Proposal for a new decompression illness (DCI) severity classification based on 98 DCI clinical cases and outcomes

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Background: DCI patients need recompression treatment immediately. However, the treatment of mild DCI is controversial, and a method for classifying the severity of DCI has not yet been established.

Methods:

1. Proposal for a new DCI severity classification strategy:

Several classifications for DCI have been proposed.

Dick and Massey(1985)[1] derived an easily calculated severity score based on the sum of grades for sensory and motor symptoms. *Debatable Point*: Applicable to approximately 50% of patients.[3] Motor disturbances and sensory disturbances are evaluated equally.

Table 1
Spinal Cord Decompression Sickness Severity Index[2]

Sensory symptoms		
Grade		
1	paresthesias	single limb or area
2	paresthesias	multiple regions
3	numbness	single limb or area
4	numbness	two limbs or areas
5	numbness	three or more limbs or areas
Motor symptoms		
Grade		
1	weakness	single limb or muscle group
2	weakness	multiple limbs or muscle groups
3	paralysis	single limb or muscle group
4	paralysis	two limbs
5	paralysis	three or more limbs

Total score = sensory grade + motor grade (maximum of 10)

Severity groups
Mild = 1-3
Moderate = 4-6
Severe = 7-10

Mitchel et al(1998)[4] derived a new system for scoring severity and measuring recovery in DCI. Good prognostic power has been reported.
Debatable Point: Complexity of calculation.

The Undersea & Hyperbaric Medical Society(UHMS) workshop(2005)[5] defined "mild" symptoms in table 2.
Debatable Point: If spinal cord DCI is not considered "mild", then sensory changes in clear dermatomal distributions should not be considered "mild" in the workshop. However, in our experience, spinal cord DCI with only sensory disturbance appears to be mild compared with DCI with motor weakness.

Table 2
Consensus Statement 1

With respect to decompression illness (DCI), the workshop defines "mild" symptoms and signs as follows:
– limb pain1,2
– constitutional symptoms
– some cutaneous sensory changes3
– rash
where these manifestations are static or remitting4,5 and associated objective neurological dysfunction has been excluded by medical examination.

Footnotes
1. The workshop agrees that severity of pain has little prognostic significance,but acknowledges that severity of pain may influence management decisionsindependent of the classification of pain as a "mild" symptom.
2. Classical girdle pain syndromes are suggestive of spinal involvement and do not fall under the classification of "limb pain."
3. The intent of "some cutaneous sensory changes" is to embrace subjective cutaneous sensory phenomena such as paraesthesiae that are present in patchy or non-dermatomal distributions suggestive of non-spinal, non-specific, and benign processes. Subjective sensory changes in clear dermatomal distributions or in certain characteristic patterns such as in both feet, may predict evolution of spinal symptoms and should not be considered "mild."
4. The proclamation of "mild" cannot be made where symptoms are progressive. If the presentation initially qualifies as mild and then begins to progress, it is no longer classified as "mild" (see also Footnote 5).
5. The possibility of delayed progression is recognized, such that the "mild" designation must be repeatedly reviewed over at least the first 24 hours following diving or the most recent decompression, the latter applying if there has been an ascent to altitude. Management plans should include provisions for such progression.

We propose a new DCI severity classification strategy based mainly on limb neurological findings. We defined DCI with only subjective symptoms as Mild-1 and DCI with sensory disturbance and/or rash as Mild-2 (Mild-1 and 2 are subgroups of the Mild group). We defined DCI with muscle weakness as Severe. The Severe group was divided into 2 subgroups: Severe-1 (Manual Muscle Testing: MMT＞3) and 2 (MMT≦3). DCI with anuresis is classified as Severe-2.

Table 3

Major groups	Subgroups
Mild -no limb muscle weakness	Mild - 1 -subjective symptoms Mild - 2 -sensory disturbance and/or rash
Severe -limb muscle weakness	Severe - 1 -MMT＞3 Severe - 2 -MMT≦3 and/or anuresis

2. Materials:

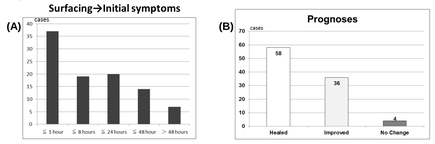
We classified 98 divers with DCI treated at our facility in 2012 by the new classification system and retrospectively evaluated their clinical outcomes.

