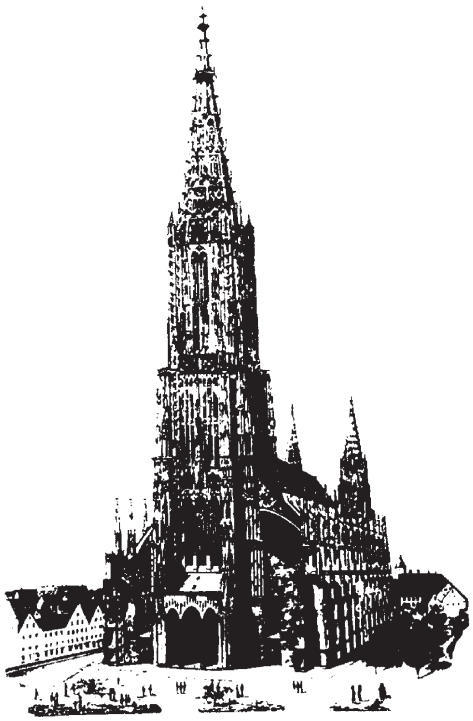
Deutsche Gesellschaft für Sportmedizin und Prävention - Wissenschaftskollegium
Sportärzteschaft Württemberg
Landessportverband Baden-Württemberg
Abteilung Sport- und Rehabilitationsmedizin, Universitätsklinikum Ulm

TRAINING, OVERTRAINING AND REGENERATION IN SPORT

– From the Muscle to the Brain –



International Symposium

October 26 to 28, 2000

Ulm, Germany

Edwin-Scharff-Haus
Kongreßzentrum Neu-Ulm

http://www.uni-ulm.de/sportmedizin

Abstracts of the Scientific Poster Sessions

OBJECTIVE AND SUBJECTIVE TRAINING STRESS AND MOOD STATES AS POTENTIAL INDICATORS OF UPPER RESPIRATORY TRACT ILLNESS IN TRAINED ROWERS

N. Hiscock[1,2], L.M. Castell[1]

Objective and subjective training stress and a modified profile of mood states were compared to incidence of upper respiratory tract illness (URTI) during a seven week training period in nine highly trained rowers. Daily training logs were maintained by each subject to provide details of objective (actual) and subjective (perceived) training stress, mood state and symptoms of URTI. Of seven reported incidences of URTI, six of these (86%) were preceded by an increase in subjective perception of training stress in the week before onset of symptoms. There was no relationship between objective training stress and incidence of URTI. Mood state did not appear to change preceding or following URTI, nor reflect objective training stress. Daily monitoring of subjective training stress may be useful in indicating a potential risk of URTI in trained individuals.

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BODY FLUID RESPONSES TO PROLONGED SCULLING IN MALE COMPETITIVE ROWERS

J. Jürimäe, T. Jürimäe, P. Purge

The purpose of this investigation was to study the influence of extensive endurance rowing training session on body fluids in 12 experienced male rowers (23.3± 6.3 yrs; 188.7 ± 5.9 cm; 82.0± 10.8 kg; body fat%: 10.9±3.3 %). The subjects rowed on single sculls 2 hr 17 min and covered 22.60 2.5 km. Before, immediately after the training session, and after 30, 60 and 120 min of recovery, body fluid balance was measured using multiple-frequency impedance device (Multiscan-5000, Bodystat Ltd, UK). Extracellular- (ECW), intracellular- (ICW) and total (TBW) body water were measured at 5, 200 and 50 kHz, respectively. Blood hemoglobin (Hgb) and hemotocrit (Hct) were measured, and changes in the blood volume (BV) was estimated according to Dill and Costill (1974). Body weight of rowers decreased significantly ($p<0.01$) from 82.0±10.8 kg to 80.6±11.2 kg during the endurance training. There were no significant changes in TBW immediately after the training session. Significant changes in the content of TBW occurred during the first 30 min of recovery (48.9±4.4 to 47.9±4.1 1; $p<0.05$). The amount of ECW also decreased significantly during the first 30 min of recovery (23.3±2.0 to 22.7±1.9 1; $p<0.05$). There were no significant changes in the balance of ICW as a result of endurance training session. BV decreased during the training session by 5.2% ($p>0.05$). There were significant relationships ($p<0.05$) between the covered distance and the following variables after the training session: body weight ($r= -0.75$), TBW ($r= -0.75$) and ECW ($r= -0.83$). Changes in the blood parameters did not correlate significantly with changes in body fluids and training volume. It was concluded that extensive rowing training session significantly changed the balance of body fluids in rowers.

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EFFECTS OF DAILY MEDIUM-CHAIN TRIGLYCERIDE INGESTION ON METABOLISM AND ENDURANCE PERFORMANCE IN RUNNERS

V. Ööpik, S.Timpmann, L.Medijainen, H.Lemberg

The effects of daily dietary medium-chain triglyceride (MCT) supplementation on metabolism and endurance performance capacity were assessed in seven well- trained male runners (age 19.4±1.7 years, body mass 65.6±2.8 kg, height 179.3±4.1 cm, VO_2 max 67.5±4.8 ml·min-1). The subjects were tested before and after MCT ingestion as well as before and after placebo (flavoured cooking oil) consumption for 7 days. The endurance capacity of the subjects was measured as running time till exhaustion at an average intensity of 80% of their VO_2 max. There was no effect of dietary supplements on endurance capacity: the running time to exhaustion before and after dietary intervention was respectively 3901±966 s and 3916±1225 s in placebo trial, 3892±1288 s and 3498±559 s in MCT trial. The concentration of β-hydroxybutyric acid in plasma was the highest (1.03±0.65 $mmol \cdot l^{-1}$) in post-test samples after MCT supplementation, being different from the pre-test level (0.45±0.42 $mmol \cdot l^{-1}$, $p<0.05$) in the same trial as well as from that observed in post-test blood after placebo treatment (0.37±0.21 $mmol \cdot l^{-1}$, $p<0.05$). The changes of the concentration of glycerol, glucose and lactate in plasma were not dependent on the nature of dietary intervention. These results suggest that daily MCT supplementation increases the availability of ketone bodies for oxidation in working muscle during high intensity endurance exercise. However, this metabolic adaptation does not improve endurance performance in well-trained runners.

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MONITORING TAPERING IN WELL TRAINED SWIMMERS

M.F. Piacentini, A. Stevens, F. Kempenaers, R. Meeusen

The purpose of the present study was to monitor the tapering period in well trained swimmers. The study was approved by the ethical committee of the Free University of Brussels. Nine well trained male swimmers performed 6 times a 300 m swim before (PRE) and after (POST) a 2 week tapering period. Blood was collected for lactate analysis at rest, after each 300 m, and during recovery. Subjects filled in a 32-item POMS before and after exercise. Significance was set $p<0,05$. During the tapering period there was a 14 % reduction in training volume (km/day). Frequency of training was 15% lower during the tapering period. Exercise performance did not improve with tapering. Lactate concentrations during the tests were 2 to 11% lower for each 300 m performed after tapering. Recovery lactate concentrations were significantly lower after tapering at all time points. POMS showed a 25% decrease in fatigue scores, a 9.6% decrease in tension scores and an 5 % increase in the scores of vigor compared to the 6 weeks prior to tapering. The lack of improvement in exercise performance after tapering is not a novelty. Monitoring mood may therefore be a tool not only in modifying the training load, but also in understanding the individual adaptations during tapering.

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METABOLIC PARAMETERS AND AMINO ACID CONCENTRATIONS IN AN ULTRA TRIATHLON

O. Volk[1], G. Neumann[2]

We examined 9 triathletes before, during and after a 48 h lasting ultra triathlon (11,4 km swimming, 540 km cycling, 126,6 km running). Blood samples were taken the evening before the start (A), after swimming (B), after cycling (C) and after running (D) to analyze 21 amino acids (AA), 3 branched chain AA (BCAA: Val, Leu, Ile), 3 aromatic AA (AAA: Trp, Tyr, Phe), several metabolic and hormonal parameters with routine measures. The table shows the results as means±SE, * indicates significance.

