

Medicina Sportiva

Med Sport 18 (3): 107-123, 2014

DOI: 10.5604/17342260.1120662

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7TH EUROPEAN HYPOXIA SYMPOSIUM FROM MOLECULES TO MT. EVEREST – FROM SCIENCE TO PRACTICE

KÜHROINTALM NEAR BERCHTESGADEN, GERMANY
SEPTEMBER 17TH TO 19TH, 2014

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In cooperation of:

CONTRAINDICATIONS IN NEUROLOGICAL DISORDERS IN THE MOUNTAINS

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The present study examines the problems posed by high altitude travelling in several neurological conditions, and in particular, whether the underlying disease will worsen in the mountains. The neurological conditions that allow to practice mountaineering include migraine and other common headaches, and epileptic seizures under good pharmacological control. Contraindications are Parkinson disease, Alzheimer disease, cerebral thrombosis, intracranial hemorrhage and vascular malformations, intracranial space occupying mass. We try to classify the risk found by previous transient ischemia of the brain, emboli from patent foramen ovale, occlusive cerebral artery diseases, multiple sclerosis, peripheral neuropathies, neuromuscular disorders, as well as psychiatric and sleep disorders. We provide recommendations regarding evaluation, advice for or against travelling in mountains and effective prophylactic measures, since individual cases should be advised after careful examination and risk evaluation either in an outpatient mountain medicine service or by a physician with knowledge of risk involved in travelling in the mountains. This area has not been fully investigated and the data are in many instances either anecdotal or based on personal experience therefore further study is needed. The main purpose of this recommendation is to avoid occurrence of acute mountain sickness or cerebral edema and recurrence of a neurological condition in a remote area where the rescue might be difficult.

STRUCTURAL AND FUNCTIONAL CHANGES OF MITOCHONDRIA UNDER HYPOXIA AND THEIR CONSEQUENCES FOR CELL FUNCTION AND SURVIVAL

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The mammalian brain is the organ with the highest energy requirements fulfilling those high demands by mainly utilizing oxygen and glucose in mitochondrial oxidative energy metabolism. The oxygen is metabolized by the terminal enzyme of the mitochondrial respiratory chain, cytochrome c oxidase (COX). This enzyme catalyzes the electron transfer from ferrocytochrome c to oxygen and in parallel the translocation of protons across the inner mitochondrial membrane which is subsequently been utilized by the ATP synthase to produce ATP. Thus, ATP can be considered an indirect product of COX which diminishes COX activity by binding to the N-terminus of COX subunit IV at high cellular energy (ATP/ADP) levels. This serves as a regulatory mechanism to adjust the energy production by the mitochondrial respiratory chain to the cellular energy demand.

Under hypoxic conditions, many changes of and in mitochondria occur, such as the mitochondrial protein expression pattern via transcriptional and posttranslational regulation, leading to changes of the activity of respiratory chain enzyme complexes affecting intracellular signaling, ATP/ADP levels, and cell function and survival. As we discovered, COX subunit IV-2 isoform expression is induced under hypoxia leading to increased COX activity to maintain high ATP/ADP levels in cells. Thus, during hypoxia there was no energy crisis observed, but an elevated mitochondrial ROS production which, in turn, causes a decreased cell viability.

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FACTORS INFLUENCING PRESSURE AND VOLUME OF THE PULMONARY CIRCULATION AS RISK FACTORS FOR DEVELOPING A HIGH ALTITUDE EDEMA – FINDINGS OF THE ADEMED EXPEDITION 2011 IN THE SOLU KHUMBU REGION OF NEPAL

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Background: At altitudes beyond 2500 meters, there is a risk to develop High Altitude Pulmonary Edema (HAPE). The risk grows with the increase of pressure of the pulmonary artery. The exact increase is not predictable yet because, besides the high altitude itself, the relevance of individual risks and behavior (preexisting diseases, speed of ascent etc.) are still unclear.

Methods: We analyzed the systolic pulmonary pressure (PAPs) as well as the maximum regurgitation flow ($v_{\max}$). Both are considered crucial factors for diagnosing a pulmonary hypertension by echocardiography. Measurements were performed at Lukla (2860 m), Gorak Shep (5170 m) and the summit of Kala Patthar (5675 m), all located in the Solu Khumbu region / Nepal. As part of the study, we compiled general background information on the participants for correlating this information with the measured data.

Results: 27 male and female participants (20-65 years) were included in the study. The results showed a highly significant rise of systolic pulmonary pressure and the maximum regurgitation flow after ascending Kala Patthar. A key finding of our study was that the rise of PAPs and $v_{\max}$ was smaller in the group of older participants although the initial measurements in Gorak Shep were significant higher. That also applied to participants who suffered from a preexisting pulmonary disease or took Diamox. Furthermore the tendency could be detected that with higher oxygen saturation PAPs and $v_{\max}$ raised more. In addition to that, a negative tendency between $v_{\max}$ and the oxygen saturation could be detected. It was also noticeable that there were more significant results detected in Gorak Shep than at the top of Kalar Patthar.

Conclusion: The pulmonary pressure increases significantly at high altitude. A clear increase of pressure is the physiologically response of the body to the increasing altitude. It is followed by a stage of adaptation. This previous increase and the phase of adaptation turns out to be lower among older people, people with preexisting pulmonary diseases or after taking Diamox. Therefore, they have to be considered key risk factors for developing a High Altitude Edema. The oxygen saturation can serve as indicator for self-assessing the risk of developing a High Altitude Pulmonary Edema and serve for orientation for the altitude profile.

MOUNTAIN SPORTIVE ACTIVITY – TOO DANGEROUS FOR PRIVATE INSURERS?

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Question: Most of the mountain sportive activities are connected with a certain mortal risk or with a risk becoming handicapped. For this reason a life and disability insurance policy is recommend. As these applicants have higher risks for the insurance companies, some sportive activities are declined or are insured only with a higher premium. What have to be respected in asking for a private cover?

Introduction: Private insurance companies have the right to determine the individual risk of each applicant (underwriting procedure) in order to calculate the premium. For this reason the insurer ask generally for medical, sportive and behavioural risks. For sportive activities like paragliding and other activities with a higher risk the insurers exclude this sportive activity from the cover or ask for a higher premium. Very rarely the companies decline the cover totally. Generally the primary insurance companies use for this evaluation tables and tools from the reinsurance companies to find comparable and adequate ratings for the clients.

Results: In the following paper the most common ratings from the insurance companies are shown. So the insurance take into account the altitude of the sportive activity and distinguish with or without a mountain guide. Furthermore for climbing the kind of climbing is important (free solo climbing, climbing in a hall, front climbing). So for trekking over 5000m for disability cover a surplus of 25% is demanded. For expedition to higher mountains the premium depends on the individual condition (guide, amateur). For other climbing activities the UIAA classification is taken into account. Speed climbing in higher mountain and building climbing are generally denied.

