

PROGRAMME



23th Capita Selecta Duikgeneeskunde



Symposium

21st Century decompression theory and DCI treatment; from Haldane to BVM, endothelium response and Heliox treatment.

for dive physicians, other care professionals, instructors, professional and techdivers

Date: Saturday 17 March, 2018

Venue: Academic Medical Centre, Amsterdam

Subjects

Neo-Haldanian decompression theory and procedures; selection of breathing gases for long exposures and saturation exposure in diving and tunnelling; Dual phase decompression theory and bubble dynamics; implementation of Dual phase decompression in tables for technical diving; the endothelial response related to diving; DCI (differential) diagnostics; DCI treatment with air/o₂ and Heliox.

Aim

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In the first place, this symposium aims to offer insights into the recent developments in decompression theory and their practical application for diving and dry work under pressure, and secondly on the diagnosis and treatment of decompression illness. Special attention is paid to the use of helium mixtures, since their use is increasing in the professional (tunnelling etc.) and recreational world.

It is intended that the lectures are given at the level of Diving Medical Physician (2d) and higher.

Knowledge of the effects of hyperbaric pressure on the human body and the adverse effects that may occur when this pressure is reduced to ambient is in existence for more than a century and a half. Yet the insights on causes, prevention and treatment of DCI continue to develop. Participants will learn about the various approaches to describe compression and decompression phenomena. These phenomena have a physical nature, the creation of gas bubbles - which can block blood vessels - and their disappearance but also a physiological one, the endothelial response to the bubbles. How the theory is implemented in decompression tables to prevent decompression illness, the disorders arising when the pressure release is too fast, will be addressed. The various types of tables for sport divers, applicable to air, nitrox, mixed gases, and those in use in the professional world (for diving, tunnelling or caisson work) will be discussed. The participants will be informed how to diagnose and how to treat this disorder according to the recent insights and best practise. For this treatment again understanding of decompression theory and its implementation in treatment tables is a necessity for successful treatment.

Since this seminar can be regarded as an advanced course, an elementary course on diving medicine is a prerequisite.

Participants

Diving physicians, academic and higher educated paramedics, high-qualified instructors with higher education and professional gas-mixture and techdivers.

The maximum number of participants is 40.

Principal speaker

Adel Taher, GP, diving and hyperbaric physician, director Hyperbaric Medical Centre in Sharm el Sheik, Egypt.

Speakers

Jean-Claude Le Péchon, MSc, MEng, JCLP Hyperbarie, Paris, France.

Dr. Albrecht Salm, Dipl. Phys., SubMarineConsulting, Esslingen, Germany.

Dr. Sigrid Theunissen, Haute Ecole Bruxelles Brabant – ISEK. Environmental, Occupational & Ageing Physiology Lab. Brussels, Belgium.

Recommendation

The course is recommended by the expert group of dive medicine of the Vereniging voor Sportgeneeskunde (Soc Sports Med) and by the Nederlandse Vereniging voor Duikgeneeskunde (NVD, Dutch Soc Dive Med).

Accreditation

In general, the level of the various lectures / subjects of the meeting are (at least) in accordance with that of EDTC and ECHM, level 1 (Medical Examiner) and Level 2D (Diving Physician).

The program comprises **6 oral contact hours** and the NVAB, VSG, SCAS and NICDA (ECB representative in the Netherlands) are requested to provide 6 accreditation points for registrations as occupational physician, sports physician, sportsdiving physician and MED Level 1 respectively. Nearly all Dutch medical societies accept accreditation points “outside own specialism” through GAIA.

The Dutch course members who have registered for accreditation will obtain their cp’s via GAIA or will be applied for with NICDA and SCAS. All others obtain a certificate after completion of the whole course, including test.

Course members from outside the Netherlands should apply with their own accreditation office on the basis of the requested MED Level 1 accreditation. Diving Physician (Level 2D) is optional.

Programme committee

Nico Schellart (chair, medical physicist and diving physiologist), Tjeerd van Rees Vellinga (occupational and hyperbaric physician), Erik van der Sande (general and sport physician) and Marga Schweigmann (general and hyperbaric & diving physician), Peter Westerweel (internist-heatmatologist) and ad hoc the lecturers.

