

# 6<sup>th</sup> ECHM CONSENSUS CONFERENCE

on

## Prevention of dysbaric injuries in diving and hyperbaric work

Organised jointly with  
the European Diving Technology Committee, DAN Europe and  
SUHMS

Friday 24<sup>th</sup> and Saturday 25<sup>th</sup> October 2003  
Geneva, Switzerland

### **Dedication :**

To the memory of Tor Nome, a most knowledgeable expert in the field of professional diving and a very charming friend died recently.

### **Questions :**

- 1) Is there a consensus about the fitness-to-dive criteria?
- 2) Is a medical re-assessment necessary for all divers?
- 3) Should safety management be the same independent of diving activities?
- 4) Which is the role of decompression procedures for prevention of dysbaric injuries?
- 5) Does personal of hyperbaric treatment chambers and compressed air workers need specific safety procedures to prevent dysbaric injury?

### **Scientific committee :**

Pr Daniel Mathieu (ECHM), Pr Alessandro Marroni (DAN Europe), Mr Crawford Logan (EDTC),  
Dr Jordi Desola (ECHM/EDTC), Dr Jürg Wendling (ECHM/EDTC)

### **Organising committee :**

Dr Jürg Wendling, Dr Jörg Schmutz, Dr Peter Knessl, Dr Christine Wehrli

## **Jury :**

- Pr Dirk Bakker (chairman), the Netherlands
- Pr David Elliott , United Kingdom
- Dr Bruno Grandjean, France
- Dr Pietro Giovanoli, Italy
- Mr Olav Hauso, Norway
- Dr Filipe Roque, Portugal
- Dr Zdzislaw Sicko, Poland
- Dr Seppo Sipinen, Finland
- Pr Daniel Slosman, Switzerland
- Dr Akin Toklu, Turkey
- Dr Ulrich Van Laak, Germany

## **Literature reviewers :**

- Dr Sandra Torti-Gerber, Switzerland : fitness to dive
- Dr Peter Müller, Germany : decompression procedures and safety

## **Experts :**

- Dr Ramiro Cali-Corleo : “Impact of pre-dive medical examination on the incidence of diving accidents”
- Dr Stephen Watt : “ Fitness to dive medical assessment: professional aspects”
- Dr Robert Van Hulst : “Fitness to dive medical assessment: military aspects”
- Dr Key Tezlaff : “Fitness to dive medical assessment: air compressed worker aspects
- Dr Chris Edge : “Fitness to dive medical assessment, recreational diving aspects”
- Dr Peter Germonpre : “How a newly identified medical condition may impact fitness to dive criteria”
- Mr Deric Ellerby : “Safety management: recreational diving aspects”
- Dr Michael Lang : “Safety management : scientific diving aspects”
- Mr Alessandro Bosco : “Safety management: professional aspects”
- Dr Jacek Kot : “Safety management: HBO aspect”
- Dr Valerie Flook : “Models for safe decompression procedures”

- Mr Jean-Pierre Imbert : “Decompression data bases : what impact to improve safety of decompression procedures”
- Mr Constantino Balestra : “ Lessons drawn from the in-field experience”
- Mr Jean-Claude Lepechon : “Specific aspects of safety procedures for air compressed workers”
- Dr Pasquale Longobardi : “ Specific aspects of safety procedures for HBO personel”
- Dr Adel Taher : “Do we have to adapt safety procedures for personel in remote HBO facility”

# Recommendations of the Jury

## Question 1

**Is there a consensus about the fitness-to-dive criteria?**

and

## Question 2

**Is a medical re-assessment necessary for all divers / pressure-exposed-individuals (PEI)?**

- 1) There is consensus within the Jury that the joint ECHM-EDTC fitness-to-dive criteria are an agreed standard for all categories of diving and work at raised environmental pressure
- 2) It is agreed that these standards may be accepted in different Countries with modifications that are required by national legislation or customary medical practice
- 3) We recommend that these standards should be reviewed periodically by ECHM and EDTC for possible modifications
- 4) The method of assessment for compliance with these fitness recommendations may vary. For example, different categories of diving may select a greater or lesser dependence on the use of self-administered questionnaires. It is considered that at present there is insufficient evidence to make a final decision on this and the Jury recommends that the ECHM-EDTC conduct a future review on the basis of validated evidence.
- 5) It is agreed that medical re-assessment is important. The ECHM-EDTC has recognized that there should be two types of re-assessment. The Jury recommends that periodic re-assessment be required for all and that re-assessment is also required occasionally in between such periodic assessments. This may be the result of some illness or accident whether it occurs while diving or when at the surface. It is recommended by the Jury that the diver or worker at raised environmental pressure be instructed on their personal responsibility for initiating this process
- 6) The Jury notes that the result of the assessment can be unfitness, fitness or an individual specification of some restricted fitness. It is agreed that the diver/ worker at raised environmental pressure has the right to appeal against any decision made by the examiner. The procedures for such appeals may vary between categories of diving/work at raised environmental pressure and between countries.
- 7) The Jury endorses the ECHM-EDTC Training Standards in Diving and Hyperbaric Medicine and recommends that these standards be reviewed periodically by the committees for possible modifications.