Summary: Most of the mountain sportive activities are assurable. Very dangerous activities like speed climbing, building climbing are denied. The other activities are insured generally with a higher premium of 25% to 50%.

THE IMPACT OF PROLONGED HIGH ALTITUDE EXPOSURE ON BRAIN VISUAL SYSTEM

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Background: It has been known for a long time that brain is the organ especially vulnerable for deprived oxygen transportation. Recent studies have shown that hypoxic environment such as high altitude can lead to (i) structural changes in the brain, (ii) functional changes in the brain, and (iii) changes in cognitive function. In the field of high altitude cognitive neuroscience only a few studies have addressed the question to what extent high altitude exposure affects visual attention. Visual attention is a core cognitive capacity, which plays a crucial role in normal everyday performance. Especially in complex and potentially dangerous environment intact visual attention is essential. The aim of our study was to assess the impact of prolonged high altitude exposure on cognitive and neurophysiological markers of visual attention. Moreover, we wanted to determine whether high altitude affects some visual attention processes and underlying mechanisms more than others (e. g. early vs late visual processing). Finally, we wanted to examine whether the observed changes would disappear after expedition or persist for longer periods after return.

Methods: Sixteen amateur climbers (without previous experience of high altitude) took part in our study. Six climbers participated in Mt. Elbrus Expedition (5642 m) and 10 climbers participated in Muztagh Ata Expedition (7546 m). We measured their brain activity during visual attention task at four time points: before the expedition, during the expedition, one week after the expedition, and one month after the expedition.

Results: The results showed that high altitude exposure influenced early and late stages of visual processing. Brain activity related to early visual processing was decreased on expedition. After the expedition brain activity were returning to baseline but did not reach baseline level even one month after the expedition. On complex visual attention task we identified decreased brain activity in posterior parts of the brain and increased brain activity in anterior parts of the brain on the expedition.

Conclusions: Our results are in consonance with previous studies showing that prolonged high altitude exposure might influence early/late visual processing and underlying brain mechanisms. Moreover, we found out that hypoxia does not affect different brain regions to the same extent. We hypothesized that increased frontal activity during complex visual attention task might reflect protective top-down regulated adaptive function, which aims to compensate for impairments in other brain regions.

DOES MODERATE EXERCISE ALTER HORMONAL APPETITE REGULATION AND OXIDATIVE STRESS DURING CONTINUOUS HYPOXIC EXPOSURE?

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Background: High altitude sojourns are often associated with increased physical activity. Both, hypoxia and exercise have been shown to influence appetite and oxidative status. The aim of the present study was to discern the effects of moderate exercise training during continuous hypoxic exposure on selected markers of hormonal appetite regulation and oxidative stress.

Methods: Fourteen healthy males participated in a continuous 10-day exposure to normobaric hypoxia ($P_{iO_2}=88.2\pm0.6$ mmHg; simulated altitude ~4000 m) either combined with moderate intensity exercise training (Exercise group, $n=8$; two 60-min exercise sessions $\cdot$ day⁻¹ at 50% of altitude-specific maximal aerobic power) or without any exercise (Sedentary group, $n=6$). To quantify fasting and postprandial plasma concentrations of selected appetite-related hormones a meal tolerance test was performed before (Pre) and just prior to the end of confinement (Post). The oxidative stress and antioxidant markers were assessed at Pre, Post and 24-hrs after confinement cessation (Post+1).

Results: No differences between Pre and Post or between groups were noted in fasting and postprandial concentrations of total ghrelin, peptide YY, glucagon-like peptide-1, and leptin. Augmented advanced oxidation protein products and nitrotyrosine levels at Post indicate increased oxidative stress levels in the sedentary group only. On the other hand, antioxidant markers (superoxide dismutase and catalase) were only increased at Post in the exercise group ($P < 0.05$). Ferric-reducing antioxidant power was higher in the exercise compared to the sedentary group at Post+1 ($P < 0.05$).

Conclusion: Daily moderate intensity exercise training during 10-day hypoxic confinement does not seem to alter hormonal appetite regulation but can attenuate hypoxia-induced oxidative stress in healthy young individuals.

PREGNANT WOMEN IN HYPOXIA – WHERE ARE THE LIMITS?

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World-wide 140 million people are living at an altitude above 2500 meters and more than 40 million travel there every year. Questions concerning health for women and their doctors came up. We know that the incidence of acute mountain sickness does not differ in pregnant versus non-pregnant women and in women versus men. Furthermore we know that both pregnancy and altitude increase ventilation. Cardiac output rises during pregnancy at high altitude, but not as much as at low altitude. Uterine artery blood flow appears lower at high than low altitude. All in all the chronic hypobaric hypoxia results in an intrauterine growth restriction. Recommendations for high altitude visitors are based on incomplete data.

Within the first half of pregnancy women with an increased risk, without high altitude experiences or complicated pregnancy should avoid high altitude exposures, because of a higher incidence of spontaneous abortion in first trimester. Within the second half of pregnancy short stays of hours to days without heavy exercise pose little risk of pregnancy or fetal complications. Stays for weeks to months increase incidence of preeclampsia, gestational hypertension, placental abruption and risk of intrauterine growth restriction. Medical visits should be done frequently. Sport activities has the potential to cause fetal hypoxia or preterm labor at high altitude. Before exercising should be allowed three to four days for acclimatization and two weeks for full acclimatization before strenuous exercise should be recommended. Contraindications for high altitude visits during pregnancy are chronic hypertension, preeclampsia, impaired placental function, intrauterine growth restriction, maternal heart or lung disease, anemia, smoking.

This lecture is based on the actual consensus statement vol. 12 “Women going to altitude” of the UIAA MedCom. It should give an overview about women specific topics of high-altitude medicine with a focus on pregnancy. The following questions will be discussed: Are there new findings in current literature? Which recommendations can give for an acute exposure and which contraindications exist?

SPORT CLIMBING AND PRETERM BIRTH

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Background: Sport climbing is a popular recreational sport with an increasingly proportion of female athletes. During pregnancy the international recommendations accentuate the benefit of regular sport activity. In this context sport climbing is associated with a high risk potential. The aim of this study was to examine if there is a higher risk of active climbing athletes for preterm birth.

Methods: A retrospective cross-sectional self-report online survey in German language collected data between September 2012 and November 2013. In addition to anthropometric and demographic data, data of climbing experience, preferred climbing discipline, skill level, changes of climbing habits during pregnancy, known risk factors for preterm birth and information of delivery and the newborn were asked for. While statistical analyses values were compared with information of German Federal Statistical Office.