Parameter	A	B	C	D
Glucose-mmol/l	5,55±0,82	6,27±1,13	5,69±0,86	6,39±1,19*
Triglycerides-mmol/l	1,49±0,70	1,79±0,76	0,86±0,20*	0,78±0,33*
Free fatty acids-mmol/l	0,308±0,101	1,164±0,602*	1,726±0,672*	1,231±0,556*
ß-Hydroxybutyrate-µmol/l	74±15	176±50*	642±522*	384±234*
AA-µmol/l	2589,8±294,5	2488,4±223,1	2003,2±233,1*	2186,5±409,3
BCAA-µmol/l	448,5±102,6	462,9±145,8	320,8±96,8*	355,1±101,3*
AAA-µmol/l	173,1±34,3	177,6±28,6	166,1±30,4	206,0±38,0
BCAA/AAA	2,6±0,5	2,7±1,0	2,0±0,6*	1,7±0,4*
BCAA/Trp	9,2±2,0	14,5±10,1	12,0±5,6	7,9±2,0*
Insulin-µU/ml	13,89±13,24	4,89±1,46*	5,93±3,55*	6,27±4,64*
Cortisol-nmol/l	223±144	623±178*	471±85*	654±277*
Testosterone-nmol/l	44,6±11,5	52,7±15,1	29,8±17,4	21,5±9,3
Urea-mmol/l	7,0±1,4	7,9±1,7	10,9±3,3*	9,2±3,4

This ultra triathlon led to an enormous metabolic stress in spite of slow moving speed, with a continuous depletion of carbohydrates, increased fat metabolism, and a breakdown of AA with increased protein catabolism. The decreased BCAA/Trp ratio may indicate central fatigue.

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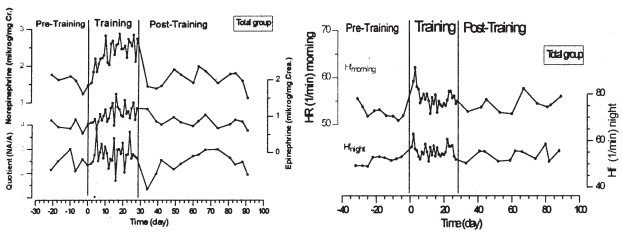
EFFECTS OF HIGH TRAINING LOADS ON URINARY CATECHOLAMINE EXCRETION AND NIGHTLY HEART RATES

P. Platen, R. Wöstmann, H. Schulz, U. Hartmann, U. Bartmus, V. Grabow, H. Heck

11 cyclists and triathletes (27.2 ± 5.3 J, 180.9 ± 5.1 cm, 75.2 ± 6.7 kg, VO_2max: 65.3 ± 6.4 ml/min/kg) participated in a 4 weeks training camp (TR, Jan/Feb 98) with the aim to induce overtraining. TR was part of a project called „Determinants to assess Regeneration“, supported by BISP (VF 0408/01/03 A/97). Subjects were investigated from 4 weeks before up to 8 weeks after TR. Before and after TR, urinary samples (overnight sampling period) were collected twice/week, and every night during TR. Mean nightly heart rates (2 - 5 am) and morning heart rates (minutes before standing up) were measured in the same nights (Polar, Vantage NV). During TR, mean training volume increased from 500 min up to 2500 min/ week. More than 50% of training was done with an intensity >75% of the power at 4 mmol/l lactate concentration. Mean urinary catecholamine excretion increased during TR in the whole group, with high inter-individual variability. In spite of elevated catecholamine excretion, mean nightly heart rates declined during TR, and mean morning heart rates remained more or less constant. We conclude, that nightly and morning heart rates are independent from urinary catecholamine excretion.

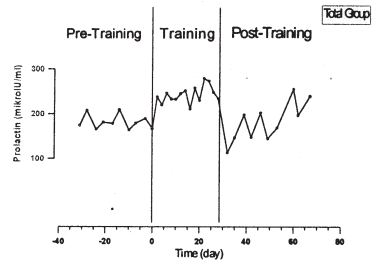


Working group „Regeneration“, German Sport University Cologne, University Bochum, University Dortmund

EFFECTS OF HIGH TRAINING LOADS CONCENTRATIONS IN ENDURANCE ATHLETES ON SERUM PROLACTIN

P. Platen, R. Wöstmann, H. Schulz, U. Hartmann, U. Bartmus, V. Grabow, H. Heck

11 cyclists and triathletes (27.2 + 5.3 J, 180.9 ± 5.1 cm, 75.2 ± 6.7 kg, VO_2max 65.3 ± 6.4 ml/min/kg) participated in a 4 weeks training camp (TR, Jan/Feb 98) with the aim to induce overtraining. TR was part of a project called „Determinants to assess Regeneration“, supported by BISP (VF 0408/01/03 A/97). Subjects were investigated frorn 4 weeks before up to 8 weeks after TR. Numerous bicycle ergometer tests were performed in this period. Before and after TR, venous blood samples (in the morning, after an overnight fast) were taken twice/week, and every second day during TR. lndividual training during TR was controlled by means of SRM-system plus heart rate measurements. Before and after TR, training was controlled by means of heart rate measurements only. Serum concentrations of prolactin (PRL) were determined with ELISA technique.



During TR, mean training volume increased from 500 min up to 2500 min/ week. More than 50% of training was done with an intensity >75% of the power at 4 mmol/l lactate concentration. An increase of PRL was observed in the whole group during TR compared to the pre- and post-training values, and from the beginning to the end of TR.
PRL changes, however, varied individually. As serum PRL concentration is a possible marker of central serotonergic activity, we conclude that high training loads might change central serotonergic activity, depending, however, on individual training volumes and intensities.

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PRE-EXERCISE CARBOHYDRATE-MINERAL DIETARY SUPPLEMENT – EFFECT IN ATHLETES

R. Pakula, K. Szyszka

In the testing done there was estimated the effect the pre-exercise oral carbohydrate-mineral dietary supplement (EN+EL®) had on physical capacity, changes in physiological parameters, acid-base balance and electrolytic equilibrium in athletes training rowing, canoeing, soccer, wrestling, cycling and long-distance running. The athletes performed exercise tests appropriate for their sports. The tested groups did 2 workouts with a 7-day- long interval each. The first workout (control group) was dietary supplement-free, while the second workout (experimental groups) followed the athletes taking orally the EN+EL® – solution (373 ml) 60 minutes beforehand. Having measured the capacity parameters we found no substantial differences between the tested groups (the control and experimental ones) as for the time the distance was covered (in the rowers, canoeists, soccer players, cyclists and runners), gains in power (in the rowers), actual workout (in the cyclists) or the number of the wrestlers' throws. As for the post-exercise heart rate there were no such differences, either. The tested dietary supplement made glucose level (Glc) stabilized, though the concentration of Glc in the canoeists, cyclists or footballers in both groups was comparatively the same. The orally taken supplement had a beneficial effect on the post- exercise acid-base balance in the soccer players, wrestlers and runners. Having summarized the tests results, the EN+EL®– formula taken an hour before an exercise seems to have had some favorable effect stimulating the exercise and post-exercise metabolism in athletes. A single pre-exercise taking of the EN+EL®-supplement helped to ease the homeostasis disorder referring to an intense physical exercise.

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IMMUNE FUNCTION AT REST IN RESPONSE TO INCREASE IN TRAINING DURATION

M. Bagger, P. Balsøv, P.K. Pedersen

Overtraining, the ultimate result of excessive training and insufficient recovery has long been associated with increased susceptibility to infectious illness. A single hard exercise bout results in suppression of the immune system and if the next exercise bout begins before fully recovered the immune function will still be suppressed. Repeating this pattern over time may eventually lead to a chronic suppression. We therefore hypothesised that overtraining would result in severe suppression of the immune function. The purpose of this study was to investigate if 4 weeks of increased training duration to 130% and 160% of normal induced chronic decrements in NK and LAK cell activity and lymphocyte proliferation at rest.Twenty-one moderately trained male runners were divided into 3 groups: 130% (n=7) and 160% (n=7) which increased weekly training duration to 130% or 160% of individual normal training for 4 weeks without changing intensity, and CON (n=7) which did not change amount of training during the study. All blood samples were taken after 42 hours without severe physical activity to eliminate the acute effect of exercise and highlight the chronic response. The NK and LAK cell activity was calculated at effector/target ratio 50/1. NK and LAK cell activity and lymphocyte proliferation did not change significantly over time for any of the groups. However, intra-group variation coefficient for the data was about 30%, suggesting a rather large biological variation. From this study we conclude, that increasing training duration to 130% and 160% of normal could be tolerated across groups over a 4 week period without chronic decrements in NK and LAK cell activity and lymphocyte proliferation at rest even though some of the athletes showed symptoms of overtraining (decrease in blood glucose and plasma free fatty acids, increase in plasma urea, and deteriorated running economy).