a. diver's profiles
b. time from surfacing to onset of initial symptoms
c. initial symptoms
d. time from onset to HBO treatment
e. number of HBO treatments
f. follow-up period
g. prognosis
We defined;
Healed: no symptoms/signs after the treatment.
Improved: change for the better of symptoms/signs after the treatment
No change: other than those above
We used the new classification for the prognostic index.
The severity score; Healed 0, Mild-1 1, Mild-2 2, Severe-1 3, Severe-2 4 points
h. classification and evaluation of clinical outcomes (a-g) by the new classification system

Results:

a. 53 male cases, 45 female cases. Ages 23-65 years (average 37.9 years)
b. 0-448 hours (median 5.0 hours, average 20.1 hours). ;Figure 1(A)
c. Numbness/tingling 27 cases, pain 25 cases, discomfort 17 cases, fatigue 13 cases, headache 12 cases, dizziness/vertigo 6 cases, rash 4 cases, abdominal pain 3 cases, muscle weakness 2 cases, nausea 2 cases.
d. 1-40 days (median 8 days).
e. 1-8 times (median 1.0, average 1.9); US Navy table 6.
f. 1 day-11 months (median 0.1 month, average 0.6 month).
g. Healed 58 cases (59.2%) + Improved 36 cases (36.7%) = 95.9% ;Figure 1(B)

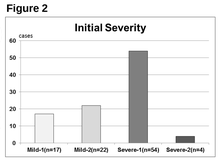
Figure 1



h.

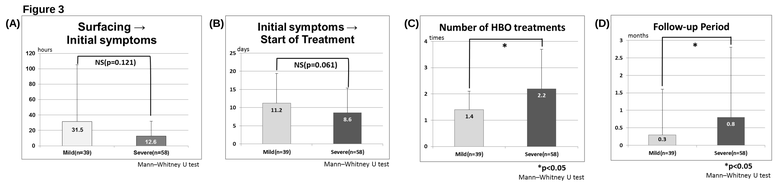
✓ According to the new classification, 39 cases were Mild (17 Mild-1 cases and 22 Mild-2 cases) and 58 cases were Severe (54 Severe-1 cases and 4 Severe-2 cases). ;Figure 2

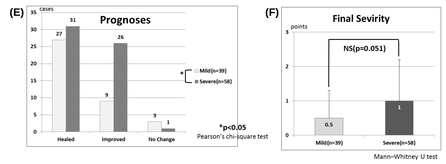
Figure 2



✓ Only 1 case could not been classified because it was an inner-ear DCS with no motor weakness symptoms.
✓ There was an observed tendency in the severe DCI subjects (8.6±6.8 days) to recompress earlier than in the mild DCI subjects (11.2±8.2 days, p=0.061); Figure 3(B); however, the severe DCI prognoses were poorer than the mild DCI prognoses (p=0.049). ;Figure 3(E)
✓ The final severity in the Severe group appeared to be higher than in the Mild group (p=0.051). ;Figure 3(F)

Figure 3





Discussion:

1. The new DCI severity classification:

DCI is considered to have a number of discrete symptoms and signs[6], which make a severity classification of DCI difficult.
We propose a new DCI severity classification strategy based mainly on the limb neurological findings because of the following reasons:

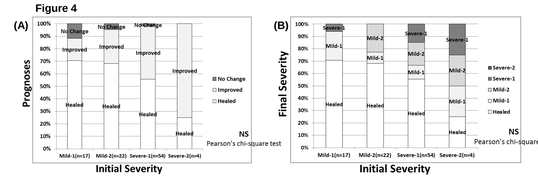
a. The study of the Institute of Naval Medicine (INM) shows that neurologic manifestations were present in more than 77% of cases,[6] which is consistent with our experiences.
b. Sundal (2011)[7] shows that 8 of the 10 subjects that have central nervous system deficits were initially misdiagnosed as type 1 DCS. They recommend that all cases with DCS should initially be treated as neurological DCS.

The new DCI severity classification was applicable to 97 of 98 patients.

2. Outcomes of 98 DCI cases

The initiation of the recompression treatment was somewhat delayed from the DCI onset in these subjects (median 8 days, range 1-40 days); however good clinical outcomes were obtained with treatment.
In particular, the outcomes of the Mild group were good; 27 of 39 mild subjects (69.2%) were healed, and 9 (23.1%) had improved symptoms. It appears that delayed treatment of the patient with mild DCI is acceptable. The new classifications seemed to correlate with patient prognoses although there is no statistically-significant difference ;Figure 4(A), and the severity score after the treatment appeared to be consistent with the patient prognoses ;Figure 4(B).

Figure 4



Conclusion:

1. We propose a new DCI severity classification strategy based mainly on limb neurological findings.
2. 97 of 98 cases could be classified by the new classification.
3. The new classification systems appear to correlate with patient prognoses.

References

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