Results: Sample size was 32 mothers, 72% had an university degree, 81% were primipara, all were singleton pregnancies. One questionnaire was excluded because of described preeclampsia. Age ranged between 21 and 39 years, weight between 48 and 93 kg, height between 159 and 180 cm (mean 167 cm), climbing experience before pregnancy between 2 and 24 years and skill level before pregnancy between 5 minus and 7 plus on UIAA-Scale. Half of the women climbed till the 36st week and 90% adjusted their climbing habits mostly by reducing climbing difficulty and doing more top roping.

Two preterm births on 36st week of gestation were found (13.3%, confidence interval 2.3 – 24.3%). In 1999 in Germany there were 7.9% preterm births in the whole population.

Conclusions: No higher proportion of preterm birth could be found. Limitations are small sample size and high social status of participants. This is the first study investigating risk of preterm birth in recreational sport climbing athletes.

RESTING ARTERIAL OXYGEN SATURATION FOR THE PREDICTION OF SUBSEQUENT DEVELOPMENT OF ACUTE MOUNTAIN SICKNESS

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Background: Acute mountain sickness (AMS) is the most common high-altitude disease affecting motor and cognitive function [1,2]. Experiences from prior high-altitude exposures are most important predictors for AMS, but often reports on previous high-altitude tolerance are not available. Several laboratory and field tests have been developed to predict AMS development [3-5]. Prediction of AMS by resting arterial oxygen saturation (SaO₂) during short-term exposure to hypoxia has been proposed as a method with acceptable accuracy in a prospective laboratory setting [6] but it remains unclear, if this method adequately predicts AMS also during exposure to real high altitude. Thus, this study evaluated the predictive value of resting SaO₂ in hypoxia on subsequent development of AMS during real high-altitude exposure.

Methods: Thirty-two persons were exposed to a simulated altitude of ~3800 m (normobaric hypoxic chamber) for 30 minutes. At the end of the exposure SaO₂ was measured by finger pulseoximetry and mean values of 4 measurements during a 2-minutes period were used for analysis (SaO₂ predict). Two models (M1, M2), based on previously published regression equations for altitude-dependent SaO₂ values of AMS-susceptible and AMS-resistant persons [3], were applied to predict AMS. M1: AMS was predicted for SaO₂ predict < (96.51 + 0.68*alt – 0.80*alt²). M2: AMS was predicted for SaO₂ predict < (98.34 – 2.72*alt – 0.35*alt²) (alt = altitude in km). Subsequently, participants were exposed to natural high altitude (3650 m) for 45 hours and AMS symptoms were determined repeatedly by the Lake Louise Score (AMS = score = 4). Positive and negative predictive value (PPV, NPV), sensitivity (SENS) and specificity (SPEC) were calculated to compare the 2 models.

Results: M1 correctly predicted AMS in 66 % of the cases (PPV 0.71; NPV 0.55; SENS 0.75; SPEC 0.50). M2 correctly predicted AMS in 56 % of the cases (PPV 0.80; NPV 0.45; SENS 0.40; SPEC 0.83). When excluding values of SaO₂ predict > 90 % (n=6), correct prediction improved to 73 % for M1 (PPV 0.71; NPV 0.80; SENS 0.94; SPEC 0.50) and 62 % for M2 (PPV 0.80; NPV 0.50; SENS 0.50; SPEC 0.80).

M1 was superior in AMS prediction compared to M2. Correct prediction was lower compared to a retrospective analysis [3] and to a prospective laboratory setting [6] using the same method. The exclusion of non-valid values of SaO₂ predict likely achieved by hyperventilation improved prediction but also identifies practical problems related to the use of this method.

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TRIP PREPARATION AND MEDICAL SAFETY MANAGEMENT OF TREKKERS IN THE SOLO KHUMBU / MT. EVEREST REGION, NEPAL – RESULTS OF THE ADEMED EXPEDITION 2011

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Background: The field study was performed to get data about the actual situation concerning trip preparation and safety management of trekkers.

Methods: A standardized questionnaire was handed out to trekkers in the Solo Khumbu region, Nepal

Results: 366 participants (215 male, 148 female), mean age 38.8 years (18 to 74 years) from a total of 37 nations participated. Individual trekkers (81.8% (81/101)) sought significantly ($P < 0.001$) more information on health care prevention than trekkers who travel with a commercial group (59.2% (148/250)). They (63.4% (64/101)) also considered repatriation significantly ($P < 0.001$) more often than commercially-organized trekkers (36.0% (90/250)). Nevertheless 50.5% (185/366) had no preparations set for an emergency evacuation. Significantly more ($P < 0.004$) members of a commercial group (34.4% (86/250)) experienced an unexpected medical event/ emergency within their group during the current trip (individual trekkers: 17.8% (18/101)).

An inquiry about first aid knowledge has shown that 53.4% of the participants (181/339) had a good overall knowledge (64 to 84 out of 105 points). Further analysis pointed out that they knew the least about teeth problems, problems connected to weather conditions and accidents. In each of these topics less than 10% of the trekkers knew 80% or more of the answers. About 15% of the participants scored 80% or higher in the questions on basics in first aid. Questions concerning head injuries (39%) and heart attack (36%) were answered correctly most often.

Conclusions: Good preparation for a trekking trip is necessary to prevent but also be prepared for some of the emergencies. Travel medical advice should include topics like travel insurance and repatriation. There is a need for environment adapted first aid classes. People score higher in topics they are used to from their daily life (e.g. heart attack, head injuries) than in problems that might occur in a rural area (e.g. bad weather conditions, frostbite).

THE USE OF PHYSIOLOGICAL PARAMETERS AS INDICATORS OF STRESS/ RECOVERY RELATIONS DURING HIGH ALTITUDE TRAINING CAMPS IN NON CYCLIC SPORTS – A MORE PRACTICAL APPROACH

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Judo is an Olympic combat sport with ongoing opponent contact and is characterized under conditional aspects with high demands on both, the anaerobic and aerobic energy system. Even before the reunification of Germany the national judo team (East Germany) conducted regularly altitude training to enhance metabolic performance. The main intention was at this point to use the benefits of known hematological and metabolic adaption processes immediately for competitions and in a longer term to maintain and enhance physical abilities required by judo.

To meet these requirements during the current competitions schedule the woman's national judo team uses frequently high altitude training to set a coupling of specific and non-specific workouts – here a kind of “block training”. It is common knowledge that in addition to the known potentially positive effects of altitude training, there is always a high risk of overload or overtraining due to the altitude exposure and the hereby associated special physiological conditions in combination with the training stimuli.

To support the team coach in taking care for the athlete's proper adaptation and health maintenance, the Olympic base center of Rhineland accompanies high altitude training camps for almost seven years.

Using this cooperation as an example, we show how physiological but also psychological parameters can be used as indicators for stress control and regeneration management in combat sports, with the aim to achieve the greatest benefit for the athletes and at the same time avoiding a potential overtraining.