Executive committee

Nico Schellart (course director) and Hans van Dam (administrative manager)

Responsibility

The Capita Selecta Duikgeneeskunde are given under the responsibility of the Academic Medical Centre, Univ. of Amsterdam (course leader Nico Schellart). The organization is by the Stichting Duik Research (SDR)¹⁾ and Biomed. Eng & Physics, AMC (Prof. Dr. A.G.J.M. van Leeuwen, chair).

Announcements

Ongoing announcements about future courses can be found at www.capitaselectaduikgeneeskunde.nl or are communicated by E-mail.

¹⁾ SDR is a non-profit organisation aimed to promote dive safety. Work for SDR is done voluntarily.

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Programme

Symposium 21st Century decompression theory and DCI treatment

9:00-9:30 **Welcome**

9:30-9:35 Introduction, Nico Schellart

1. **9:35 -10:25 Jean-Claude Le Péchon**, Neo-Haldanian decompression theory and Haldanian based decompression procedures.

2. **10:25 -11:15 Albrecht Salm**, Dual phase decompression theory and bubble dynamics

Break

3. **11:30-12:15 Adel Taher**, DCI (differential) diagnostics

4. **12:15-13:00 Jean-Claude Le Péchon**, Selection of breathing gases for multi-day and saturation exposure and decompression in diving and tunnelling.

Lunch

5. **13:45-14:45 Sigrid Theunissen**, The endothelial response related to diving with specific attention to the role of anti-oxidants

6. **14:45-15:30, Albrecht Salm**, Implementation of dual phase decompression in tables for technical diving

Break

7 **15:45-16:45, Adel Taher**, Air/oxygen and Heliox DCI treatment

16:45 - 17:00 Test

Refreshments

Lecturing time includes 10 min of discussion.

Contact time: 6h00



Disclaimer: Capita Selecta Duikgeneeskunde (i.e. AMC and SDR) is bound to execute the educational program, but small program changes are under reserve.

The lecturers



Jean-Claude Le Péchon



Albrecht Salm



Adel Taher



Sigrid Theunissen

Jean-Claude Le Péchon graduated as biochemical engineer from INSA in Lyon in 1963 and as marine biologist from Nice University. He has been employed at the Musée Océanographique of Monaco as a research engineer and incidentally as scientific diver during the Conshelf III Experiment (the 100 msw undersea habitat organized by Jacques-Yves Cousteau in 1965). Later he joined CEMA in Marseilles (J.Y. Cousteau) to carry out research on breathing gases and to develop procedures for very deep dives (1000 m with animals; 500 m with humans) and was a test diver in the Saturation II simulated dive at 400 msw. From 1973 to 1986, he served with CG DORIS, an offshore and civil engineering commercial diving company. In 1986 he founded JCLP Hyperbarie, a global consultancy agency/ bureau specialized in matters related to life support and safety under pressure (commercial diving, tunnelling, space and hyperbaric medicine). He has been involved in more than 75 tunnelling projects with compressed air or gas mixtures, up to 6.9 bars and as well as in saturation diving technology. Although retired, he is still teaching physiology and technology of diving- and hyperbaric medicine at several universities in France and all over the world. He is a National Instructor for SCUBA diving (Air, Nitrox and Trimix) and holds a deep sea commercial diver certification since 1974. He has published many papers in magazines, books and international congresses etc., and often speaks at international congresses on different topics concerning diving, hyperbaric medicine and compressed gas work.

Albrecht Salm obtained a Ph.D. in physics and computer science at the University of Munich after his graduation at the University of Stuttgart. He was a commercial diver and Instructor for 'Hard Hat' and Saturation Diving. Since 1985 he is a PADI Master Scuba Diver Trainer #33913, and a Technical & Extended Range Instructor for SSI (Scuba Schools International, now 2nd or par to PADI), #12653. He contributes to the "CAISSON" (the quarterly GTUEM journal, GTUEM is: Gesellschaft fuer Tauch- und Ueberdruckmedizin, which reads in english: Association for Diving-& Hyperbaric Medicine), the Technical Diving Magazine (www.techdivingmag.com) and to "Diving & Hyperbaric Physicians Trainings" for the OEGTH (OeGTH is: Oesterreichische Gesellschaft fuer Tauch- und Ueberdruckmedizin. Both GTUEM and OEGTH are like smaller sisters from the UHMS). Currently he is working as a consultant with the international SubMarineConsulting Group (www.SMC-de.com)

