PROGRAMME

27th Capita Selecta Duikgeneeskunde

International Symposium
Physiology and medicine of the metabolic and inert gases in diving

for dive physicians, other care professionals and instructors

Date: Saturday 30 November, 2019
Venue: Amsterdam Universitair Medische Centra, location Academic Medical Centre, Amsterdam

Aim
This symposium aims to give insight in the use of diving gases, their physiology and pathophysiology. The theme includes safety aspects, both medical as well as general. After this seminar, the physician will have the knowledge to decide which gas mixture for inhalation is most safe and adequate based on the planned exposure.
The metabolic gases This course aims to give insight into the effects of high partial pressures of oxygen as it occurs in diving and working in compressed air. Moreover, it discusses also the adverse effects of high partial pressures of oxygen, carbon dioxide and carbon monoxide. The reason for the favourable (not CO) as well as the adverse effects of these gases is that they play a prominent role in the metabolism; they are pre-eminently the metabolic gases. Their role in physiology and pathophysiology under normobaric, hyperbaric and also hypobaric (space and aviation) conditions will be discussed from historical as well as present day perspective.
The inert gases The most important inert gas in diving is the bi-molecule of nitrogen: N_2. This gas is the prime cause of decompression illness and also of N_2 narcosis. To prevent the former, often gas mixtures are applied with a lower N_2 content than in air by partly exchanging N_2 for He (and in special cases also H_2). Theoretical knowledge of the matter above is of importance for the diving physician and supervisor, since the adverse effects of O_2, CO_2, CO, N_2 and He explain all kind of disorders. By choosing the correct gas mixture in diving and in tunnelling (bounce and saturation approach) disorders can be prevented. In diving and tunnelling the consequences of a wrong choice may be lethal.
After this seminar, the physician will have the understanding of the dangers of too high partial pressures of the various gases and will know how to select the adequate gas mixture.
The level of this seminar is at least that of an advanced course and therefore may be considered as a master class. A basic course in diving medicine (in the Netherlands e.g. by SHF or VSG) is a prerequisite for physicians. For instructors a thorough knowledge of gas mixture choice and handling, and of DCI prevention and gas toxicities is required.
Besides participants of the Netherlands, we also would like to welcome participants from abroad. We hope that their reduced fee is helpful to enable their attendance.

Speakers
*Mattijn Buwalda, MD, a*naesthesiologist-intensivist and dive medicine physician, Odijk, The Netherlands.
Jean Claude Le Péchon, MSc, MEng, consultant in dysbaric medical safety management, Hyperbarie, Paris,

Recommendation
The course is recommended 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 DMAC, level 1 (Medical Examiner) and Level 2D (Diving Physician).The program comprises 6 oral contact hours (6 cp).

The Dutch NICDA, NVAB, NVD (under reserve) and VSG are requested to provide 6 accreditation points for the meeting and "outside own specialism" (GAIA) will yield 6 points too for GP's and clinicians.
On completion of the entire course, including the test and when registered for accreditation the Dutch physicians will obtain their points automatically (via GAIA) or added by Capita Selecta to the NICDA and NVD (under reserve) administration offices.
Physicians from outside of the Netherlands will obtain a certificate (only they) and should themselves submit a request to their own accreditation office.

General: mission of the "AMC Capita Selecta Duikgeneeskunde".
The Capita Selecta Duikgeneeskunde (CSD), refresher courses dive medicine, are given by the Academic Medical Centre (AMC), a one-board-cooperation of the medical faculty of the University of Amsterdam (UvA) and the academic hospital with the UvA. This hospital has a special position within the Dutch academic hospitals; it is the cradle, also in Europe of a related discipline, hyperbaric medicine, performed in the "Boerema Tank". The International Capita Selecta Diving Medicine, offered to dive physicians, has a typical 'Alma Mater' character.
In the first place, these Capita Selecta present discipline-wise education in dive and caisson/tunnelling medicine. In addition, they also give education in new developments as they occur in the academic hospitals and medical faculties. This implies that, within the lectures, the characteristics of disorders are discussed, including their diagnostics and treatment, form the point of view of the present academic state of the art.
In short, the Capita Selecta are marked by a mix of education in the dive medicine of the respective discipline and up-to-date education in the discipline itself. Also, the Capita Selecta will pay attention to the requirements of the medical examination.
The Capita Selecta are aimed for non-specialized physicians, first line physicians, sports and occupational physicians, professional dive physicians, clinical doctors and paramedical academics and technicians. This holds irrespective the nationality of the participant; the lectures are given in English.
In general, the lecturers often have their affiliation with academic hospitals and research institutes, and have an international reputation in patient care, academic education and/or medical research as becomes clear from their curriculum vitae.
To have lower thresholds for the courses, the venue is easy to reach and centrally located, and moreover the course is low-budget.