ILLNESSES FORCING FOREIGN TREKKERS AND NEPALESE WORKERS TO AN INPATIENT TREATMENT IN EVEREST REGION, NEPAL – RESULTS OF 2ND ADEMED-EXPEDITION 2011

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Background: Trekking, especially in Nepal, is popular more than ever. Each year thousands of foreign tourists come to Everest Region for trekking and mountaineering. With the tourists Nepalese people also come to this altitude region for working as porter, guides, builder or in guest houses. The number of tourists and worker increases each year. We tried to find out the causes and their changes throughout the last years, forcing trekkers and workers to an inpatient treatment or evacuation.

Methods: We did a retrospective analysis of the case documentation at Kunde Hospital (3840m) of the last 15 years (Jan 1996 to Sep 2011). Only transit patients, meaning foreign trekkers and workers, who do not belong to the local population, were included. Using the inpatient logbooks with basic documentation (name, gender, age group, nationality, purpose of visit, diagnosis, period and length of treatment and condition at discharge) we transferred all data to a data base and transferred the diagnosis to ICD-10-WHO 2011 for classification and analysis.

Results: We got data from 479 patients of all ages, 363 (75,8%) male, 116 (24,2%) female. 202 trekkers (42,2%) and 277 workers (57,8%) from 35 different countries have been treated as inpatients at Kunde Hospital during the evaluation period. Severe illnesses, either diseases or trauma, forcing visitors (trekkers or workers) of the Everest Region to an inpatient treatment are increasing. Most cases are due to any kind of altitude sickness (45,5%), acute gastroenteritis (10,4%) or any kind of acute respiratory infection (8,4%). Severe cases of altitude sickness amongst trekkers are decreasing, but amongst workers are increasing. Severe cases of acute gastroenteritis amongst trekkers are increasing.

Conclusion: Prevention methods for trekkers to Everest Region concerning any kind of altitude sickness seem to be effective. But prevention of altitude sickness amongst workers (guides, porter, builder) must be improved. Acute gastroenteritis might be an unaware “new” risk for trekkers – prevention and education is needed.

NECESSITY FOR SPECIFIC FIRST AID COURSES FOR PEOPLE WHO DO VIA FERRATAS

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Background: The popularity of doing via ferratas in the region of the European Alps has increased a lot. We have analysed the pattern of injuries from accidents, which have occurred on via ferrata, and First Aid (FA) knowledge from the persons on such alpine routes. The aim was to create specific FA courses for those sports persons. FA in the mountains differs to the first aid in urban regions because the conditions in the wilderness are completely different to the cities. Consequently the FA knowledge should be adapted to such conditions. Additionally the time which the rescue service needs to reach the patient is much longer than in urban regions. Therefore the victims depend on the FA knowledge of their companions. Because of the rising popularity of the via ferratas – pushed by tourism bureaus which promote them as easy and safe alpine adventure which brings more and more people with less experience in climbing and mountaineering – the number of accidents while doing via ferrata showed an extreme increase during the past few years. Preventive strategies are therefore necessary.

Method: A total of 391 questionnaires could be collected at the Fiderepass Hut (2070m, Allgäu Alps, Germany) and the Tuckett Hut (2272m, Brenta, Dolomite Alps, Italy). The participants were asked for demographic characteristics, overdue injuries and accidents while doing via ferrata. Then 18 questions about FA in a wilderness region were asked. At the end the participant had to estimate their own FA knowledge. The questions about FA were similar to those of a previous study and had been evaluated at a group of physicians trained in Alpine Medicine.

Results: 391 of 430 questionnaires could be evaluated (return rate 90.0%). FA knowledge of via ferrata climbers does not meet the demands, e.g. many participants were able to make the diagnosis a myocardial infarction – an extremely rare event in the mountains – but couldn't handle the initial treatment of a fracture, which is more likely while doing via ferrata. The results and a potential curriculum for specific FA courses for people who do via ferrata will be presented during the lecture.

HYPOXIA AND CARDIAC DISEASES – WHERE ARE THE LIMITS?

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Over the decades all disciplines of mountain sports became a popular activity for the general population. Participants of all age groups may be seen. Recently exposure to artificial hypoxia for fire protection or hypoxia training added new questions to the topic. The age of the climbing population includes all age groups now. With age the probability of individual health risks increases. Qualified advice is needed to enable athletes to climb safely when a preexisting, often chronic disease may occur. "Safely" means, that neither the disease should be worsened by the activity nor the disease itself causes risk when climbing.

To give a good advice a detailed actual health status of the person is a must. Therefore it should be taken into account that standard ergometry does not give adequate information about the performance (and load) when climbing. Furthermore it should be accepted that there is no procedure for endurance testing which has been evaluated at altitude or in hypoxia so far (except Borg's scale, Küpper et al., submitted for publication).

The lecture gives an overview how to manage the most important preexisting cardiocirculatory diseases as there are coronary heart disease, arrhythmia, and hypertension when the patient wants to continue mountain sports or work in hypoxia. Careful adjustment of the climbing in combination with perfect therapy and a strict patient survey is the key, but without a good partnership between the climber and his or hers doctor any concept will fail. However: It is definitively not state or the art when doctors principally ban climbers to continue climbing whenever they have made the diagnosis of a chronic disease.

RISK IN MOUNTAIN SPORTS – FACTS AND DATA

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Objective: To give a review about recent research concerning risk in sports with special focus on mountaineering or climbing disciplines. The data should be used for an evidence based discussion about risk and prevention in mountain sports, especially when insurance topics should be discussed.

Methods: Literature research (Medline etc.) and own studies and papers concerning accidents, acute and overuse injuries and their consequences in sports. All data are given as incidences per 1000 hours of activity. Severity is given as NACA injury score.

Results: In the 80's so-called "classic" mountaineering showed an incidence rate of 37.5/1000hrs which was ~8 times lower than rugby, ~20% lower than women handball or similar to football Champion's League. Actually the data for climbing disciplines per 1000 hrs are as follows: ice climbing 4.07, competition rock climbing 3.1, ski / snowboard 1.0, "classic" mountaineering 0.56, sports climbing (rock) 0.027-0.079 (for comparison: Nordic Walking 0.9, mountain bike 1.0, volleyball at schools 6.7).

Conclusions: The procedure of insurances to calculate their risk when they offer contracts to mountaineers or climbers is completely independent from any reality and hard data are consequently ignored or at least significantly biased. In consequence some easy but high mountains worldwide (e.g. Island Peak, Nepal) and some of the hardest ones (e.g. Fitz Roy, Argentina) are covered by the policies, but some of those which are easy but show a high incidence rate are not (e.g. Kilimanjaro, Tanzania).

During the last decade mountain sports and climbing showed an even lower incidence rate than some school sports (e.g. volleyball). This indicates that there is no single argument to add a risk loading for mountaineers or climbers to their insurance contracts. However, there are perspectives to make mountain sports even safer.