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NORADRENALINE AS A MONITORING TOOL FOR OVERREACHING AND REGENERATION IN ELITE SWIMMERS

S. Hooper and L. Mackinnon

Noradrenaline levels have been shown to change with overreaching or overtraining and with regeneration from intense training. The purpose of this study was to further investigate changes in urinary noradrenaline levels in response to increased training and regeneration and to determine whether an early morning sample could provide similar information to entire overnight collection. Twenty nationally ranked swimmers were tested five times: before increased training; after each 2wk of 6wk increased training; and after 1wk of regeneration. For each session subjects provided the previous night–urine collection and an early morning sample, a Profile of Mood States, and a performance swim after which recovery heart rate and rating of perceived exertion were measured. The swimmers also kept a daily training log. Two swimmers were classified as overreached as they met the criteria for a positive classification and another two swimmers met these criteria but had to be discarded from the statistical analysis because illness accompanied their symptoms. Significant relationships were demonstrated between overnight and early morning noradrenaline concentrations; between overnight noradrenaline concentration and swim distance, gym time and morning training effort. It was concluded that further investigation is warranted into early morning urinary noradrenaline levels for monitoring overreaching and regeneration.

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HEAT SHOCK PROTEINS AS A BASIS FOR EXERCISE RELATED IMMUNITY

P.L. Moseley

Exercise is a complex stress, which results in changes at the systemic, tissue, and cellular levels. Intracellular accumulation of the primitive, highly conserved intracellular peptide transporters, the heat shock or stress proteins (HSP), during physiologic stresses confers tolerance to subsequent otherwise lethal cellular stresses. Recent evidence suggests that the cellular accumulation of HSPs may have important effects on the adaptation of the whole organism as well. While the HSPs are clearly important inside the cell in adapting to environmental stresses, the appearance of HSPs in the local extracellular environment due to the death of stressed cells or by the translocation of HSPs to the cell surface - may be one of the central signals to activate the immune response. The local, as opposed to global, immune system activation, triggered through local HSP-mediated immune responses may be important in both normal and injurious immune activation of exercise. These effects may extend from local muscle inflammation to the recruitment and activation of immune cells to sites of infection or malignancy. The demonstrated alterations of stress proteins caused by exercise may be important in facilitating these immune and inflammatory effects.

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GENDER DIMORPHISM OF THE IMMUNE RESPONSE IN HIGH ENDURANCE ATHLETES.

M.K. Angele[1], C. Loser[2], S.M. Nitsch[1], W. Scherbaum, M. Lehmann[2] and J.M. Steinacker[2]

Depressed immune responses have been demonstrated in males following trauma and severe blood loss whereas females do not show such a depression. Although trauma-like changes following excessive exercise have been demonstrated it remains unknown whether high endurance athletes also exhibit gender dimorphic immune responses. To study this, effects of 4 weeks of high intensity training for the world championships on B-cell function were investigated in 24 female and 30 male rowers from the German national junior team. Blood samples were obtained at the beginning, after a maximal exercise test, on the 14, and 28 day of the training period. Plasma IgG, IgM, testosterone, and prolactin levels were determined. Furthermore, the susceptibility to infection and the morbidity of allergies was registered. The results indicate that female rowers exhibited significantly increased plasma IgM and IgG levels. Plasma testosterone levels were higher in males compared to females and further increased within the study period. Plasma prolactin levels temporarily peaked in females at the beginning of the study period and remained elevated compared to males. Male rowers suffered more often from infections of the upper respiratory tract whereas in females allergy assooiated diseases were predominant. Thus, the more vigorous immune response in female rowers might contribute to the decreased susceptibility to infection and the increased morbidity of allergies. This gender specific immune response appears to be mediated by sex hormones. Those results suggest that high endurance athletes might represent a useful model for studying gender specific immune responses following stressful conditions, i.e. trauma or blood loss. Moreover, modulation of sex steroid plasma levels might represent a novel approach for maintaining immune responses in immunocompromised patients.

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WHITE BLOOD CELLS AND LYMPHOCYTE SUBPOPULATIONS IN TOP SOCCER PLAYERS

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Introduction: In previous studies a slight activation of the immune system after repeated intensive physical exercise has been observed. The aim of the present study was to investigate, whether these changes can be observed in soccer players during a season.
Subjects and methods: Ten players of a first divison soccer team participated in the observational study. Blood samples were taken during the preparations for the championship (1), after the beginning (2) and in a phase of high physical and psychial stress (two games/week) at the end of the championship (3). The following parameters were determined: Leucocyte count, white blood differential, CD4+ / CD25+, CD8+ /CD45+, CD20+, CD16+/56+. The significance of the data was validated by Frieman and Wilcoxon test, using a significance level of $p<0.05$.
Results and discussion: The leucocyte count increased significantly from 5075±1316) to 6040±1861) cells/l, mainly due to increase of the granulocyte count. Furthermore the expression of the CD25 antigen on CD4+ cells (21 vs. 34%,) and the expression of the CD45 antigen on CD8+ cells (27 vs. 39%) was significantly higher. We didn't observe significant changes of the NK-cell counts (CD16+/56+). These observations in top athletes suggest that high physical and psychial stress is followed by an increased expression of activation parameters on white blood cells. These parameters might be useful in the recognition of overtraining though at the moment these parameters are lacking sensivity and specificity. The higher granulocyte count might indicate an acute phase reaction after repeated exhaustive exercise.

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EFFECTS OF ADDITIONAL HEAT STRESS (IN VIVO AND IN VITRO) ON EXERCISE-INDUCED EXPRESSION OF HSP72 IN LEUKOCYTES

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Exercise-induced changes in HSP-expression were causally related to heat, oxidative and cytokine stress. We investigated the influence of additional heat stress (in vivo and in vitro) on HSP72-expression in leukocytes after intensive endurance exercise to determine the role, of temperature in exercise-related HSP-changes. Methods: Twelve non-heat-acclimated athletes completed two continuous runs (CR1 and CR2) on the treadmill (60 min) with one week rest inbetween. Running velocity was kept constant at 90 % of the individual, anaerobic threshold. Six subjects performed CR1 at 28 °C room temperature (group HH1), the other six at 18 °C (group NH1). Both groups performed CR2 at 28°C (HH2, NH2). Blood samples were drawn at rest, 0, 24 and 48 h after CR1 and CR2. HSP72 expression in leukocytes was analyzed by flow cytometry and RT-PCR. Results: In group HH1 we found a significantly higher increase of core temperature (T_c 39,6±0,68/38,95±0,6) and of HSP72- expression 24 h and 48 h after CR1 than in group NH1. HH2 showed a significant upregulation of HSP72 till 24 h after CR2 followed by a deep decrease and was accompanied by a reduced T_c (39,17±0,46/39,8±0,3) compared to NH2. Additional stimulation of leukocytes immediately after exercise with heat shock in vitro (2 h, 42°C) revealed a further significant increase of HSP72-expression in all groups, which was less intensive in HE2 and NH2. Conclusion: High environmental temperature has an additional effect on exercise- induced HSP-response. The reduced heat shock response in vitro after CR2 may be, interpreted as adaptation to the previous exercise bouts independent of T_c, and environmental temperature. Adaptive effects on HSP72-level in leukocytes to one exercise bout in the heat should not be related to T_c alone, other factors like oxidative or cytokine stress may be, applicable.

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CD45 ISOFORMS APPEAR TO BE A MAJOR TARGET FOR OXIDATIVE STRESS IN MONONUCLEAR CELLS OF TRAINED ATHLETES

E.Martel[1], E. Fehrenbach[2], A.M. Niess[3], E.M.Schneider[1]

We applied a sensitive gele elctrophoresis to analyze the spectrum of oxidized proteins in athletes at rest as compared to non-trained individuals. Ficoll-separated peripheral blood mononuclear cells (PBMC) were lysed and incubated in dinitrophenylhydrazine (DNPH). Cellular proteins subjected to oxidative stress have characteristic carbonyl residues which readily react with DNPH to dinitrophenol (DNP), a hapten structure detected by specific antibodies in Western blots. We compared so-called oxyblots of five PBMC-lysates of trained athletes with four PBMC- lysates of non-trained, age-matched controls. Three protein bands corresponding to 218kDA, 210kDA and 200kDA molecular weight were prominent in some oxyblots, but did not represent major bands in the protein gels. This largest oxidized proteins were identified as the CD45 complex expressed on all leukocytes and is also called leukocyte common antigen (LCA). LCA displays protein tyrosine phosphatase activity to activate kinases involved in T- cell receptor stimulation as well as B-cell differentiation. The major isoforms expressed on the leukocyte surfaces were CD45RO (180kDA), CD45RB (200 kDA) and CD45RA (220 kDA). Leukocytes of the trained individuals displayed oxidized CD45RA 3/5, CD45RB in 5/5, and CD45RO 5/5. By contrast, non-trained individuals more frequently lacked oxidized CD45RA 2/4, CD45RB was oxidized in 3 of 4 and CD45RO was oxidized in all cases (4 out of 4). In conclusion CD45 isotypes characteristic for memory and naive T-cell effectors constitute a major target for oxidative stress in trained individuals and may be responsible for transient or sustained alteration of cellular immunity in vivo.

