANCE

Record the best time (seconds) of four attempts at the Sharpened Romberg test (SRT) (maximum of 60 seconds). If the patient achieves 60 seconds on any attempt, no further attempts are necessary.

Admission score

Scoring is as follows: best SRT time 41 - 60 seconds = score **0**; 26 - 40 seconds = **1**; 11 - 25 seconds = **2**; 0 - 10 seconds = **3**.

Progress score is calculated exactly as for admission score.

15 SPEECH

Admission score

A speech disturbance is scored as follows: **0** = no deficit; **1** = subjective abnormality only; **2** = mildly abnormal, for example, slight speech slurring; **3** = definite abnormality, for example, significant dysarthria, dysphasia.

Progress score is calculated exactly as for admission score.

16 REFLEXES

Admission score

Examination of the reflexes is scored as follows: **0** = no abnormality; **1** = abnormal reflexes confined to one limb; **2** = abnormal reflexes in more than one limb; **3** = abnormal reflexes plus up-going plantar(s) or clonus.

Progress score is calculated exactly as for admission score.

17 GENITO-URINARY FUNCTION

Admission score

GU function is scored as follows: **0** = no problem; **1** = subjective difficulty with any of: initiating stream; power of flow; or stopping stream; **2** = clear objective difficulty with any of: initiating stream; power of flow; or stopping stream, but still able to void; **3** = any of gross incontinence; inability to void; impotence.

Progress score is calculated exactly as for admission score.

18 RASH.

Admission score

Rash attributable to DCI is graded as follows: **0** = no rash; **1** = fine macular rash present but difficult to see; **2** = distinct rash; **3** = prominent erythematous rash with raised macules.

Progress score is calculated exactly as for admission score.

19 HEARING LOSS

Admission score

If the patient believes that hearing loss has occurred as a result of DCI, perform an audiogram and examine the ears. **If** the audiogram shows a sensorineural loss, there are symptoms (other than audiovestibular) to support the diagnosis of DCI and there is no clear evidence of middle ear barotrauma beyond grade II, then score the patient as follows: score **0** = subjective changes with normal audiogram (no loss greater than 20 dB at any frequency in either ear); score **1** = hearing loss 20-40 dB any frequency either ear; score **2** = hearing loss 40-60 dB any frequency both ears; score **3** = hearing loss greater than 60 dB either or both ears.

Progress score is calculated exactly as for admission score.

20 DIZZINESS / VERTIGO

Admission score

If there is vertigo / dizziness in association with non-audiovestibular symptoms typical of DCI, then score the dizziness / vertigo as follows: score **0** = nil; score **1** = subjective “dizziness” without true vertigo; score **2** = true vertigo (accompanied by nystagmus) intermittently or with provocation; score **3** = unremitting true vertigo.

Progress score is calculated exactly as for admission score.

21 BOWEL DYSFUNCTION

Admission score

Bowel dysfunction is scored as follows: score **0** = no dysfunction; score **1** = subjective change only; score **2** = decreased anal sphincter tone without fecal incontinence; score **3** = decreased anal sphincter tone with fecal incontinence.

Progress score is calculated exactly as for admission score.

22 LYMPHATIC INVOLVEMENT

Admission score

Consider each of the anterior cervical, sub-mental, maxillary, posterior triangle, axillary, supra-clavicular, inguinal areas as a "node region". Where lymphatic involvement arises in relation to other symptoms of DCI, score as follows: score **0** = nil; score **1** = enlarged tender lymph nodes in one node region; score **2** = enlarged tender lymph nodes in more than one node region; score **3** = enlarged tender lymph nodes with associated oedema.

Progress score is calculated exactly as for admission score.

TABLE 3

CO-DEPENDENT SYMPTOM RELATIONSHIPS

Primary symptom	Co-dependent symptoms that are not used in calculation of the severity score
Lower limb weakness	Gait disturbance
	Balance disturbance
	Lower limb coordination
Upper limb weakness	Upper limb co-ordination
Objective sensory change	Paraesthesiae and other subjective sensory change
Balance disturbance	Gait disturbance
Dizziness / vertigo	Balance disturbance
Lower limb co-ordination	Gait disturbance

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score. Where a full recovery has occurred, the recovery score will be equal to the initial severity score. Where no improvement has occurred, the recovery score will be 0, and if the patient has actually deteriorated the score will be negative.

Clearly, some patients cannot or should not be assessed using this algorithm as this system can only be used for patients who have undergone an assessment which can detect all relevant disease manifestations. Consequently, this would exclude the following patients: those who require emergency recompression; those whose Glasgow coma score (GCS) is less than 15/15; those who the examiner is reluctant to move from the supine position for fear of posturally induced arterial gas embolism; or those who are not fluent in the same language as the examining doctor.

Case reports

Two cases are presented below to illustrate the application of the system.

Case 1

A 32 year old male had dived to 21 m for 40 minutes. He presented 30 hours after diving.