Programme committee
Nico Schellart (chair, medical physicist an diving physiologist), Tjeerd van Rees Vellinga (occupational and hyperbaric physician), and Marga Schweigmann (GP, hyperbaric & diving physician), Peter Westerweel (internist-haematologist), Lex Mulder (occupational and sports physician, medical examiner of divers) and 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 Amsterdam Universitary Medical Centres, location 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, director).

Announcements
Ongoing announcements about future courses can be found at www.duikresearch.org, http://www.capitaselectaduikgeneeskunde.nl/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.

Programme

International Symposium
Physiology and medicine of the metabolic and inert gases in diving

9:15-9:35 ***Nico Schellart*** Introduction. The physics of O_2, CO_2, CO, He, H_2, N_2 in the gaseous phase.

9:35-10:35 Jean-Claude Le Péchon**,** Historical Bert and Lorain-Smith; O2, CO2 in the past and nowadays

10:35-11.15 ***Mattijn Buwalda*** Medical aspects of intoxications by O2. Symptoms, (Differential) Diagnosis and Treatment

Break

11.30- 12.30 ***60 Jean-Claude Le Péchon*****,** Selection of diving gases composition using O_2 He, H_2, and N_2 in open circuit diving and corresponding decompression procedures?

Lunch

13:20- 13:50 ***Mattijn Buwalda*** Medical aspects of intoxications by CO2 and CO. Symptoms, (Differential) Diagnosis and Treatment

13:50-14:20 ***Mattijn Buwalda*****.** Inert gases and Central Nervous System in diving; Nitrogen narcosis, Helium and HPNS

14:20-15:20 Jean-Claude Le Péchon**,** Industrial use of He containing breathing mixtures. Bounce diving and saturation.

Break

15:35-16:15 ***Mattijn Buwalda*** Rebreathers in recreational diving

Test

6 cp's

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

Mattijn Buwalda is an anaesthesiologist-intensivist (DESA EDIC) working as a freelancer in the Netherlands and abroad and as Dive Medicine Physician in London and Brussels. After certification as a diving medicine physician by the ECB he worked as a hyperbaric anaesthetist at the London Hyperbaric Medicine Unit Whips Cross Hospital London. He is especially interested in extreme physiology and extreme medicine. He has given many lectures in Holland and the UK on topics related to oxygen and pressure. Examples can be found on his website www.mattijnb.nl. Mattijn is instructor dive medicine for the Advanced Wilderness Life Support Course NL. He has also been instructor and course director in ATLS (Advanced Trauma Life Support) and similar courses. He founded the anaesthetics simulator lab in the University Medical Centre Utrecht and is still involved with the development of the common trunk vital functions for last year medical interns. He is the author of dive medicine related chapters in the handbook on drowning and the Dutch course book in sport medicine. As a former normoxic trimix CCR diver he lived up to the motto: 'dive docs should dive themselves'. For diving, he has frequently visited Malta, Cyprus, the Red Sea and Bonaire

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 ingineer and incidentally as scientific diver during the Conshelf III Experiment (the undersea habitat sponsored by Jacques-Yves Cousteau). Later he joined CEMA in Marseilles (J.Y. Cousteau) to do 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 gas mixtures, up to 6.9 bar and as well as in saturation diving technology. Although retired, he is still teaching physiology and the 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.