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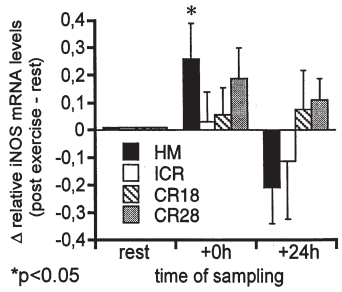
EXPRESSION OF iNOS-mRNA IN HUMAN LEUKOCYTES - IMPACT OF DIFFERENT TYPFS OF RUNNING EXERCISE

A.M. Niess[1], E. Fehrenbach[2], R. Veith[2], M. Sommer[1], E. Schlotz[2], K. Roecker[1], H. Northoff[2], and H.-H. Dickhuth[1]

Nitric oxide (·NO), synthesized by inducible NO synthase (iNOS), plays an important role in immune modulation and function. NO acts also as a cell-damaging agent that is involved in various diseases such as septic shock and chronic heart failure. We compared the effect of 4 different running protocols on iNOS-mRNA inhuman leukocytes (LE) as assessed by RT-PCR.



LE were isolated at rest, 0 and 24 h after a half marathon competition (HM, n=10), after an incremental treadmill run followed by a continuous run until exhaustion (ICR, n=8) at 110% of the individual anaerobic threshold (IAT), and after a 60 min treadmill run (90% IAT) at 18°C (CR18, n=6) and 28°C (CR28, n=5) room temperature. A significant rise in iNOS-mRNA was only detected after HM (see fig.). HM also induced the most pronounced cytokine release as measured in parallel. In-vitro heat stress (42°C,2h) increased relative iNOS-mRNA levels in LE from 0.41±0.06 to 0.95±0.13, p<0.05. In conclusion, prolonged intensive running 1 exercise induces expression of iNOS-mRNA in LE which seems to reflect an inflammatory response to heavy exertion. Cytokines and hyperthermia are assumed to be involved in exercise-induced up-regulation of leukocyte INOS.

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PARALLEL CHANGES IN MUSCLE SP72 AND MHCI EXPRESSION WITHIN STATES OF OVERUSE AND DISUSE

E.G. Noble, D. E. T. O' Neill and F. K. Aubrey

Stress protein 72 (SP72), the inducible isoform of the SP70 family, is constitutively expressed in proportion to the content of type I myosin heavy chain (MHCl) in rat hindlimb muscle. In order to assess the relative importance of slow muscle phenotype (i.e. MHCI content) on this pattern of expression, male Sprague-Dawley rats were subjected to two interventions designed to prevent changes in MHC I expression associated with altered contractile activity. First, surgically induced overload (OV) of the plantaris (PLT), combined with 3,5,3'-triiodo-DL-thyronine (T_3) administration enabled increases in contractile activity of PLT while preventing the normal OV induced elevation in MHCI. Second, thyroidectomy (TX) and resection of sciatic nerve (DEN) enabled a decrease in muscle contractilc activity while inhibiting the normal decline in MHCI associated with DEN in the soleus (SOL). In the overloaded PLT, T_3 not only blocked the increased expression of MHCI mRNA and protein observed in euthyroid controls but had a similar effect on SP72. In denervated SOL of TX rats, loss of MHCI was prevented and although SP72 levcls declined, TX was capable of maintaining SP72 levels above those observed in euthyroid counterparts. When the second intervention was examined in the PLT, TX and DEN combined to elevate MHC I expression relative to its euthyroid counterpart with a similar tendency in SP 72 (p = 0.08). Collectively, these data suggest that changes in constitutive expression of SP 72 with altered contractile activity may be relatcd to changes in slow muscle specific gene expression.
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ISOMETRIC STRENGTH AND CONTRACTILE PROPERTIES OF KNEE EXTENSOR MUSCLES IN TRAINED PATIENTS FOLLOWING PARTIAL MENISCECTOMY – AN ONE- YEAR STUDY

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Ten males and eight females aged 24.9±3.1 and 22.5±2.5 years (training period 7.2±1.9 ; and 6.0±.7 years, physical activity 4.6±1.0 and 3.83±0,98 hrs per week) before and following arthroscopic partial meniscectomy, and 22 controls (11 males and females, aged 21.5±0.7 and years, training period 6.9-6.7 years and physical activity 4.6-4.4 hrs per week, respectively) participated in the study. The maximal voluntary contraction (MVC) force and electrically evoked tetanic contraction characteristics of knee extensor muscles was determined before the operation, one month, three months, six months and one year after surgery. The stimulation voltage was adjusted to provide the force of 25% from isometric MVC of the knee extensor muscles. The force-time curve of the electrically evoked tetanic contraction was analysed on-line and rate of force development at the level of 50% from tetanic contraction force (RFD) and half-relaxation time (HRT) were calculated. There was reduction of knee extensors MVC by 25.9±4.0 % in men and 23.6±5.3 % in women (p<0.001) in the operated leg before the operation, 23.9±4.0 and 23.3±3.7 % (p<0.01) one month after arthroscopy, 17.5±4.5 and 13.9±2.4 % (p<0.05) three months later respectively as compared with the non-operated healthy extremity. RFD values decreased by 33.6±12.2 and 26.7±10.3 % before the operation (p<0.01), and by 20.0±7.2 and 26.9±7.8 % (p<0.01) one month later, respectively. The HRT was longer in the operated leg before (0.0895±0.0037 s in men and 0.1020±0032 s in women, p<0.001), one and three months (p<0.01) following arthroscopy. There were no statistical differences in parameters six months and one year following partial meniscectomy.

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EFFECTS OF WEIGHT RESISTANCE TRAINING VS. DESMODROMIC TRAINING ON MUSCLE CROSS SECTIONAL AREA AND STRENGTH

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The purpose of the study was to find out whether strength endurance training performed with an accommodating resistance device that doubles the eccentric workload (desmodromic training, DES) is superior to conventional weight resistance training (WRT). 18 male volunteers were randomly assigned to DES (25.8±4.1 y, 181.5±6.7 cm, 78.8 ±6.0 kg) or WRT (24.3±2.5 y, 179.3±8.4 cm, 72.9 ±9.0 kg) after a 3-week lead-in. They performed bilateral strength training of the quadriceps with low-resistance, high- repetition dynamic exercise 3x/week for 4 weeks. Two subjects of DES dropped out after the first session because of muscle soreness (max. CK in one >26000 $U \cdot l^{-1}$). Before and after the 4-week training muscle cross sectional area (CSA) measured with magnetic resonance scanning increased significantly in both groups (DES 2.2±2.2 %, $p<0.05$, WRT 2.4±2.5%, $p<0.05$). Isokinetic test of knee extension for determination of strength endurance (SE, 180°s^{-1}, 50 repetitions) increased significantly in both groups (DES 11.6±4.0%, $p<0.001$, WRT 10.0 ±4.7%, $p<0.001$) whereas maximal torque (MT, 60°s^{-1} , 3 r) increased significantly in DES only (12.3±11.8 %, $p<0.05$, WRT 3.2 ±5.9 %). There was no significant difference between DES and WRT for any parameter. Desmodromic strength endurance training of the quadriceps did not have greater effects on CSA and SE than the conventional weight resistance training. There might be some advantages of desmodromic training method in maximal strength training. However, special caution seems to be needed to prevent injuries in desmodromic training.