Admission symptoms

- Intense lethargy
- Mood swings (transient emotional shifts e.g. started crying for no reason)
- Nausea without vomiting
- Bilateral shoulder pain 2/10
- A fine, difficult to see, rash on his chest
- (all symptoms static, except shoulder pain which was remitting)

TABLE 4

DERIVATION OF THE IMPORTANCE INDEX AND CONVERSION FACTOR FOR EACH SYMPTOM

Symptom / sign	Specificity	Natural history	Incapacity	Co-dependent	Importance index	Conversion factor
Weakness lower limbs	2	8	4	6	20	**6.67**
Weakness upper limbs	2	8	4	2	16	**5.33**
Genito-urinary disturbance	2	8	3	0	13	**4.33**
Gait disturbance	2	6	4	0	12	**4.00**
Objective sensory change	2	6	2	2	12	**4.00**
Bowel dysfunction	2	6	3	0	11	**3.67**
Coordination deficit lower limb	2	4	3	2	11	**3.67**
Balance disturbance	1	4	3	2	10	**3.33**
Visual disturbance	2	4	3	0	9	**3.00**
Coordination deficit upper limb	2	4	3	0	9	**3.00**
Speech disturbance	2	4	3	0	9	**3.00**
Hearing loss	0	6	3	0	9	**3.00**
Mood disturbance	1	4	3	0	8	**2.67**
Cognitive disturbance	1	4	3	0	8	**2.67**
Dizziness / vertigo	1	0	4	2	8	**2.67**
Tinnitus	0	6	1	0	7	**2.33**
Paraesthesiae or other subjective sensory change	2	2	1	0	5	**1.67**
Musculoskeletal pain	1	2	2	0	5	**1.67**
Abnormal reflexes	1	4	0	0	5	**1.67**
Lymphatic involvement	1	2	1	0	4	**1.33**
Nausea	0	0	2	0	2	**0.66**
Lethargy / fatigue	0	0	2	0	2	**0.66**
Headache	0	0	2	0	2	**0.66**
Rash	1	0	1	0	2	**0.66**

Admission diagnosis

Musculoskeletal / constitutional / ? neurological DCI

Severity score at admission (CF = conversion factor)

Admission score lethargy = 3 x CF importance 0.66 xCF progress 1 = 2

Admission score mood = 2 x CF importance 2.67 x CF progress 1 = 5.34

Admission score nausea = 1 x CF importance 0.66 x CF progress 1 = 0.66

Admission score pain = 1.5 x CF importance 1.67 x CF progress 0.75 = 1.9

Admission score rash = 1 x CF importance 0.66 x CF progress 1 = 0.66

Score = 2 + 5.34 + 0.66 + 1.9 + 0.66 = 10.6

Discharge symptoms

None

Severity score at discharge:

No symptoms therefore Score = 0

Recovery score at discharge:

Severity admission 10.6 - discharge 0 = Score 10.6

Case 2

A 33 year old male had dived to 55 m for 15 minutes with a rapid ascent. He presented 2 hours after diving.

Admission symptoms

Pain right shoulder 2/10

Paraesthesiae both legs constant and prominent

Weakness all groups both legs, worst 3/5

Unable to pass urine

Unable to walk

Objective deficit to light touch and pain both legs

Balance - unable to stand unsupported

Coordination - Unable to perform heel-knee-shin test (HKS) on left, clumsy on right

Reflexes - clonus at both ankles, bilateral up-going plantars

(All symptoms progressive, except shoulder pain which was static)

Admission diagnosis
Progressive neurological (spinal) DCI

Severity score at admission (CF = conversion factor)
- Admission score pain = 1 x CF importance 1.67 x CF progress 1 = 1.7
- Admission score paraesthesiae = 2 x CF importance 1.67 x CF progress 1.25 = 4.2
- Admission score lower limb weakness = 2.5 x CF importance 6.67 x CF progress 1.25 = 20.8
- Admission score bladder = 3 x CF importance 4.33 x CF progress 1.25 = 16.2
- Admission score gait = 3 x CF importance 4 x CF progress 1.25 = 15
- Admission score objective sensory change= 2.5 x CF importance 4 x CF progress 1.25 = 12.5
- Admission score balance = 3 x CF importance 3.33 x CF progress 1.25 = 12.5
- Admission score lower limb co-ordination = 3 x CF importance 3.67 x CF progress 1.25 = 13.8
- Admission score reflexes = 3 x CF importance 1.67 x CF progress 1.25 = 6.3

Note. Gait, balance, and coordination are co-dependents of lower limb weakness; paraesthesiae is a co-dependent of objective sensory change. These scores are therefore not included in the severity score calculation.

Score = 1.7 + 20.8 + 16.2 + 12.5 + 6.3 = 57.5

Discharge symptoms
Reflexes, clonus at left ankle
Gait, limping but normal pace
Objective deficit to light touch and pain in both legs
Balance, sharpened Romberg test score 35 seconds

Severity score at discharge (CF = conversion factor)
- Progress score reflexes = 3 x CF importance 1.67 x CF progress 1 = 5
- Progress score gait = 1 x CF importance 4 x CF progress 1 = 4
- Progress score objective sensory change = 2.5 x CF importance 4 x CF progress 1 = 10
- Progress score balance = 1 x CF importance 3.33 x CF progress 1 = 3.33

Note. With the weakness resolved, gait and balance are no longer co-dependent and these are included in the calculation of the discharge severity score.