Adel Taher, a diving instructor and diving medical specialist at the time, he was the driving force behind the multi-place, multi-lock chamber in Sharm el Sheik as he saw the need for a facility to specialize in diving related accidents. The chamber was built in the USA. He is, in addition to being director of the Hyperbaric Medical Centre in Sharm el Sheik also the founder and director of the diving chamber of Dahab. With over 200 diver-HBO treatments per year, he is without any doubt world leader and trained many physicians in hyperbaric medicine. Dr Adel Taher is member of many international medical diving committees, and lectures about his work at universities, courses, etc. all over the world. He is also the director of DAN-Egypt, a member of the UHMS and of the EUBS. He was the driving force behind the EUBS Annual Scientific Meeting in Sharm el Sheik in 2007 and a recognized invited speaker at their congresses. Diving still is his passion. He worked intensively on diver education and raising the awareness of dive professionals and divers regarding proper management of dive accidents in remote areas and the proper utilization of normobaric oxygen. The Hyperbaric Medical Centre in Sharm hosts dive medical specialists from all over the world to offer hands-on experience.

Sigrid Theunissen has graduated from the Université Libre de Bruxelles in 2004. She is professor in sports and physiology at the Haute Ecole Bruxelles-Brabant (ISEK) since 2007. She obtained her PhD at the Université de Bretagne Occidentale (UBO), France in 2013 about the effect of dark chocolate on endothelial function after a SCUBA dive and successive breath-hold dives. Her main research theme is diving physiology and in addition she is one of the leading scientists in a hypobaric hypoxia project of ISEK, a collaboration with

other institutes. She is a senior member of ISEK's Occupational Physiology laboratory. She is first author and co-author of articles in international peer-reviewed journals on oxygen physiology and author of many proceedings and poster presentations in international congresses. She is the secretary of the Belgian underwater society, member of EUBS and an enthusiastic recreational diver (2* CMAS and Nitrox). .

The symposium coordinator

Nico Schellart graduated as biologist and specialized in physiological and biomedical physics. He studied visual information processing of the retina, resulting in a PhD in 1973 (University of Amsterdam). He is an associate professor with the department of Biomedical Engineering and Physics of the AMC and was associate editor of a bio-engineering journal. He has researched information processing of the visual and auditory system of the brain in animals and humans by fundamental and clinical EEG and MEG methods. His neuroscience studies have resulted in publication of some 50 papers, 80 abstracts and 10 contributions in textbooks and been published a free electronic textbook on biomedical physics. He has studied the brain and the visual system under hypoxic and hyperoxic conditions in both the laboratory as in the field, including pre-cordial Doppler studies, and recommends HBO treatment for patients with cerebral radiation damage. He published some 20 dysbaric and HBOT studies in e.g. Cancer, J Appl Physiol and UHM, and ten different conference proceedings (like EUBS and UHMS). He is a frequently asked reviewer of journals in applied, sports and environmental medicine. Since 2011 he is course director of the CSD. He teaches diving physiology, is member EUBS and NVD, was member of UHMS (during Obama administration), and often participated with contributions in their annual meetings. Also, he has tested the technical and physiological performance of dozens of dive computers (www.diverresearch.org), and he is a recreational scuba- and a former free diver.

Aim and description of lectures

1. Jean-Claude Le Péchon, Neo-Haldanian decompression theory and Haldanian based decompression procedures.

This lecture aims to give an insight into the definition of the main parameters used by most tables calculations (Solubility and diffusion of gases from inspired gas to tissues versus compartments, half time principles, saturation, oversaturation, critical ascent parameters, M-values, repetitive dives, etc) .

The original Haldanian approach (1908) based on Haldane's research will be explained as well as the more recent tables derived from this concept, such as the Bühlmann (1988 Switzerland) and Workman (US Navy 1965) tables. These application are all based on parallel compartments. Some other theories, the diffusion (Hempleman Royal Navy 1972) and serial compartment (Canadian DCIEM tables of Nishi) approach will also be discussed. All these models are deterministic. A discussion of the probabilistic models is outside the scope of this presentation.

2. Albrecht Salm, Dual phase decompression theory and bubble dynamics.

This lecture aims to give an insight into the basics of bubble physics, cavitation and tribonucleation, bubble dynamics and evolution and the basics of dual phase theory and its application in diving.