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ACUTE IMMUNODEPRESSION AFTER VO_2 MAX TESTS PRECEDED BY EIGHT WEEKS OF WINTER TRAINING

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The effects of a bout of exhaustive exercise after an 8-week winter training regime leading up to regional championships were studied on 27 cross-country runners (6F, 21M) living at moderate altitude. Ethical permission was obtained for the study. Peripheral blood cell numbers and some aspects of immune function were investigated. Fasting blood samples were taken at the start of the study (S2); halfway through the study (S3); immediately after performing VO_2max tests (S4) and the morning after the VO_2max tests (S5). Measurements included numbers of circulating total white blood cells (WBC), neutrophil and lymphocyte differentials, T-cell subsets (CD4 and CD8), neutrophil activity, and intracellular measurement of the cytokine IL-6 in CD4 and CD8 cells. At S2, neutrophil numbers were significantly higher in females than in males. No gender differences were observed at S3, or immediately after VO_2max (S4) but lymphocyte numbers in males were nearly two-fold higher than females the day after the VO_2max tests (S5; $p<0.01$). A marked increase in numbers of WBC ($p<0.006$) was observed in all subjects at S4 compared with the other time points. However, there was no change in neutrophil differentials. There was a marked decrease ($p<0.001$) in the ratio of CD4/CD8 cells at S4. There was a marked reduction in neutrophil activity ($p<0.001$) in all subjects immediately after VO_2max, compared with the other time points, and an increase in CD4IL-6 and CD8IL-6 ($p<0.001$ and 0.02 respectively). The marked decreases in neutrophil activity and the CD4/CD8 ratio after VO_2max tests, suggest some immunodepression resulting from a bout of exhaustive exercise following prolonged training.

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SKELETAL MUSCLE HSP70 IS INCREASED IN PATIENTS WITH PERIPHERAL ARTERIAL OCCLUSIVE DISEASE

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Heat shock protein (HSP70) has been studied in the ischemic myocardium and proven to provide protection against ischemia; furthermore, it has be demonstrated that HSP70 can be induced in skeletal muscle; however, HSP70 expression in ischemic skeletal muscle in patients with peripheral arterial occlusive disease (PAOD) has not been reported. This study was designed to investigate HSP70 expression in skeletal muscle in PAOD with different clinic stages. Twenty-six patients with PAOD (clinical classification according to Fantaine\rquote s criteria: stage II: 7; III: 8 and IV: 11, respectively) and seven non-PAOD controls were enrolled in the study. Muscle samples were taken from calf muscle in which an ischemia in PAOD was expected. HSP70 was quantitated by SDS-PAGE using ultrasensitive silver staining with reference to a series of known amount HSP70. HSP70 mRNA was determined by RT-PCR with α-actin as internal reference. Results show that in comparison with that of controls, HSP70 increased significantly in PAOD, although the increase of HSP70 was different in PAOD with regard to clinical stage, and the highest level of HSP70 was observed in PAOD III. HSP70 mRNA showed similar results. Therefore, HSP70 is increased in PAOD and HSP70 expression is different between different clinical stages of the disease. The upregulation of HSP70 in PAOD might take place at transcriptional level. Induction of HSP70 might provide protection against ischemic changes in skeletal muscle, and the failure to further increase HSP70 in PAOD IV might result from insufficient regulation of HSP70 and might be partly responsible for ischemic changes of the disease.

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LEPTIN, GROWTH HORMONE - IGF AXIS, AND MYOSINE HEAVY-CHAIN EXPRESSION AND EXHAUSTING TRAINING

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A nutrient-sensing signal of adipose and muscle tissue may be represented by leptin which has profound effects on the hypothalamic hormonal regulation, on somatotropic axes and putatively on muscle protein expression.
Methods: The effects of training on the somatotropic hormonal axis and somatotropic effects on expression of myosine heavy chain (MHC) were examined in six trained athletes during three weeks of intensive resistance training (RT) and low intensity endurance training (ET), respectively; each followed by a regeneration week (Rl and R2). Morning resting venuos blood samples were obtained before (0) and after training phases RT, Rl, ET, R2. Leptin, basal growth hormone (GH), insulin-like growth-Factor (IGF-I) und IGF-binding Proteins (IGFBP1 und IGFBP3) were measured and a muscle sample from m. vastus lateralis was taken for MHC analysis by SDS gel electrophoresis and silver stain, relative content of MHC isoforms was measured. **Results:** During resistance training, leptin, GH and IGF-I decreased significantly. During endurance training, leptin, GH and IGF-I increased again slightly (n.s.) compared to resistance training. Body fat and BMI did not change. MHC I did not change during RT but increased during Rl, there was no change during ET but a slight decrease after R2 (n.s.). **Discussion:** The low basal levels for leptin in highly trained athletes and the decrease during resistance training are related to the high metabolic load. There were close correlations of leptin, IGF, IGFB s and insulin to performance. MHC expression was closly correlated to IGF-I, IGFBP1, IGFBP3 and insulin thus demonstrating the close relation of somatotropic hormones, metabolism and muscle protein expression. The study confirms that the metabolic load of training which is indicated by leptin levels will be reflected in hypothalamo-pituitary downregulation and depression of somatotropic hormones which have a direct impact on MHC expression.
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OVERLOAD, REGENERATION AND CENTRAL NERVOUS SYSTEM – THE ANIMAL MODEL

R. Meeusen

Physical exercise influences the central dopaminergic, noradrenergic and serotonergic systems. A number of studies have examined brain noradrenaline (NA), serotonin (5-hydroxytryptamine, or 5-HT) and dopamine (DA) with exercise. Although there are great discrepancies in experimental protocols, the results indicate that there is evidence in favour of changes in synthesis and metabolism of monoamines during exercise. The symptoms associated with overtraining, such as changes in emotional behaviour, prolonged feelings of fatigue, sleep disturbances, and hormonal dysfunctions are indicative of changes in the regulation and coordinative function of the hypothalamus. The hypothalamus, is under the control of several „higher" brain centres and several neurotransmitters. It has been suggested that exercise exerts its putative psychological effects via the same neurochemical substrate (the monoamines) as the antidepressant drugs, known to increase the synaptic availability of transmitters. Likewise, study of the neurobiological aspects of exercise may add to a more complete understanding of the etiology and treatment of overtraining. In several brain nuclei chronic stress will create an adaptation mechanism (autoreceptor mediated, neurotransmitter interactions, or other mechanisms). When an animal is confronted with a novel stressfull stimulus, a sensitisation will occur. However, in chronic, very intense stress situations this sensitisation of hippocampal 5-HT release does not occur. One might speculate that in overtraining (the step beyond coping with stress) a comparable mechanism occurs.

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OVERTRAINING IN CYCLISTS - THE USE OF A TRAINING LOG TO MONITOR TRAINING AND OVERTRAINING

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The purpose of this study was to establish a quantification of training by a training log that includes physical, physiological and psychological parameters, and to examine if this logbook might be a tool to predict OT. We refined the method developed by *Foster et al* (1998) by adding Muscle Soreness (MS) and Mental Wellbeing (MW). The new formula for Global Daily Training Activity is GDTA = T x I x M x MS x MW. The training of eight elite road cyclists during a period of one year was examined. High scores on muscle soreness (+ 5 successive days), mental state, illness and underperformance were considered signs of OT. These signs were compared to the calculated training load of each week, which was derived from the formulae. A Pearsonís Correlationís Coefficient ($p<.01$) was used to compare the signs of OT with the score on the formula. Two comparisons were made. First: the number of signs of OT to both the formula of *Foster et al* (1998) and to our formula, and secondly, the peaks in training load - registered by one or both formula(e) – were compared to the number of signs of OT. With the *Foster* formula significance appeared in only one direction, i.e. signs of OT were preceded by peaks. This outcome confirmed the results of *Foster et al* (1998). Our study on the other hand provided twofold significance, i.e. peaks in training were followed by signs of OT and signs of OT were preceded by peaks. So our formula not only had a retrospective but more importantly also a prospective value in predicting OT.