MILITARY MISSIONS AT HIGH ALTITUDE – TACTICAL ASPECTS OF HIGH ALTITUDE PHYSIOLOGY

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Several studies, especially of the U.S. Armed Forces, show that soldiers are very susceptible to mountain sickness. During Operation Anaconda, the most intense fire fight after Vietnam, approximately 40% of all casualties were related to disease non-battle injuries as acute mountain sickness (AMS, 14.6%) and orthopedic injuries due to the alpine terrain (25%). Especially Special Operations Forces, but also conventional forces are regularly deployed to heights above 2500m, the threshold the human body has to acclimatize. Those experiences encouraged us to develop a high altitude physiology educational program, especially directed to tactical aspects of military missions at high altitude.

In contradiction to the European Alps, countries of current or possible military engagement show a completely different relief. In the Alps freedom of movement is limited very often even below the threshold of 2500m due to profound alpinistic skills necessary to move there. In ongoing or possible scenarios heights of more than 4000m can be reached regularly with vehicles and the relief is mostly technically easy. This means that those heights are accessible for all soldiers on short notice.

The training in tactical high altitude physiology takes place in non European foreign countries and encloses additionally an intensive military medical research. Challenging and realistic acclimatization profiles for military operations are chosen by purpose with the consequence of reaching high altitude fast and even accepting AMS to develop. One defined goal of the training is that every soldier experiences his specific symptoms of high altitude. Additionally high altitude and acclimatization tactics, special breathing techniques, the usage of height specific medication, pulse oximetry and Mountain sickness scores is practiced intensely. This program requires the constant presence of a military physician who is experienced in high altitude medicine, has a high alpinistic skill level and profound knowledge of emergency and travel medicine. All high altitude tactical decisions and treatments are closely discussed between the physician and the training manager and explained to the participants for reasons of education. In addition life and survival at high altitude and in alpine areas (from hygiene to alpine dangers) are educated and trained automatically.

This presentation describes the concept of “tactical high altitude physiology” in detail.

PHYSICAL AND PHYSIOLOGIC DETERMINANTS OF SPORT CLIMBING

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Background: Sport rock climbing is fast becoming increasingly popular, including the range from competitive sport to recreational activity. It is characterized as a full-body exercise that provides low and high-intensity bouts, and challenges physical strength and endurance, flexibility, agility, balance, and mental capacities, as well as providing a health benefit. However, little is known about the physical, physiologic and psychologic factors that determine climbing ability and distinguishes climbers at different levels. As such, this study aimed to identify the physical, physiologic, and psychologic factors that determine the peak on-sight sport climbing grade and thus climbing ability.

Methods: 27 male subjects aged 18-36, novice to top-end sport climbers (complete grade range French 5A-8A) were tested for 43 physical, physiologic, and psychologic variables, which were statistically modelled to i) assess the predictive value of each variable for climbing performance, and ii) to identify which variables significantly explain the variation in climbing ability and how much they do so, by a multifactorial analysis to identify the determinants of climbing ability.

Results: 11 of 43 measured variables correlated significantly ($P < 0.05$) and 5 of 43 tended to correlate ($P = 0.05-0.1$) with climbing performance; thus, 16 variables were identified to strongly or at least partly affect climbing performance. The determinant variables clustered around specific shoulder and arm strength and endurance, upper-body and arm power-endurance (exercise sustainable maximum 1-2 mins), hip flexibility, whole-body and upper-body endurance (maximal and peak oxygen uptake), and forearm grip and pincer strength. Next, multiple univariate linear regression identified shoulder endurance (1), hip flexibility (2), upper-body power-endurance (3), and forearm strength (4) to significantly account for respectively 49%, 13%, 10%, and 8% (all $P < 0.05$) to the variation in climbing performance, and together explained 80% of climbing ability. In contrast, finger strength did not contribute to variation, and no variable alone contributed >50 .

Conclusion: Our results confirm the complexity of climbing, whereby peak performance is affected by a multitude of physical and physiological factors; however, the main determinants relate to shoulder and arm strength and endurance and hip flexibility. Thus, this identifies factors that differentiate climbers at different levels, and points to factors to train to improve performance.

HEPATITIS B PREVALENCE IN UPPER DOLPO IN THE MID WESTERN HIMALAYA OF NEPAL

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Hepatitis B is one of the most common viral infections in the world. Almost one third of the World's population has been infected with the virus and about 350 Million people live with chronic infection leaving in up to 30% of people affected to liver fibrosis, cirrhosis and hepatocellular carcinoma. Especially in low resource countries hepatitis B is highly endemic with predominant vertical transmission, leading nearly always to chronicity.

In Upper Dolpo, a remote and former Tibetan part of Dolpo District in the Nepalese Himalaya, modern health care services are virtually absent. During winter season many Dolpopa move to Kathmandu to seek health care in the free of charge "winter clinic". In Jan/Feb 2014 we assessed among all Dolpopa who attended the winter clinic HBV, HDV and HIV-serology as well as risk factors of transmission and alcohol consumption patterns. 65 of the 304 patients were tested positive for HBs-AG (21.4%). 13% of the women in childbearing age were found HBe-antigen positive Hepatitis B carriers with a very high risk of vertical transmission to the child. Of 50 children < 12 years, 12 (22%) have been infected with HBV, 9 of them chronic (75%). In a logistic regression model the odds to acquire HBV was significantly increasing by 1.53% (95%CI: 0.23-2.8%) per life year (life-time risk) and we could proof a significant inverse correlation between age and chronicity (2% per life year (95% CI: 0-4%)). No HDV co-infection was found and all patients were tested negative for HIV. 50% of the patients, surveyed in the AUDIT have risky patterns of alcohol consumption (AUDIT score >8) and 18% were found with an AUDIT score >20, which is highly suggestive to hazardous alcohol use disorder. The results of the questionnaire on hepatitis B risk behavior indicated a high potential of acquiring sexually transmitted diseases.

The high endemicity rate of chronic HBV infections is in line with findings in Tibet and is in contrast to the low endemicity in other parts of Nepal. The overwhelming majority of the chronic infections is acquired perinatally or in early infancy. Implementation of newborn HBV-vaccination programs must have highest priority. More detailed investigations as well as awareness and education campaigns regarding liver health, alcohol use disorder and viral hepatitis are of utmost importance.

CARDIOVASCULAR RISK PROFILES AND PRE-EXISTING CONDITIONS IN TREKKERS – AN EPIDEMIOLOGICAL STUDY IN THE SOLO KHUMBU REGION, NEPAL. DATA FROM THE 2ND ADEMED EXPEDITION 2011

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Background: High alpine trekking is strenuous and possibly hazardous, especially if one does not have the good health or skill of an experienced mountaineer. Even so chartered expeditions to destinations such as the Everest region are gaining popularity. Simultaneously, cardiovascular disease and its risk factors are on the upgrade and one of the top priority health issues worldwide. A combination of these factors may lead to problems that could not only ruin the trekker's holiday but also have severe medical consequences. Our purpose was to examine how people with pre-existing conditions handle the strain of trekking at high altitude, how many of them there are and where they meet difficulties that do not apply to a healthy person.