The CSD director and symposium manager

Nico Schellart graduated as biologist and specialized in physiological and biomedical physics. He investigated visual information processing of the retina, resulting in a PhD in 1973 (University of Amsterdam). He is an associate professor with the dept. of Biomedical Engineering and Physics of the Amsterdam University Medical Centres, location AMC and was associate editor of a bioengineering journal. He has investigated information processing of the visual and auditory system in the brain, with animals and with humans by fundamental and clinical EEG and MEG research. His neuroscience studies have been published in some 50 papers, 80 abstracts and 10 contributions in textbooks and published an electronic free textbook in biomedical physics. He has studied the brain and the visual system under hypoxic and hyperoxic conditions both in the lab and in the field, including pre-cordial Doppler studies, and recommends HBO treatment for patients with cerebral radiation damage. He published these about 20 dysbaric and HBOT studies in e.g. Cancer, J Appl Physiol and UHM, and in conference proceedings (like EUBS and UHMS) and is regularly reviewer of journals in applied, sports and environmental medicine. He teaches diving physiology. is member EUBS and NVD, was member of and often participated with contributions in their annual meetings. Also, he has tested the technical and physiological performance of dozens of dive computers (www.duikresearch.org), and is a recreational scuba (Nitrox) and formerly a free diver.

Aim and description of lectures

Jean-Claude Le Péchon, Historical Bert and Lorain-Smith; O_2, CO_2 in the past and nowadays

From this historical review one can learn how renowned researchers draw correct and false conclusions on the basis of limited material obtained with very simple methodology as considered nowadays.

The physiological effects of high partial pressures of O_2 and CO_2 have been extensively evaluated by **P. Bert**. He drew several conclusions (1878):

1 - Oxygen at high partial pressures kills all living cells. The signs are species dependant. Convulsions are the most obvious symptom still called after him: Paul Bert effect.

2 - At low partial pressures O_2 is responsible for acute altitude mountain sickness.

3 - Carbon dioxide triggers ventilation rate, and at very high partial pressures when mixed with O_2 it can induces anaesthesia.

He also was a very active politician and created public schools obligatory for all children including girls. He made universities accessible to girls and created a national school system for primary school teachers and was always trying as much as possible to remove the church from teaching in schools and universities. In 1886, it is in recognition of his political achievements that he deserved National Funerals.

Lorain Smith worked later, (1895-99) on O_2. In 1895, with Haldane he unfortunately established a wrong O_2 transport mechanism of the alveoli. It took until 1914 to discover the actual mechanism. The work of Lorain Smith on O_2 induced pneumonia with their species specific treatment schedules will be addressed. Then he tried to explain decompression sickness as described by P. Bert but his explanation, O_2 induced pulmonary physiology which would reduce gas exchange, was completely wrong. However the description of pneumonia was correct and it has been named after him: Lorrain Smith Effect. Nowadays, there is a sound evaluation of medium O_2 partial pressures effects that uses a unit called the OTU (Oxygen Toxicity Unit) that allows comparisons of exposures to various values of PO_2 and which was initially established by Clark and Lambertsen. Concerning the neurological effect of PO_2 there is a calculation incorporated in dive computers that is absolutely meaningless and that should be removed from all computers (CNS clock).

The effects of CO_2 have been mixed up with nitrogen narcosis for many years until both effects could be clearly split from each other

Mattijn Buwalda, Medical aspects of intoxications by O_2. Symptoms, (Differential) Diagnosis and Treatment

This lecture teaches the listener about the symptoms, (differential) diagnosis and treatment O_2 intoxications.

Oxygen radicals are responsible for neurological and pulmonary O_2 toxicity during diving. A relatively acute surge in radicals can overwhelm the brain's defences (vasoconstriction and antioxidants) and produces symptoms of neurotoxicity. In contrast to this 'Blitzkrieg' we can view pulmonary O_2 toxicity as 'a war of attrition'. That is a sustained lower level of O_2 radicals attacking the pulmonary membranes.