- 8) The Jury recognizes that in some Countries the trained medical examiner (Level 1) may not have the legal authority to sign a fitness to dive certificate for all diving/work capacities. The Jury recommends that the ECHM-EDTC Standards of Fitness be brought to the attention not only of national government authorities (already aware through their EDTC Representatives) but also the national organizations for occupational and sports medicine and the various recreational diving organizations

### **Question 3**

#### **Should safety management be the same independent of diving/hyperbaric work activities?**

- 1) The risk management methodology composed of three steps: risk analysis, risk evaluation and risk control (ref: EN ISO 14971), should be applied to every activity involving underwater diving or exposure to compressed gas. All the individuals diving or exposed to compressed gas atmospheres should follow the same rules.
- 2) The general rule that no single failure may cause serious accidents has to be implemented through safety plans.
- 3) Risk control includes the introduction of barriers that may be of technical and/or organizational and/or operational nature.
- 4) Responsibilities shall be clearly defined before any operation.
- 5) In every activity, Emergency Procedures (EPs) as well as Standard Procedures (SPs) shall be prepared in advance in order to minimize the consequences of failure/accidents
- 6) Emergency Procedures (EPs) and Standard Procedures (SPs) shall be in written form, easily available, adapted to the situation, regularly updated and familiar to everyone involved in the diving / compressed gas activity
- 7) Everybody involved in a diving / compressed gas activity shall be trained to react appropriately to emergency situations according to his/her level of responsibility.
- 8) In diving / compressed gas activities performed in a professional capacity, prevention measures shall be in place through regulations. It should be understood that, in recreational diving, any such regulations might have a limited impact/effect; education is therefore essential to implement a safety-oriented culture in recreational divers. Main targets for such education are, as a priority, persons connected with responsibility: managers, medical advisers, instructors, diving guides, etc.
- 9) There should be a reporting system of incidents organized in a way that information is readily available and shared.
- 10) All individuals involved in diving / compressed gas activities shall be informed by the responsible person of the hazards and the implemented preventive measures before giving his/her informed consent.
- 11) The joint ECHM-EDTC Committee should periodically review these recommendations.

#### **Question 4**

#### **What is the role of decompression procedures in prevention of dysbaric injuries?**

Background:

Diving/ Exposure to Pressure is considered to be safe according to the data currently available.

However, this is based upon clinical symptoms of DCI rather than upon bubble production.

“Haldanian” decompression models (and currently adopted models for saturation diving/exposure) are still an acceptable basis for prevention of DCI. They should be adapted to the bubble phenomena, which are generally present at the end of a dive/exposure to pressure.

Mathematical models, experience from saturation diving/exposure to pressure and first studies based upon bubble detection in divers / pressure-exposed-individuals (PEI) show evidence that deep stop and reduced ascent rate contributes to lower bubble production.

Recommendations:

1. It is recommended that groups of experts join their efforts in order to perform studies using bubble detection methods in the field.

2. However, studies like this have to focus on bubble production in divers / pressure-exposed-individuals (PEI) always using dive / exposure profiles that are considered to be safe according to the current diving medical knowledge. This can be accomplished by collecting large numbers of data from unrestricted diving / exposures including adequate pre-, post dive / exposure questionnaires, electronic filed dive / exposure profiles, and possibly bubble detection or any other suitable method.

3. A surveillance system such as a centralized database is considered to be an extremely helpful tool for development of safer decompression procedures.

## Question 5

**Do personnel of hyperbaric treatment chambers and compressed air workers need specific safety procedures to prevent dysbaric injury?**

- 1) Certain differences between hyperbaric treatment attendants and compressed air work exist.
- 2) Generally the occupation of working as multiplace hyperbaric attendant is safe.
- 3) Incidence of DCI in hyperbaric chambers has been variously reported depending on treatment pressure (depth). The overall incidence rate was extremely low with no correlation of DCI and gender of tender. There was a linear correlation with increasing pressure and incidence of DCI.
- 4) Prevention of DCI by oxygen breathing and rotation of hyperbaric attendants is extremely useful.
- 5) Standards for medical fitness to dive are written primarily for occupational in-water divers and/or compressed air workers, and do not specifically address the requirements of hyperbaric medicine attendants. It is recommended that the specificities of hyperbaric medical attendants will be included in revised ECHM-EDTC fitness standards.
- 6) Oxygen decompression seems to be the best method for safe decompression of compressed air workers. Development of customised tables, taking into account the specific working conditions in different hyperbaric environments is recommended.
- 7) If oxygen breathing for compressed air workers or hyperbaric personnel is not possible in the present situation, technical solutions should be developed to enable oxygen breathing at any time during the hyperbaric exposure according to the needs of the employee.