Methods: 350 participants answered a questionnaire and underwent basic physical examination, taking place in guest houses along the Everest trek.

Collective: 60% of the participants were male, 35% female (5% unspecified), mean age was 42.7 years (AGEmin: 18 y, AGEmax 76 y). Most interviewees were from European countries.

Results: 44.6% of the participants suffered from at least one preexisting disease and 79.4% from at least one form of current health issue, including acute mountain sickness (AMS). Manifest AMS with a Lake Louise Score >3 points was found in 25.1%, while 72.6% showed at least one symptom of AMS, the most frequent being sleep disturbance (44.3%). Orthopedic (26.0%) and cardiovascular (12.6%) diseases were the most frequently mentioned preexisting conditions, the cardiovascular status of our participants ranging from healthy athlete to distressed elderly with multiple valvular defects.

The cardiovascular risk profile showed a great percentage of smokers (30.0%), arterial hypertension (35.1%) and advanced age (31.4%), the most frequent minor risk factors being physical inactivity (46.6%), positive family history (29.7%) and high occupational stress level (42.3%).

10-year-risk for cardiovascular events and calculated heart age according to the Framingham study (D'Agostino 2008) revealed a mean cardiovascular risk of 6.4% (max. 30%) and a heart age +4.95 years older than biological age (max. +27 years).

Conclusions: The interviewed collective was older, physically less prepared and more burdened with preexisting disease than expected. Especially cardiovascular disease and corresponding risk factors were common, partially reflecting the incidence of these items in the general public.

Trekking with minor cardiovascular risk factors or pre-existing conditions is definitely possible, if certain prerequisites are met, as in many of our participants: they were well-informed about their condition, their medication and the itinerary. Also, the physical exercise and daily achievements confirmed the participants in their health behaviour, such as losing weight, adding physical activity to their weekly schedule and rethinking their diet. It is necessary to emphasize that the image of the alpine trekker is not always associated with a good health status and that especially in chartered expeditions of greater group size the focus is seldom on the wellbeing of the individual. The result can be exhaustion, sickness and even death, when further ascend is forced and people cannot choose their own time and speed according to their prelimitations.

PRIMARY HYPERTENSIVE YOUNG MEN IN ACUTE HIGH-ALTITUDE HYPOXIA*

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Clinically healthy young men with a family background of primary hypertension (n = 16) and age-matched healthy normotensive volunteers (n = 15) had to breath for 30 min either 12 % O₂ in N₂ (hypocapnic hypoxia test) or 12 % O₂ + 2 % CO₂ in N₂ (isocapnic hypoxia test). It was found that the best parameter to distinguish the means of these two groups was breathing rate. The borderline-hypertensive young men exhibited the higher breathing rate both in normoxia and in the hypoxia tests. We propose to determine not only blood pressure and heart rate but also additionally breathing rate over 24 hours, especially during sleep, to support an early diagnosis of primary hypertension. This might be useful when one has to decide which military profession a young men should choose.

In the second study after 4 hrs of normoxia young volunteers were exposed for 8 hours to a simulated high-altitude of 4200 m in the low-pressure chamber of the German Air Force in Fürstenfeldbruck, Germany. All 15 normotensives tolerated this altitude over the full time. In contrast, beginning after 4 hours of high-altitude exposure, 8 out of the 18 hypertensives had to be removed from the low-pressure chamber because of symptoms of moderate Acute Mountain Sickness (AMS).

The means of the cardiovascular, renal, ventilatory and hormonal responses in the two groups during the 8 hours at 4200 m altitude were quantitatively different, though not enough to explain the reduced high-altitude tolerance of the young men with family background of primary systemic hypertension.

It is assumed that young men with a family background of primary hypertension are predisposed to develop cerebral edema in sustained high-altitude hypoxia. This should be taken into account when teams are formed that have to operate at long-lasting altitude.

*Supported by the German Ministry for Defence

TREKKING WITH ORTHOPEDIC AND TRAUMATOLOGICAL DISEASES - RESULTS FROM THE ADEMED EXPEDITION 2011

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Background: Trekking to the Mount Everest basecamp got more popular in the last few years. A lot of older people go on a journey to the Solu-Khumbu region.

Question: What kind of musculoskeletal system diseases are in the field? What kinds of problems caused by preexisting diseases have to be solved? Should we advise older people against those journeys?

Methods: The epidemiological study was based on a custom-made questionnaire and a physical examination.

Results: There were 350 volunteers who participated in our study during those four weeks that we stayed in the Solu-Khumbu region. We did examinations at four locations on our way to the Mount Everest basecamp. 91 of our volunteers had orthopedic or traumatological preexisting diseases. Those were spine-, shoulder-, pelvic-, femoral-, knee- and foot-related conditions.

Conclusions: Most of the people had problems caused by the high altitude. Although there are a lot of patients with preexisting diseases, the travel medicine advice should be mainly concerned about the altitude adjustment.

ICE CLIMBING INJURIES IN ELITE CLIMBERS (WORLD CUP)

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Objective: To evaluate accidents and overuse injuries in elite (world class) ice climbers to develop strategies for further increase of safety in ice climbing.

Methods: Questionnaire (Basic data, activity and performance in climbing, Injuries and overuse problems (number, treatment...)). The collective were the climbers of the Saas Fee World Cup 2010.

Results: N=73 (58 male / 15 female) joined. With a mean age of 25 years and a mean BMI of 21.6 elite ice climbers are older and heavier than elite rock climbers ($P<0.001$). They have a shorter climbing career and climb less often ($P<0.01$). Nearly all of them are active in most disciplines of ice climbing (alpine walls, waterfall, artificial ice, mixed terrain) and experienced rock (sport) climbers (UIAA grade ~9). 17 athletes reported a total of 23 overuse symptoms (95.6% arms/shoulders, ~31% easy avoidable). 54/73 athletes reported a total of 108 accidents (36% head, 16% legs). 64.8% were minor problems (NACA 1), 28.7% NACA 2, 6.5% NACA 3 (no case was NACA 4 or higher).

Conclusions: Elite ice climbers suffer from many injuries, but most of them are minor ones. They show overuse problems mainly at the upper extremities and acute injuries mainly at the lower limbs and the head (face!). Most of the injuries may be prevented with minor effort. This will further reduce the even low risk in ice sports climbing.