The avoidance of O_2 toxicity is not only relevant for diving but has also changed the way O_2 is used in clinical medicine. Where in critically ill patients, not that long ago, O_2 was used in abundance, we now consider O_2 a potential toxic agent and titrate its administration to its actual need. Some examples will be given of how O_2 is used in today's practise of anaesthesia, cardiology and intensive care. That O_2 can harm us is not surprising if you consider the fact that life originated on earth without O_2! Cells had to learn 'to live with it' in favour and non-favour. This will be illustrated with a brief review of the biochemistry of radicals and anti-oxidants.

Jean-Claude Le Péchon, Selection of diving gases composition using O_2,He, H_2 and N_2 in open circuit diving and corresponding decompression procedures

This lecture teaches the listener about how to select diving gases using O_2, He, H_2 and N_2 in open circuit diving and corresponding decompression procedures.

Air is the most common breathing media for diving; However it has several draw backs: at medium depths the nitrogen content (79 %) leads to long decompression times; at greater depths (> 40 m) in addition to a decompression penalty, it is a dense gas impeding ventilation and nitrogen becomes narcotic. Solving those issues requires reducing nitrogen content of the breathing media:

It will be explained that only for medium depth Nitrox is an adequate breathing gas and why for greater depths the non-narcotic helium is used with at the same time less O_2 (to prevent acute or pulmonary O_2 toxicity) according the expected duration of the exposure. Examples of mixes will be discussed.

Helium has a pressure limitation; too high pressures induce HPNS but with a well-chosen mix this can be avoided. Most decompression procedures calculate inert gas uptake in the various compartments with halftimes. These for He can be derived from those of nitrogen. It will be explained that the limitation and accepted M values are depending on the various types of models. There is no widely accepted consensus on the calculation of gas elimination, in particular because there are so many ways to take bubbling into account.

Mattijn Buwalda Medical aspects of intoxications by CO_2 and CO. Symptoms, (Differential) Diagnosis and Treatment

This lecture teaches the listener about the CO_x toxicities - which may be deadly - and their symptoms, (Differential) Diagnosis and Treatment.

All open circuit divers have a mild degree of hypercapnia. This is the body's way of preventing the added work of breathing producing too much extra carbon dioxide resulting in a circulus vitiosus. Severe hypercapnia in closed circuit divers can be the result of malfunctioning of the rebreather. This will be dealed in the lecture about rebreathers.

Carbon monoxide poising in diving is rare and can be caused by polluted cylinders. Not so rare is CO poisoning due to a malfunction residential boiler or house fire. The pathophysiology, treatment and symptoms will be reviewed..

Mattijn Buwalda, Inert gases and Central Nervous System in diving; Nitrogen narcosis, Helium and HPNS

This lecture teaches the listener about the enigmatic mechanisms of gas narcosis and HPNS.

Chemically seen nitrogen is inert but it has a huge impact on the diver! Nitrogen narcosis and HPNS may appear to be two sides of a coin, depression versus excitation, a view that agrees with the old theory of pressure reversal of anaesthetics. However, we now know that nitrogen narcosis (as most modern anaesthetic agents) work by binding to certain protein receptors and HPNS can be seen as a pure pressure effect affecting the conformation of ion channels, protein receptors and transmembrane proteins.

The human brain works by countless activating and inhibiting neural connections. The euphoric state seen in the beginning of nitrogen narcosis (as in alcohol) can be seen as inhibition of inhibitory neural networks, whilst during severe nitrogen narcosis inhibition predominates. Considering the myriad of neurotransmitters and specific receptors all, under influence of inhibition and activation, it is no wonder that neuroscience has not come up with a simple picture of how nitrogen narcosis and HPNS works. I will try to shed some light on nitrogen narcosis and HPNS by extremely simplifying current knowledge. I hope you forgive me in advance.

Jean-Claude Le Péchon, Use of Helium containing breathing mixtures in the industry. Bounce and saturation exposures.

This lecture teaches the listener about the industrial use of deep-bounce diving and saturation exposures on He-mixtures.