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OVERNIGHT URINARY CATECHOLAMINES EXCRETION IN SOCCER PLAYERS

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Until now, there are only a few studies on overtraining in soccer. *Lehmann et al.* (1992) found a 50% decrease in overnight urinary catecholamines (UCAT) excretion, while *Naessens* (1995) and *Mackinnon et al.* (1997) only considered noradrenaline excretion. The purpose of this prospective study was to compare the UCAT excretion during 5 months in semi-professional soccer players with data from weekly Profile of Mood States (POMS) and training diaries. 18 soccer players trained four times a week and had one competition every weekend. Overnight UCAT were collected 3 times. There were no significant changes in noradrenaline excretion. A statistically significant decrease in adrenaline excretion was noted between 1st and 2nd ($p=0{,}0342$) and 1st and 3rd ($p=0{,}0033$) collection. This could not been linked to a significant alteration in mood state and performance. Two players reported a progressive increase in muscle pain, decrease in physical and mental wellbeing. UCAT excretion of both players was within the group limits in the first collection, but made a major decrease in 2nd and 3rd collection. One of them reported major sleeping problems, while the other one showed a steady increase in resting heart rate. These two players possibly suffered from a sympathetic overtraining syndrome. For the whole group of soccer players, we found a statistical significant decrease in nocturnal adrenaline excretion, not related to significant alterations in POMS and diary notations. Two individuals exhibiting signs and symptoms of overtraining do have a consistent alteration in adrenaline excretion, POMS and diary scores.
We thank „Biorad"for helping with the analysis of the UCATS

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PLASMA TESTOSTERONE AND CORTISOL RESPONSES TO PROLONGED SCULLING IN MALE COMPETITIVE ROWERS

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The purpose of this investigation was to study hormonal responses to a single endurance rowing training session in 12 male competitive single scull rowers (23.3±6.3 yrs; 188.7±5.9 cm; 82.0±10.8 kg; body-fat%:10.9±3.3 %). Anaerobic threshold (AT_4) was determined during the first measurement session on a rowing ergometer (Concept II, Morrisville, USA). The second measurement session consisted of an endurance rowing training session on single sculls for about 2 hrs (7891.4±760.8 sec; covered distance: 22.6±2.5 km; mean heart rate: 136.2±6.6 beats·min^{-1}; intensity: 77.4±3.8% from calculated AT_4). Venous blood samples were obtained before and immediately after and after 30, 60 and 120 minutes of exercise. Cortisol (C), total testosterone (T_{tot}) and sex-hormone-binding-globulin (SHBG) were measured, and free testosterone (T_{free}) and T_{free}/C ratio calculated. The lactate concentration in blood did not change significantly during the training session (before: 1.7±0.4 mmol·l^{-1} after: 1.9±0.4 mmol·l^{-1}). Body mass was significantly decreased after the training session (before: 82.0±10.8 kg; after: 80.6±11.2 kg). The concentrations of C and T_{tot} were not significantly changed during the rowing training and two hours of recovery. Significant reduction in T_{free} value occurred during the first 30 minutes of recovery and further reduction occurred during the second hour of recovery. Body mass immediately after the training session was significantly related to the covered distance ($r=-0.75$). Covered distance was also significantly related to the concentrations of C ($r = 0.49$) and T_{free} ($r=-0.58$) immediately after the training session. In summary, prolonged low intensity training session posed a similar anabolic and catabolic stimulus for trained rowers.

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INFLUENCE OF RADICAL SCAVENGER VITAMINS ON ERYTHROPOIETIN (EPO) PLASMA CONCENTRATIONS IN TRAINED SUBJECTS AFTER OXYGEN DIVING

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Study objective: EPO constitutes a hypoxia induced gene product, the expression of which is negatively influenced by oxidative stress. lt was tested whether radical scavenging vitamins C and E influence EPO plasma concentrations following short intervals of submersed physical activity under hyperoxic hyperbaric environmental conditions. **Methods:** 8 trained divers took daily 1 g of ascorbic acid and 600 IU of d-GL-tocopherol, and 8 trained divers placebo, >3 h before diving with 0_2 as breathing gas at average depths of 4 m for 30 min on 2 consecutive days, and additionally on day 3. Groups were comparable with respect to 0_2 consumption during dives. Venous blood was obtained on days 1, 2 (pre-dive) and 3. EPO plasma levels were determined by a highly sensitive chemiluminescence immunoassay. **Statistics:** Wilcoxon signed-rank and Mann-Whitney Utest. **Results:** Decreasing EPO plasma concentration on day 2 compared to baseline was the leading feature in both groups (p=.046/.018). Between days 2 and 3 an increase in EPO concentrations, in 50% even exceeding baseline, was observed in the vitamin (p=.009) but not in the placebo group (p=.115). No inter-group differences were found at the various days. **Conclusions:** In the majority of divers, hyperbaric hyperoxia induced a persisting EPO decrease in the placebo, but a transient EPO decrease in the vitamin group. Radical scavengers may attenuate EPO decrease in response to repeated oxygen diving.

Group	day 1		day 2		day 3		EPO
of Divers	Median	Range	Median	Range	Median	Range	conc.
Vitamins	3.7*	1.7-5.2	2.55*#	1.7-4.7	3.6#	2.6-5.9	mU/ml
Placebo	3.65*	2.5-5.0	2.6*	1.4-4.4	3.0	1.2-5.9	mU/ml

*p<.05 day 1 compared with day 2 #p<.05 day 2 compared with day 3

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NORADRENERGIC EFFECTS ON EXERCISE PERFORMANCE

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The purpose of the present study was to examine the effects of a selective NA reuptake inhibitor (NARI) (Reboxetine 2x4mg REB) on exercise performance. Seven well trained male cyclists (VO_2max 73.5 + 6.4 ml/kg/min) participated to the study. Subjects completed two 90 min time trials at 65% $Watt_{max}$. Performance was measured as the time necessary to complete the pre set amount of work. Drugs were given in a randomized double blind cross-over design. Blood samples were analyzed for ACTH, PRL, cortisol, GH, beta-endorphins and catecholamines and were taken at rest and at 30 minute time intervals until the end of exercise and after 5 min of recovery. The NARI had no influence on the time to complete the target amount of work, (REB: 97min + 3 min, PLAC: 92 min + 1 min). Lactate concentrations, HR, RPE values from the Borg scale showed no difference between trials. All hormones increased during exercise and were higher in the REB trial at the end of exercise and during recovery. On the other hand GH decreased during exercise in the REB trial and was significantly lower than PLAC at the end of exercise and during recovery. In conclusion, the results demonstrate that performance is not influenced by a selective NARI in well trained endurance athletes. The differences observed in the hormonal response to exercise are indicative of an acute central effect of the drug. The regulation of the hormonal response to exercise is therefore dependent on the interaction between different neurotransmitters.

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SLEEPING HEART RATE IS LITTLE INFLUENCED BY TRAINING LOAD

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Objective: In some studies sleeping heart rate (SHR) was considered a marker of overreaching or overtraining. The aim of the present study was to determine the variation of SHR in four middle and long distance runners during one competition season and to proove the influence of different training means on SHR. The study was part of a project called „Determinants to assess Regeneration“, supported by BISP (VF 0408/01/03 A/97). **Method:** In 4 middle and long distance runners mean SHR (between 2 and 5 a.m.) was determined with a heart rate monitor (Polar, Vantage NV) during one season up to two times weekly. Daily protocolled training was catagorized in 6 intensity levels compared to regularly performed treadmill step tests: regeneration (REG): ~1 mmol/l lactate, endurance 1 (E1): <1.5 mmol/l, E2: <1.5-3.0 mmol/l, E3: <3.0-6.0 mmol/l, high intensity training (HIT): >6 mmol/l, competition (COMP). Means were compared using the Mann-Whitney test. Significance was set at p<0.05. **Results:** Individual variability for SHR was enormous (tab.1).

Tabelle 1: Number of determinations, mean, SD, minimal and maximal values for SHR of four athletes

	Athl1	Athl2	Athl3	Athl4
N	157	192	111	65
mean±SD	47.9±3.5	42.8±2.4	57.2±4.4	50.2±4.0
min/max	40.1/58.6	37.6/51.2	49.8/76.9	44.0/62.2

Training load has no significant influence on SHR in three athletes. For Athl 1 SHR during the night after E3 was 2.2 min^{-1} (p<0.05) and after COMP 4.9 min^{-1} higher (p<0.01). **Conclusion:** The high variation of SHR during a whole season in all examined athletes could only be explained in one athlete partly by training load. Therefore, the use of SHR as a marker of training load seems to be questionable.