UPDATE: STATISTIAL ANALYSES OF METEOROLOGIAL DATA OF GERMAN ALPS AND LOWER MOUNTAIN RANGES

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In 2011 we presented the results of the statistical analyses of data of the meteorological observatories Hoher Peissenberg (987 m), Wasserkuppe (950 m) and Zugspitze (2962 m). For this investigation, we analysed time series of temperature, precipitation, wind and other meteorological parameters partially back to January 1781. In the statistical analyses we observed an increase in temperature of 1° to 2°C in the last 100 years, an increase in precipitation in high altitude regions and a seasonal redistribution in precipitation to autumn and winter in all investigated regions. In this contribution we reanalyse the previous observations and present the latest climate development between January 2011 and June 2014.

This contribution investigates data of three meteorological stations, which are examples for the local progression in the area around these stations. It is not the aim to present climate models for the whole alpine area.

CRANIOCEREBRAL INJURY DURING EXPEDITION CLIMBING

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Mountaineers are at risk for traumatic injuries. The European Alps already provide a difficult and demanding terrain for mountain rescue, even more it is in higher mountain ranges around the world. On the basis of a case report describing severe craniocerebral injury to a soldier during a military expedition at Huascaran (6878 m), Andes Peru the following topics are discussed.

1. Preparation (establishing contacts in case of need)
2. Communication (cell phone, Iridium satellite phone)
3. First aid (body check, medication)
4. Rescue and transportation (by comrades, helicopter, ambulance aircraft, hospitalization)

The expedition was well prepared and equipped and the rescue process was supported by the German embassy in Lima directly. This provided the use of a MI-8 helicopter, an ambulance aircraft, the initial surgical treatment in a high standard hospital in Lima and the repatriation to a hospital in Germany of maximum care within 3 days. However, the key to successful rescue and complete recovery of the patient were highly advanced skills of all expedition members in mountain rescue and first aid. This provided a fast evacuation of the patient out of a crevasse and gentle transportation through rough and difficult mountainous terrain to a safe place before nightfall. Despite low temperatures in a glacier environment the patient did not become hypothermic at any time. By now the patient has reached full recovery in his function as a soldier of the German Special Forces.

CLINICAL EMERGENCY DIAGNOSES AMONG DENTAL AND MEDICAL SYMPTOMS UNDER HYPOXIA CONDITIONS

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The emergency diagnosis under hypoxia conditions is difficult because of the similar symptoms in dental and medical disorders. The author presents the special symptoms and diagnoses, which you can expect in an emergency at a high altitude basecamp.

A NEW APPARATUS FOR ALTITUDE AND RESPIRATORY TRAINING WITH THE FOCUS ON GAS-GAS EXCHANGE

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Aims: To provide a new apparatus, that can simulate oxygen-depleted mountain air at different altitudes, and delivers it to athletes as an intermittent hypoxic training, or to patients as a respiratory training. The apparatus may even be used as a medical respiratory test before flying.

Mechanism: The apparatus reduces the oxygen content of the air by passing the ambient air through a gas exchange module, which has a structure similar to the hollow fiber membrane in an oxygenator. The gas exchange occurs due to the difference in partial pressures pO_2 and pCO_2 of the exhaled air outside the hollow fibers and the fresh air inside the hollow fibers.

Experiments: Several experiments were performed in order to characterize the new apparatus. Different parameters were changed, such as the target subjects (sportsman, young and healthy, old and smoking), different constant flow rates, or continuously changing flow rates, and like different dead volumes in the chamber. Lastly, the measured minute ventilations were compared to the values which were calculated via a simulated model.

Results: The partial pressure pO_2 was reduced gradually and the pCO_2 was increased steadily over time. After 6-8 minutes, they reached constant values. As a consequence, a simulated atmosphere was also secured. Another result was that there was no significant difference when running the test with a single constant flow rate or with a continuously changing flow rate. In addition, the change of the dead volume was reversely proportional to the running process of the test. Upon increasing the physiological dead space by a factor of 3, it took 3 times longer to achieve the required constant pO_2 and pCO_2 values. Moreover, via the model simulation, our findings support the hypothesis that rather than pO_2 , pCO_2 has stronger effect on the increase of minute ventilation during hypoxia (for athletes when $pCO_2 \geq 45\text{mmHg}$, and for normal, healthy subjects when $pCO_2 \geq 40\text{mmHg}$).

Conclusion: In the new apparatus, pO_2 and pCO_2 partial pressure values vary as a function of 4 parameters. These are gas flow rate, the hollow fiber material, the surface area of the gas exchange module and the external dead volume. O_2 is a necessary and vital element for life and metabolism, while CO_2 , a normal product of the aerobic metabolism, plays an important role as a physiological regulator. The apparatus is suitable for intermittent hypoxic training, respiratory training, and medical testing. In addition, its low price, portability and good functionality make it worth to introduce this apparatus into the market.

A PRACTICAL APPROACH TO ALTITUDE MEDICINE FOR STUDENTS OF SPORTS SCIENCE AND MEDICINE

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Altitude Medicine and Physiology offer the possibility of an in-depth understanding of human exercise physiology for students of Sport Science and Medicine. However, they are rarely part of universities' curricula, which may be related to the topics' complexity. We describe a practical approach, which aims to increase students' interest in altitude medicine and offers practical experience of hypoxic phenomena and experimental knowledge with limited expenses.

Briefly, the course consists of 6 lectures covering basic altitude physiology (cardial, ventilatory and haematological adaptations, AMS, HAPE, non-medical risks, travel medicine) and an excursion. In the week preceding the excursion students daily measure heart rate and breathing frequency after bed rest. On the morning before departure, haematocrit (HCT) and SpO_2 is measured in all students in normoxia (490 m a.S.L.). 2-3 students perform an incremental cycle ergometer till exhaustion. Blood Lactate [La], ventilatory (breathing frequency, tidal volume) and metabolic parameters (VO_2 , Respiratory ratio (RER)), and power output are measured. Then the whole groups travels directly to the Diavolezza House (Switzerland 2979 m aSL) ascended by cable car. In the next morning, all experiments are repeated in hypobaric hypoxia.

The results show expected decreases in SpO_2 , maximal and submaximal performance, and $VO_{2\text{max}}$, increases in HCT, resting heart rate, breathing frequency, and RER. The VO_2 /power ratio remains unchanged, but [La] changes are inconsistent between individuals. The results of the experiments are discussed with the students during the excursion, which is enriched by ski touring activities.

The combination of lectures, excursion and experiments is feasible and allows a practical and surrounding introduction to altitude medicine for medical students.