Why does a bubble exist and why does it grow or shrink? The critical diameter concept. The role of bubble seeds (gas nuclei). How does a bubble exchange gases with its environment? Is a spherical bubble real or does it look more like a "cigar"? The role of the oxygen window. What is "Dual Phase"? Introduction to Bubble-Decompression Models and bubble dynamics. Basics of the "Varying Permeability Model" (VPM). The weaknesses in the VPM. Shortcomings of decompression modelling. Thus we discuss other Bubble-Models like BVM, the Bubble Volume Model used by the USN NEDU, the United States Naval experimental Diving Unit, and other modern Hybrid-Deco-Models, like the "Copernicus".

3 Adel Taher, DCI diagnostics

This lecture aims to give an insight into the necessity to perform an accurate and correct DCI diagnosis.

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Establishing an accurate diagnosis in diving accidents is becoming a necessity as failure to do so can have dire consequences, not only to the patient, but also to the insurance company and the rescue team involved. Divers that learned how to dive in the 70ies and 80ies are steadily getting older and *continue* to dive. This means that many are diving while being medicated for hypertension, cardiac disease, diabetes mellitus and other ailments. Degenerative diseases, disc prolapses and atherosclerotic changes can very often produce symptoms that mimic decompression and other diving accidents. These divers' physical fitness is also questionable!

A neurological examination is performed to determine any neurological deficits present and to aid in reaching a proper diagnosis. The level of hydration is a very important factor that needs to be investigated, especially if the dive site is tropical or subtropical and the diver is staying at a 'resort'. Should medication be prescribed and given to the patient or not, is a frequently asked question and the author believes that it should be decided by the attending physician and according to his experience.

4. Jean-Claude Le Péchon, Selection of breathing gases for multi-day and saturation exposure and decompression in diving and tunnelling.

This lecture aims to give an insight into the rationale to select the composition of breathing gases during long duration exposures to increased pressure in saturation modes whichever the objective of the exposure (deep offshore dives, dam dive at altitude, tunnelling in deep underground space...).

The involved gases are oxygen, nitrogen and helium. Each gas limitations will be reviewed associated with their physical properties as well as physiological impact. From this information the possible composition of the mixes to be used for each type of exposure and each specific phase of the exposures will be described (Compression, storage pressures, intermediate decompressions and final decompression). Practical applications of actual situations from these various fields will be presented : Heliox, deep Trimix for experimental simulations, Hydrogen (anecdotic), and shallow saturation with Nitrox or Trimixes. Impact of gas toxicities on table design in multi-day and saturation diving and tunnelling.

5. Sigrid Theunissen, The endothelial response related to diving with specific attention to the role of anti-oxidants

This lecture aims to give an insight into the consequences of diving on the endothelial function. Scuba diving induces a decrease in flow-mediated dilation (FMD), associated with an increase in oxidative stress. This was interpreted as an endothelial dysfunction due either to hyperoxia or to the action of circulating bubbles generated after surfacing. The objective of this lecture is to present the comparison of the effects of diving with air and a series of successive breath-hold dives on endothelial function and oxidative stress. Preventing

post-dive endothelial dysfunction is essential. The role of Nitric oxide will be presented as well as the effects of diving on inflammation, microparticles production, neutrophil and platelets activation.

6. **Albrecht Salm**, Implementation of dual phase decompression in tables for technical divers

This lecture aims to give an insight into practical application of VPM for technical diving. Technical diving is usually beyond the recreational envelope, i.e.: deeper, longer, with multiple gases, normally other than air and a considerable amount of Helium for the bottom phase and high oxygen partial pressures during the decompression phase. The outcome from VPM-tables and meters is contrasted with abundant tables and meters, based on perfusion.

Dive tables versus dive computers in technical diving. VPM modifications. Shortcomings of dive computers. The controversy around "Deep Stops". "My model is better than yours ...": Solution to this dilemma: statistically based decompression tables and P(DCS), the statistical probability of contracting decompression sickness. In-sights from real world diving: the DAN database (35.000 dives) and the DJRS, the Dive Jump Reporting System from the USN (0,8 million dives).

7 **Adel Taher**, Air/oxygen and Heliox DCI treatment

This lecture aims to give an insight into treatment of DCI victims with the various protocols. Sometimes HBO appears not adequate and the more advanced Heliox treatment can be considered. In- and outs will be discussed and illustrated with a case.