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STRETCHING, MASSAGE AND PASSIVE RESTING DURING SHORT TERM RECOVERY AND ITS EFFECTS ON PHYSICAL PERFORMANCE

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Aim of the present study is to investigate effects of 25 minutes recovery either with passive stretching, massage or passive resting. 8 healthy male subjects performed in random order exercise tests comprising 2 phases with cycle ergometry and isometric strength tests of leg extensors. The first cycling consisted of pedalling for 4 min at 1W/kg fat free body mass followed by 7 min at 2 W, 3 W and 3.5 W/kg fat free body mass (step test). After a recovery period of 25 min (with either passive stretching, massage or passive resting) the cycling was repeated: Following the last exercise level (3.5 W/kg), power was increased by 20 W every 60 s until subjects felt exhausted (ramp test). To investigate the effects on local fatigue of leg extensors, 60s strength tests were performed before and immediate after the cycling and recovery periods. All subjects additionally participated in control tests in which no cycling and no treatment but strength testings took place: In all tests we measured time courses of oxygen uptake (MetaMax 3b, Cortex), heart rate (Vantage NV, Polar), lactate (Accusport, Boehringer) and isometric quadriceps peak torques. The results of the ramp tests showed significant lower power after massage, whereas only minor difFerences were found for the resting and stretching. Maximal oxygen uptake, heart rate and lactate were not significantly influenced by the recovery modes. Compared to the control tests we found significant reductions of maximal and mean torques after passive stretching whereas the other treatments tended not to influence muscle strength. Massage and passive stretching did not provoke big increases in physioal performance after short term recovery. Moreover, such treatments could elicit different physiological mechanisms which even might reduce muscular power.

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PSYCHOLOGICAL MONITORING DURING TRAINING AND REGENERATION IN ELITE ATHLETES

Michael Kellmann

Athletes in general are likely to show a broad range of inter and intraindividual differences. The different effects of the same training stimulus can be explained by the individual recoverystress state. The concept of the recoverystress state indicates the extent to which someone is physically and/or mentally stressed as well as whether or not the person is capable of using individual strategies for recovery and which strategies are used (*Kellmann and Kallus*, 1999). From the perspective of a biopsychological stress model (*Janke and Wolfgramm*, 1995) recovery and stress should be treated using a multilevel approach, dealing with psychological, emotional, cognitive behavioral/performance, and social aspects, considering these aspects both separately and together. Until now, physiological parameters cannot diagnose reliable stress and overtraining in its early stages. In contrast, standardized psychological methods for the diagnosis of the recovery and stress provide a relatively stable, reliable, sensitive, and economical assessment of early signs of overtraining. Research dealing with psychological training monitoring and overtraining is mostly based on the Profile of Mood States. However, this instrument may be inadequate to examine recovery processes since it was not generated for this purpose. *Kellmann and Kallus* (2000) developed the Recovery-Stress-Questionnaire for Athletes which measures the frequencies of stress and recovery. Both questionnaires and an „Erholungsverlaufsprotokoll" (recovery protocol over time) are especially useful in longitudinal settings. Results and examples of all three instruments will be used to discuss the complex issue of proper regeneration in elite athletes.

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STRENGTH - ENDURANCE TRAINING FOR PATIENTS WITH STABLE HEART DISEASE AND GOOD TO MODERATELY DECREASED LV FUNCTION

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Strength training for heart patients seemed not to be indicated until recently. There was fear that this kind of training could lead to malignant ventricular arrhythmia and to inappropriate blood pressure increase. This opinion is changing, however, since cross-sectional strength studies with heart patients showed no increased risks, even in patients with severe LV failure.
Methods: We examined 10 patients with heart disease (nine with coronary heart disease, one with valvular heart disease) 6 or more months after acute incidence such as myocardial infarction, PTCA or heart surgery. The left ventrical function was slightly to moderatly reduced. Before and after the training all patients had an echokardiogram, a treadmill ergometer test with a 12 lead ECG, a double leg press max test under ECG and blood pressure monitoring, a lungfunction test and a blood sample test. The patients underwent a normal fitness training for 3 months, twice a week. The training was performed under the supervision of a physician and an experienced physiotherapist. The training consisted of a warm-up period with ten minutes cycling and 10 different exercises for shoulder, chest, arm musculatur, leg extensors and flexors and abdominal muscles. During the first 4 weeks the patients trained with 10 repetitions per exercise with 50% Repmax, in the following 4 weeks with 2 series each of 10 repetitons per muscle group, respectivly 3 series in the last 4 weeks. **Results:** During the whole training there was no orthopedic or cardiovascular problem. The left ventricular function and the end-diastolic diameter remained unchanged. There was a clear improvement in the double leg press max test and no change in body mass index. All patients were deligthed and wanted to continue the training.
Discussion: Our study shows that strength - endurance training under controlled conditions is feasible and safe for patients with stable heart disease and good to moderatly decreased LV function. Further studies with a larger group of patients and a control group will follow.
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STRESS RESPONSE AND GLUCOSE ELIMINATION AFTER PROLONGED EXERCISE WITH AND WITHOUT CONTINUOUS SUPPLEMENT OF CARBOHYDRATES

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Prolonged exercise without supplement of carbohydrates (COH) leads to excess of catecholamines and cortisol and to muscular cytokine reaction such as TNF-alpha which causes insulin resistance. Aim of this study was to examine if COH could reduce muscular cytokine reaction and prevent reduction of glucose elimination after prolonged exercise. **Methods:** 8 triathletes (79,6 ± 6 kg, 183,8 ± 5,8 cm, Pla4 299 ± 51,1 W) performed two 2-hours bike ergometrys (1.h 75 %, 2. h 65 % Pla4) followed by an oral glucose tolerance test (OGT). A third OGT served as control. During ergometry, each 15 minutes placebo or a COH-solution were admistered (cross-over, single blinded). Blood samples were taken each 30 minutes. **Results:** Glycerol increased, while it was higher in the placebo group (PG). Free fatty acids increased in the placebo group. Cortisol showed an increase both times, while there was no difference between both groups during exercise. During OGT we demonstrated a higher level for cortisol in the PG. Epinephrine stayed constant in the COH-group and showed an increase in the PG. Leucoytes increased both times, where as this increase was higher in the PG. During OGT, blood glucose was higher in the PG. OGT-control and OGT-COH showed no difference. The relative glucose (compared to base-line) were higher in OGT-placebo. No difference between OGT-control and OGT-COH. Insulin followed the absolute glucose levels. The glucose/insulin-quotient was higher in the placebo group for the first 30 minutes after exercise. **Discussion:** It could be shown that supplement of COH reduced stress response. To the same time, elimination of blood glucose admistered after exercise was not reduced. Three mechanisms are possible: 1. Influence of other hormones such as cortisol, glucagon or hGF. 2. Affection of glucose transporters. 3. Loss of insulin function could be caused by TNF-alpha.
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LONG QT-SYNDROME WITH EXERCISE AS A TRIGGER – A CASE REPORT

Opitz-Gress, S. Reissnecker, U. Gastmann, J.M. Steinacker, M. Lehmann

The long QT-syndrome is a ion-channel disease, characterized by QT-time prolongation, syncopal attacks, ventricular arrhythmias up to ventricular fibrillation and sudden death. It may be inherited autosomal dominant (Romano-Ward-Syndrome) or, if combined with deafness, autosomal recessive (Jervell and Lange-Nielsen-Syndrome). Cases without family involvement have also been reported. In November '98 we saw a male patient, 52 years old, who reported a 20-years history of repeated presyncopal attacks, ventricular arrhythmias, dyspnoea and angina pectoris mostly after training. The patient performed a nearly daily training of either jogging, cycling, soccer, athletics or cross-country skiing. Coronary angiography excluded a coronary heart disease. In 1992 echocardiography revealed a dilative cardiomyopathy with good left ventricular function. In long duration ECG's ventricular arrhythmias with ventricular 9-er runs were found. ECG's at rest and during ergometry always showed normal QT-time. Epilepsy was excluded. Family history was negative. We suggested a heart rate oriented, low intensity training and started a therapy with carvedilol, later metoprolol which were terminated due to side effects (exanthema). Treatment continued with Fosinorm and Aspirin. As symptoms worsened and even low intensity exercise could not be performed due to presyncopes, we initiated an electrophysiological examination in February 2000. Ventricular stimulation induced twice a ventricular fibrillation. Catecholamin-administration showed a highly pathologic prolongation of the QT-time from 396 msec to 500 msec. After pacemaker implantation a therapy with bisoprolol was started. After this intervention the patient reported an improvement of his former complaints. This case shows the difficulty of diagnosing a rare disease despite matching symptoms, with exercise acting as a trigger. The diagnosis was rendered more difficult as QT-time was normal in ECG's and the family history negative. After diagnosis and appropriate therapy a heart-rate oriented, low intensity training could be performed.
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GONADOTROPIC, SYMPATHETIC AND NEUROPEPTID HORMONE LEVELS DURING TRAINING AND REGENERATION OF JUNIOR CYCLISTS