MEDICAL CONTRAINDICATIONS FOR MOUNTAINEERING OR FLYING IN HYPOXIA – INTRODUCTORY CONSIDERATIONS

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David Hillebrandt showed during his presentation at the Tatra-symposium (2013) "*Diabetes – Personal practical experience of management in the field*" a photo from Kinabalu (Borneo) with 13 medical contraindications for climbing: "Do not climb if you have a history of suffering from the following ailments". He gave a very impressive example for a diabetic type 1 in mountaineering and climbing, however. – A similar photo was taken by Markus Tannheimer in the Kilimanjaro region, more specific, however. "Points to remember: 1. Hikers should be physically fit. 2. If you have a sore throat cold or breathing problems, do not go beyond. 3. Children under 10 years of age are not allowed above 3000 meters a.s.l. 4. If you have heart or lung problems do not attempt the mountain at all without consulting your doctor. 5. Allow plenty of time for the body to acclimatize by scending slowly". – Thomas Küpper demonstrated a photo from a police station in the region of Chin-an (China), advising travelers and mountaineers: "Hikers on this path should be aware of the high risk of accidents; the elderly, woman, children, and the drunken are prohibited from climbing".

A case report by Thomas Küpper: A passenger with a moderate problem of pulmonary gas exchange contacted his doctor who sent a MEDA sheet to Air Berlin to organize oxygen just to be on the safe side. The airline did not respond, but they did not allow the passenger to enter the aircraft when he arrived at the gate. Grounding of pilots, caused by medical decisions, has severe consequences for pilots and airlines. Therefore a special regulation exists to give special physicians by single-case examination the possibility to prolong the license.

An explorative questioning of my former student Carolin Chladek with 107 mountain athletes (German Alpin Club, DAV) about frequency of asthmatics showed 13 cases with asthma (12 %) and no problems with mountaineering. Another former student Solveig Piszar examined thoroughly the dangerous nightly hypoglycemia of diabetics after endurance activities at afternoon or evening, caused by glycogen depletion during endurance activities and filling up during sleep in the night. She asked consultants for diabetics and looked in documents for consulting diabetics, guidelines and scientific literature. **Result:** This dangerous effect during sleep is known in literature and in consultants for diabetics (69 % of $n = 16$), but not distinctly enough written in documents and guidelines, especially not the special recommendation of measuring the glucose-value at least once during the night after endurance activities. This example shows how special instructions can improve consultations for patients.

Discussion: Most of the described recommendations might have a forensic background to exclude a liability claim. The consequences for patients and physicians should be discussed and documented, based on own experience of the lecturers.

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DIFFERENT VENTILATORY RESPONSES DURING HYPOXIC TESTING RESULTING FROM A HIGH-ALTITUDE ALPINIST EXPEDITION AND PERFORMANCE IN HYPOXIC CONDITIONS.

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We investigated the hypothesis that high values and/or a larger increase in $\dot{V}_E$ during testing in hypoxic conditions (HYP) are not necessary predispositions for successful climbing in high-altitude expeditions. An incremental testing protocol on a cycle ergometer was used to determine the ventilatory threshold (VT) in HYP ($\text{FiO}_2 = 0.15$). Seven experienced alpinists (mean $\pm$ SD for: age: 50 ± 6 yrs; Wt: 76 ± 5 kg; Ht: 175 ± 8 cm) volunteered to participate in this study after they had reached the summit of Gasherbrum II (8,032 m) and Ama Dablam (6,828 m). Changes in $\dot{V}_E$ in HYP (POST – PRE values) differentiated the P_{VT} values of subjects who increased their P_{VT} ($N = 4$) (responders, R) and non-responders (N, $N = 3$) who did not increase their P_{VT} . At a similar absolute power of 120, 140 and 180 W, individual results for $\dot{V}_E$ decreased or remained similar in the R sub-group, but reached higher values of blood pH, PCO_2 and $[\text{HCO}_3^-]$ than in the N sub-group. $\dot{V}_E$ increased uniformly in the N sub-group and achieved higher values than in the R sub-group. Despite the differentiation of individual values of the $\dot{V}_E$ response that accompanied different performances in HYP, the R and N sub-groups reached the summit of both mountains without oxygen supplementation. Therefore, an increase in $\dot{V}_E$ and/or higher values does not seem to be a necessary precondition for successful climbing at high altitude.

REPORT AND EXPERIENCES FROM AN EXPEDITION TO NORTH POLE

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This contribution reports about an expedition, which was performed in the year 2000 with nordic skiing and sliding carriages. The expedition started at a polar research station, which was built on drift ice at the 88th degree of latitude. The distance up to the north pole was about 120 km and the duration of the expedition has been eight and a half days. Special experiences were the handling of problems with polar ice drift and ice leads. Due to the climate warming it is not possible anymore, to track this route today.

HUMAN PERFORMANCE DURING HIGH ALTITUDE HIGH OPENING PARACHUTE JUMP - BODY CORE TEMPERATURE AND OXYGEN SATURATION

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Background: Data as ascertained in the lab are only very severe in the real environment to transfer. Often other results were found in the real environment and thereby the efficiency of the human performance was estimated wrong. In particular the influence of the environment is to be incorporated in the physiological whole consideration. However, measurements are very difficult in the field because the present measuring possibilities are either too invasive the hardware is too heavy, or the measured parameters are wrong interpreted without having a look into environmental conditions. Now moreover a method was found to examine this closer.

Methods: Parachutists became instrumented with a new system which included also the environmental parameters. New developed and off the shelf available sensors, all non-invasive, were used. Getting a "whole understanding" of the complexity between environment and physiological reactions a full setup and combination of parameters were measured. Foresightful, regarding further investigations under different environmental conditions the setup of the used system was chosen that carefully to have the possibility to compare all recorded data and have the sensitivity of all given surroundings.

Results: In a preliminary investigation 39 participants became the corresponding equipment and were measured during real parachute jumps in Eloy, AZ, USA. It was observed that the oxygen saturation decrease under 90%, but already during the flight. That indicated clearly the desaturation right before the action. During the whole time flight, exit and landing the body core (BCT) and skin temperature (ST) were measured. BCT increases during the whole time with a peak in contrast to ST which decreases significant. In the complexity these data with the physiological circumstances and environmental condition have to go be interpreted carefully.

Conclusions: Obviously measurements of physiological data obtained in the lab seem to be different compared to those in real environments. Particularly, the selection of the sensors to be used for physiological data recordings and the inclusion of environmental parameters point the complex process. But there is a need to combine all these conditions to get the whole understanding of the efficiency of human performance. In the present preliminary investigation it was feasible to show by survey in the real environment that it is possible to measure physiological data without disturbing the human being. With this acceptable setup it is possible to validate human performance in different environments with the same approach and will help also to find the physiological response of the unchanging human body in the changing climates.

DENTAL EMERGENCY TREATMENT UNDER HYPOXIA CONDITIONS

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For the emergency treatment under hypoxia conditions a sufficient emergency kit does not yet exist. The author has developed a kit for the use in the basecamp. The kit is lightweight, under 2 kg, and an addition to the normal basecamp emergency kit. There is as well a guideline developed for the medical professional and a second guideline for the amateur.