What kind of first aid should be given at the site of the diving accident (boat, shore). And after medivac, which HBOT treatment table will be used. The administration of HBOT therapy is coupled with several choices and decisions that need to be made in the course of the management process of a diving accident. Upon the patient's arrival at the recompression chamber, the treating physician will need to decide which route to take; the choices made in turn will depend on the physician's level of experience, the technical capabilities of the recompression chamber, the capabilities of the staff, their level of training, as well as the presenting clinical picture of the patient and the most probable diagnosis. What (pre-)medication should be given? How to minimizing present tissue oedema, and minimizing the periods of tissue hypoxia, etc. Also the extent of dehydration and re-hydration will be discussed. DCI accidents of technical divers show an increasing tendency. In which cases is Heliox treatment is recommended?

At the end the author questions, if all diving accidents really need recompression therapy in a chamber or not. What about the consequences of 'undeserved hits' for future diving How frequently they occur..

Registration, fees and accreditation

Registration fee: physicians €90 and non-physicians (paramedics, instructors etc.) €65.

Accreditation charges for Dutch physicians:

NVAB* €90,

VSG* (GAIA) €60,

NICDA and accreditation “buiten eigen vakgebied” €45,

SCAS €1.

The fee includes electronic reader, test (obligate), certificate (NOT for NL physicians); lunch and drinks. Credit points are administrated with GAIA by CSD or communicated with SCAS and NICDA (Attendance of whole symposium is mandatory to obtain credit points).

Registration** is open at half November 2017: see www.capitaselectaduikgeneeskunde.nl

Hotels

Suggestions for nearby hotels are:

Hotel Abcoude

Kerkplein 7, 1391 GJ Abcoude

+31 (0)294 281 271, info@hotelabcoude.nl

Rooms from ca. 85 €/day

Bus connection with AMC: no. 120 and no. 126, 2 times per hour (ca. 15 min).

Hotel Fletcher

Schepenbergweg 50, 1105 AT Amsterdam

+31 (0)20- 3113670 , <http://www.fletcherhotellamsterdam.nl>

Rooms from ca. 150 €/day

Walking distance (ca. 20 min in total)

Stichting Duikresearch

For information about SDR see www.duikresearch.org (NL) or www.diverresearch.org (ENG).

The sites offer many free downloadable reports and research publications.

* Late accreditation, after the meeting, is possible only for NVAB and VSG (both via GAIA) and requires an additional €25 in administration cost to be credited to:

NL bank account: NL05INGB0005856014

to the name of Stichting Duik Research, to be marked with “March2018” and accreditation type.

** **Cancellation** The fees of accreditation and administrative costs (€15,-) are not refunded.

More than 2 months in advance: restitution of remaining amount; between 2 and 1 month in advance: restitution of 50% of remaining amount; 1 month or less no restitution. The course member will obtain a reader.

Receipts are not provided. It is recommended to use your confirmation of payment or a transaction copy of your bank account.

Entertainment

Stay one more night for culture and entertainment in one of the most exciting cities of Europe.

The **Koninklijk Concertgebouw** (Royal Concert Hall)
- (*Ticket should be ordered long in advance*).

The **Muziek Theater** (Stopera)
- (*Ticket should be ordered long in advance*).

And many more flamboyant podium art theatres.

Museums

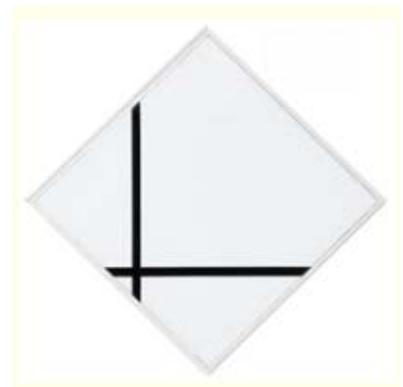
- **Rijksmuseum** (The National Museum), by Europeans with the *Louvre* ranked directly after the *van Gogh Museum*.
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- **Van Gogh Museum**, in 2017 by Europeans evaluated as the best in the world.
- **Stedelijk Museum** (City Museum) with 20 Century Art
- Many more attractive museums.



Rijksmuseum
Rembrandt van Rijn
The "Nachtwacht"



Van Gogh Museum
Vincent van Gogh
Self-portrait



Stedelijk Museum,
Piet Mondriaan
Composition with 2 lines



Scheepvaartmuseum



The Amsterdam Canals