A. Elser[1], U. Gastmann[1], J.M. Steinacker[1], K.G. Petersen[2], M. Lehmann[1]

Background: Aim of the study was to examine training and regeneration in athletes by gonadotrophic (LH, FSH), sympathetical (norepinephrine NA, epinephrine E, Dopamine D) or neuropetidergic (leptin L, inhibin B IB) hormones. **Methods:** Morning resting blood samples of seven male junior cyclists were taken 2, 4 and 7 weeks after the end of season (EOS). The training load was 435, 226, 183 km/wk for week 2, 4, 7 after EOS, respectively.
Results: 10 km time trial was nearly constant (920s, 920, 905; week 2, 4, 7 after EOS). Basal catecholamine excretion of NE, E, and D decreased first slightly (ns) (NE=75, E=65, D=50 µg/100 mg of creatinine), then increased after 7 weeks (NE=225, E=125, D=125) (ns). IB increased (ns) from 220 to 250 pg/ml, L from 0.54 to 0.9 ng/ml (week 4 to 7) (ns).The correlation between E in plasma and IB was significant (p=0.04). FSH and L correlated significantly (p=0.05), as well as FSH and D (p=0.004), FSH and E (p=0.003), FSH and LH (p=0.01). Basal NE excretion [µg/100 µg of creatinine] and basal NE excretion [ng/min] correlated significantly (p<0.0001). There was no correlation between all hormones observed and the result of time trial.
Discussion: The results of time trial were nearly constant what can be attituted to incomplete regeneration and/or effects of detraining. The corresponding changes in the observed hormones and e.g. to FSH are consistent with the hypothesis that regeneration may be monitored by hormonal levels although the absolute magnitude of changes was not high enough to be significant, except the correlation between E and IB and the gonadotropin FSH and L, D, E and LH.

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EFFECTS OF AMBULANT CARDIAC REHABILITATION (PHASE II) - ULMER MODEL-

S. Reißnecker, A. Opitz-Gress, D. Moshidi, M. Lehmann, J.M. Steinacker, U. Gastmann,

In contrast to anglosaxen countries cardiac rehabilitaion (phase II) in Germany is normally stationary performed. However, since a few years there exist several models of outpatient programs, too. The „Ulmer model“ that we have performed since 1998, bases upon two main cornerstones: risik factor management and exercise training especially interval training. **Methods:** Fourteen patients with coronary heart disease (11 after acute myocardial infarction, 3 after bypass surgery) performed an ambulant rehabilitation program no longer than 7 days after discharge from hospital. The program consisted of 4 weeks of supervised exercise training, nutritonal and relaxation therapies and risk factor management. Before and after rehabilitation all patients had an echocardiography, a treadmill ergometer test with a 12 lead ECG, a VO_2 max test, a lung function test and blood sampling. The patients underwent an exercise training three times a week. The training consisted of a warm-up period and an increasing intervall training with 60% of HRreserve.
Results:

	Before rehabilitation	After rehabilitation
P max (W)	133 ± 60	164 ± 31 *
VO_2 max (ml·kg/min)	22.1 ± 6.5	27.0 ± 10.4
RR sys. rest (mmHg)	132 ± 19	122 ± 20 *
RR dias. rest (mmHg)	81 ± 16	76 ± 10
EDD (mm)	56.3 ± 6.7	56.1 ± 7.5
Cholesterol (mg/dl)	202 ± 19	186 ± 31 *
LDL-Cholesterol (mg/dl)	120 ± 35	101 ± 35 *
* Significance	p< 0,05	

Conclusion: The „Ulmer model“ is a practicable and safe ambulant cardiac rehabilitation program with good short outcome.

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MOOD STATE AND NOCTURNAL CATECHOLAMINE EXCRETION OF JUNIOR ELITE ROWERS

A. Elser[1], M. Kellmann[2], B. Böhm[3], P. Jehle[3], W. Lormes[1], J. Steinacker[1], M. Lehmann[1]

Background: Aim of this study was to examine the relation between mood state, nocturnal catecholamine excretion (norepinephrine (NE), epinephrine (E), dopamine (D)) and performance in overreaching and tapering.
Methods: Once a week during 5 weeks, nocturnal urine excretion of 10 elite junior rowers (world champions) was estimated, mood state was determined using the Recovery-Stress-Questionnaire for Athletes (RESTQ) and performance was quantified by a 2000 m time trial. The athletes started with 2 weeks of overreaching training, followed by a recreational period.
Results: Catecholamine excretion: NE, E and D increased in week 1-3 significantly (s), decreased (s) in week 3-5. The initial values differed not from the values after 5 weeks.In week 4, power at 4 mmol/L lactate (P_{la4}) and maximum power (P_{max}) increased, maximum lactate concentration (La_{max}) decreased and velocity of 2000 m time trial increased from 5.38 m/s (week 1) and 5,45 m/s (week 3) to 5,81 m/s. Performance and hormonal response on training load were reflected by the state of recovery in the RESTQ. „Fatigue“ peaked after week 3, „somatic complains“ after week 2, „somatic relaxation“ after week 2.
Conclusion: Fatigueing training was accompanied with increased nocturnal catecholamine excretion in this experiment. These findings are consistent with the hypothesis that there is a link between mental and physical „fatigue“ and the tonus of the sympathoadrenergic system. Beside maximal performance as the key parameter, nocturnal catecholamine excretion and mood state seem to be valuable parameters for monitoring a successful training.

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Programme

Thursday, October 26, 2000

18:00 - 22:00 **Opening Reception**
Brauhaus Barfüsser, Augsburger Straße, 89231 Neu-Ulm

Friday, October 27, 2000

08:30 - 09:10 **Introduction**
Chairs: Manfred Lehmann, Ulm; Jürgen M. Steinacker, Ulm
Speakers: Peter Gierschik, Ulm; Hans Hermann Dickhuth, President, DGSP; Manfred Lehmann, Ulm

09:20 - 11:00 **Training and regeneration in sports**
Chairs: Axel Urhausen, Saarbrücken; Richard Budgett, London
Tim Noakes, Mike Lambert, Cape Town; Harm Kuipers, Hans Keizer, Maastricht; Werner Lormes, Ulm; Richard Budgett; London

11:30 - 12:00 **Lecture: Protein metabolism during exercise**
Chair: Hans Hermann Dickhuth, Tübingen
Speaker: Jacques R. Poortmans, Brussels

12:15 - 13:00 **Poster: Metabolism - Adipose Tissue - Leptin**
Chair: Hans Keizer, Maastricht

14:30 - 16:15 **Cellular protection, metabolism and immunological function**
Chairs: Hinnak Northoff, Tübingen; Lindy Castell, Oxford
Speakers: Pope L. Moseley, Albuquerque; Yufei Liu, Ulm; Bente Klarlund Pedersen, Kopenhagen; Hinnak Northoff, Tübingen

17:00 - 18:00 **Poster: Muscular adaptations - stress proteins - cytokines**
Chairs: Earl Noble, London, Ontario; Walter Schmidt, Bayreuth

Saturday, October 28, 2000

08:00 - 09:45 **Peripheral mechanisms of adaptation and regeneration**
Chairs: Horst Michna, Köln; Martin Halle, Göttingen
Speakers: Rudolf Billeter, Leeds; Jürgen M. Steinacker, Ulm, Robert F. Considine, Indianapolis; Horst Michna, Köln

10:15 - 13:30 **Hypothalamic hormonal regulation and the central nervous system**
Chairs: Peter Bärtsch, Heidelberg; Michael Kjaer, Copenhagen
Speakers: Karl-Georg Petersen, Freiburg; Manfred Lehmann, Ulm; Anthony Hackney, Chapel Hill; Uwe Gastmann, Ulm; Romain Meeusen, Brussels

15:00 - 16:00 **Poster: Hormonal Regulation - Sexual glands - HP -Axes**
Elio dePalo, Padua; Alois Berg; Freiburg, Germany

16:40 - 18:10 **Monitoring of regeneration**
Chairs: Paavo V. Komi, Jyväskyla; Marcello Faina, Rome
Speakers: Sue Hooper, Brisbane; Michael Kellmann, Potsdam;Carl Foster; LaCrosse

18:10 - 18:40 **Concluding discussion**
Chairs: Paavo V. Komi, Jyväskyla; Jürgen M. Steinacker; Ulm

Sunday, October 29, 2000

09:30 - 22:00 **Excursion to the Allgaeu**

Location: Edwin-Scharf-Haus, Silcherstraße 40, 89231 Neu-Ulm; Phone: +49-731-80080

Registration and information:

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