Score = 5 + 4 + 10 + 3.3 = 22.3

Recovery score at discharge

Severity admission 57.5 - discharge 22.3 = Score 35.2

Discussion

Although the development of this scoring system for DCI severity is cumbersome to describe, the system is simple to use. Importantly, it can be applied to divers presenting with a wider spectrum of clinical problems than any of the others proposed. Indeed, this is the first system which allows severity scoring in those divers who present with either trivial or no neurological signs: a presentation which we see commonly in Australasian sport divers and consider to be important.

The prognostic significance of many of the symptoms and signs of DCI is not described by data, and it follows that assessment of their relative importance for a scoring system of the type described here will inevitably involve subjective ratings. We have rationalised this process by the use of rating scales designed to reflect both prognostic significance and incapacity potential. This rating system has resulted in a ranking of relative importance (Table 4 page 92) which seems consistent with the limited data which establishes prognostic significance for some symptoms and signs of DCI.[4,6,7]

This system has the significant advantage of providing a recovery score which should allow comparison of recovery between patient groups. It is notable that the first of the two illustrative cases presented here achieved full recovery, while the second did not. However, the recovery achieved by the second patient was significantly greater from a functional perspective, and this is reflected in the recovery scores. Quite the opposite interpretation would accrue from the traditional consideration of recovery as “complete” or “incomplete”. We have chosen to assess recovery by subtracting the score at review from the initial score, as this method gives the most accurate recovery measurement. Other authors using scoring systems have calculated “percentage recovery”,[4] but unless cases are stratified to account for severity, this system risks creating the same error as the division of recovery into complete or incomplete categories.

We propose that this system is useful in the context of clinical trials in DCI therapeutics. The system is designed to be easily adjusted and patients re-scored either in response to suggestions generated by this discussion paper, or as data describing the prognostic significance of symptoms and signs accumulate. Dr Tony Holley has completed a validation study of 100 cases of DCI treated at the Royal New Zealand Navy Hospital which investigates the prognostic value of the severity score at admission. This will be presented at the Undersea and Hyperbaric Medicine Society 1997 Annual Scientific Meeting and published in a later edition of the SPUMS Journal as his DipDHM project.

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Acknowledgement

We thank Dr Michael Davis, Director of the Christchurch Hospital Hyperbaric Medicine Unit, for his assistance with the importance rating of symptoms and signs of DCI.

Dr Simon Mitchell is the Director of the Slark Hyperbaric Unit at the Royal New Zealand Navy Hospital.

Dr Tony Holley is a full time Medical Officer at the Royal New Zealand Navy Hospital.

Dr Des Gorman is Associate Professor of Medicine at the School of Medicine, University of Auckland, and Visiting Consultant in Diving and Hyperbaric Medicine at the Slark Hyperbaric Unit.

Address for correspondence

Dr Simon Mitchell, Slark Hyperbaric Unit, Naval Base, Auckland, New Zealand. Phone +64-9-445-5922. Fax +64-9-445-5941.

NON-STEROIDAL ANTI-INFLAMMATORY DRUGS IN DECOMPRESSION ILLNESS: A PRELIMINARY REPORT

Mike Bennett

Key Words

Decompression illness, drugs, hyperbaric oxygen, treatment.

Introduction

This brief presentation is a progress report on the multi-centre, randomised controlled trial currently underway into the efficacy of adjunctive tenoxicam (Tilcotil, Roche Pharmaceuticals), a non-steroidal anti-inflammatory drug (NSAID), in the treatment of decompression illness (DCI). The pharmacology of such an agent and the rationale for administration are subjects for another presentation at this meeting and so will not be dealt with in any detail.

At the Prince Henry and Prince of Wales Hospitals in Sydney it has been the practice of some of our clinicians to administer a NSAID as adjunctive therapy for divers (and others) suffering with DCI. Thus, in addition to standard recompression tables and fluid replacement, divers would typically receive piroxicam (Feldene - Roerig Pharmaceuticals) dispersible 20 mg daily for 7 days in the expectation that such treatment may improve the resolution of symptoms both in the short and medium term. This practice was not based on any objective evidence. This study is to elucidate the efficacy or otherwise of this approach. It is in the early stages and no analysis which involves breaking the randomisation code has yet been made.

Rationale of the study

The treatment of DCI has traditionally been limited to recompression, use of 100% oxygen and appropriate decompression schedules. Correction of dehydration and appropriate posturing to prevent any (or further) gas entering the cerebral circulation are accepted as important adjunctive measures.

This regime has proved very effective in treating military and professional divers where recompression facilities are immediately available. However, it has recently become clear that there is a significant rate of incomplete resolution of symptoms and signs in several series of recreational divers with DCI. In Australasia this rate is typically between 20 and 35% of all cases seen.[1-4] This has recently been confirmed in a report from our unit in Sydney.[5] In addition, it is often noted that recreational divers require more treatments to achieve resolution than professionals.