The industry uses hyperbaric interventions mostly for underwater works in diving. In civil engineering compressed air work has been extensively used since the middle of the XIXth century, almost exclusively with compressed air. Such exposures followed immediately with decompression are called bounce interventions. For pressure above 5-6 bars (gauge) or depths > 50-60 m, using compressed air can be questioned and introduction of He in the breathing media should be considered. With air and depths > 150 m (He-mixture) decompression times become impractically long. It will be explained how this problem can solved with the so called saturation technique. Deep bounce dives are not used any more in the oil industry. In the early days (70's) it was frequent, with Heliox or Trimixes according to the culture of the companies; the depths were up to 150 m in those days mostly for drilling platforms. For the oil and gas industry diving deep with Heliox mixes is most of the time carried out from DSVs (depths 50-200 m). Examples of profiles and gases will be described. High pressure bounce interventions on Trimixes are possible in modern tunnelling operations. An example of the procedure will be explained. In tunnelling when the number of inspections and repair of the cutters is high and the pressure is above 4 bars, saturation intervention becomes the best issue. Well known examples will be discussed (Western Schelde, The Netherlands; Hong Kong; Bosphorus tunnel in Turkey).

Mattijn Buwalda Rebreathers in recreational diving

This lecture teaches the listener about the harms of closed circuit (CC) diving.

Although divers have to do several intense and expensive courses to become a rebreather diver, the incidence of DCS and deadly dive incidents seems to be higher compared to recreational diving. The CC is a complicated 'technical' machine but it can seldom be blamed. It is usually lack of adequate training or complacency that converts a potentially solvable minor problem into a deadly incident. After a brief layout of the anatomy of a rebreather, it will be explained how hypoxia and hypercapnia may kill the ''tek'' diver.

Fees

Physician with Dutch registration (BIG):	€ 135,-
Physician with a non-Dutch registration:	€ 90,-
Non- physician:	€ 60,-

The following Dutch accreditations are included in the fee.

- NICDA
- NVD (under reserve)
- NVAB
- VSG
- Outside own field[1)]

[1)] for GP's, clinicians, and other AbSg physicians.

The fee includes electronic reader, test, certificate (*only for physicians without Dutch BIG registration*), lunch and drinks. Receipts are NOT provided: use your registration confirmation or bank transcription.
Registration implies agreeing with these and additional conditions of the CSD (see also website).

Registration starts 1 August 2019: www.capitaselectaduikgeneeskunde.nl.

Hotels

Suggestions for nearby hotels are:

Hotel Abcoude
Kerkplein 7, 1391 GJ Abcoude
+31 294 281 271, 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.fletcherhotelamsterdam.nl/locatie
Rooms from ca. 150 €/day
Walking distance (ca. 20 min in total)

Further:
Hotel De Witte Dame, Rooms from ca. 120 €/day. https://www.hoteldwd.nl/
Hotel de Goudvink, Rooms from ca. 140 €/day. www.hoteldegoudvink.nl/

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).*

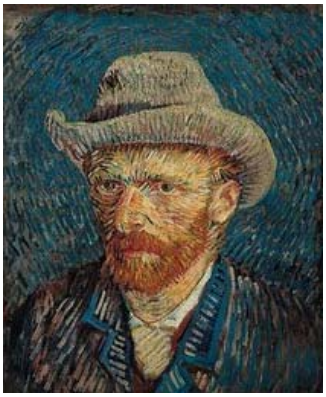
The **Muziek Theater** (Stopera)
- (*Ticket should be ordered long in advance).*

And many more flamboyant podium art theatres.

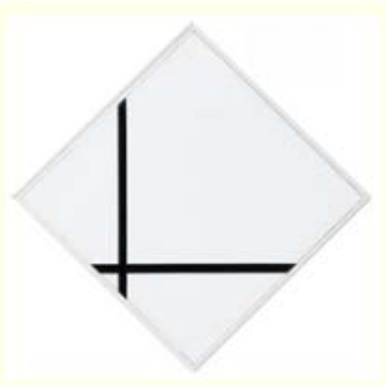
Museums

- **Rijksmuseum** (The National Museum), completely renovated and with the Vatican Museum and the Louvre one of the best general museum of the world.
- **Van Gogh Museum**
- **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 Mondiaan
Composition with 2 lines

Scheepvaartmuseum

The Amsterdam Canals