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I. Methods

FAST SOLUTION-EXCHANGE EQUIPMENT FOR THE PATCH-CLAMP METHOD. *L. Lacinová, M. Marko*, Institute of Molecular Physiology and Genetics, Slovak Academy of Sciences, Bratislava, Slovak Republic.

A system for fast solution exchange was developed in a space several millimeters in diameter. The solution exchange in such a space is complete within several tenths of milliseconds. This made the equipment suitable particularly for the patch-clamp method. The solution exchange is controlled by an electronic relay. The relay has remote control and can be synchronized with a computer. The experimental solution is driven into the immediate proximity of the investigated cell by a specifically adjusted tip. The cell is placed in the mouth of such a tip. Lowering the amount of the solution necessary for the experiment to a couple of milliliters is another advantage of this equipment.

TECHNOLOGY OF A TEMPERATURE MICROSENSOR WITH A FAST RESPONSE FOR MEASUREMENTS IN LIVING CELLS. *I. Dittert, F. Rech, V. Rohlíček*, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.

We describe the results of a project the goal of which was the development of a method for measuring the temperature in a cellular microvolume and its hardware implementation. The main prerequisite of the designed method is its noninterference with functions of the studied living tissue. The proposed method is based on the measurement of electrical resistance of thermosensitive semiconducting glass which is filled into the tip of a glass micropipette similar to currently used microelectrodes. An important part of the project also includes the development of measuring instrumentation and auxiliary equipment (1). The developed microsensor may contribute to an experimental study of thermodynamically open systems in biology. At present, the microsensor is being tested in biological preparations.

1. *Rech F., Dittert I., Vyskočil F.* *Physiol. Res.* 41: 251–255, 1992.

STEREOLOGICAL MEASUREMENTS OF THE MEAN GLOMERULAR VOLUME. *L. Kubínová, Z. Zemanová, J. Heller*, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.

A method for the measurement of mean glomerular volume was developed in order to study the effect of low protein diet (7 %) on the growth of the glomeruli in Wistar rats. The glomeruli of two populations of nephrons – superficial and juxtamedullary – were used. The method was based on the stereological principle of the disector (1), unbiased 3-D probe enabling to count 3-D particles. The disector planes were represented by two consecutive sections of kidney halves 8 µm thick. The sections were laid side by side on glass slides and were evaluated under a magnifying glass and then under a light microscope with an ocular test system. Our study has proved the good applicability of recent stereological methods requiring minimal technical equipment for morphometrical measurements of the glomeruli.

1. *Sterio D.C.*: *J. Microsc.* 134: 127–136, 1984.

THE APPLICATION OF POINT PROCESS STATISTICS TO THE STUDY OF THE SPATIAL DISTRIBUTION OF PARTICLES IN BIOLOGICAL TISSUE. *M. Gronychová, P.M. Groves¹, S.J. Young¹, M.E. Martone¹, I. Krekule*, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague and ¹Medical School, UCSD, La Jolla, USA.

Second order point process statistics are often used to describe the spatial distribution of particles in biological tissue because these processes are relatively easy to simulate and evaluate. However, two problems may be encountered in practice, when transforming the particles under examination to events (points) of the model: a) the minimum distance between neighbouring points (NND) is limited by the diameter of particles so that a model of a hard core process characterized by the absence of small NDD values must be considered, b) the nonzero thickness of individual serial sections of the tissue must be taken into account. Thus, the projection of a 3D process into the observed 2D process results in a decrease of NDD values which may mask the hard core process. We illustrated both problems by using simulated and experimental data (1).

1. *Groves M.P., Martone M.E., Young S.J., Armstrong D.M.*: *J. Neurosci.* 8: 892–900, 1980.

COMPUTER ASSISTED METHODS OF SURFACE AREA ESTIMATION FROM SERIAL TISSUE SECTIONS. *R. Palovský, P. Karen*, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.

The surface area and volume represent basic characteristics of a 3D studied sample of a tissue. These characteristics must often be estimated instead of measurements which are excluded because of the nontrivial shape of the sample that cannot be modelled by regular geometrical bodies, e.g. spheres etc. Stereological estimators are suitable for the above task, especially if the tissue is studied through its serial sections. The volume can be estimated by the Cavalieri principle or by counting voxels. The surface area of a smooth body can be estimated by summing up the area of polygons (triangles) forming the computer rendered surface of the sample or by application of the method of the spatial grid (1) based on Cauchy's theorem. All the mentioned methods were implemented as an extension of the GSE graphic editor (2). Estimates made on models (defined geometrical bodies) and on experimental data are shown and the advantages of the stereological approach are documented.

1. *Howard C.W., Sandau K.*: *J. Microsc.* 165: 183–188, 1991.

2. *Karen P.*: *Physiol. Res.* 41: 26P, 1992.

MULTIFUNCTION IBM PC BOARD FOR EXPERIMENTAL NEUROSCIENCE. *Yu.L. Kaminski, J. Bureš¹, I. Krekule¹*, Institute for Brain Research, Russian Academy of Sciences, St. Petersburg, Russia and ¹Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.

We developed a multifunction IBM PC board to simplify the HW applied to experiments in neuroscience. The board contains the usual interfaces, with the computer bus and the real-time process, i.e. A-D (16 chan., 40 us/conv., 12 bit/sam.), D-A converters and discrete I/O. Moreover, it consists of a set of signal shaping, normalization, isolation amplification and control circuits which can easily replace whole instrumentation between the biological signal source and the processor. The board contains various circuits which can be used for implementation of a number of different systems. The parameters of some circuits (e.g. Schmitt triggers, 8 channel amplifier, 2nd order analog filters) are SW controlled. To achieve the economy of the board applications, expensive ICs are connected through sockets and installed when needed. Applications of the board in signal acquisition, preprocessing and monitoring are presented.

COMPUTER AIDED TEACHING OF THE PHYSIOLOGY OF MEMORY. *I. Šipinková, J. Záhumsný, M. Tatlánek, K. Kosák,* Institute of Physiology, Faculty of Medicine, Comenius University, Bratislava.

A computer programme on human memory was introduced into the undergraduate medical physiology curriculum during the course on higher functions of the nervous system. The programme consists of a tutorial on memory (i.e. an instructive introduction to the problem presenting schematic knowledge about human memory) and an interactive part with tests on short-term memory. The following memory test were included in the programme: 1. visual memory recall test for meaningful words; 2. auditory memory recall test for meaningful words; 3. visual memory recall test for meaningless words and 4 visual memory recognition test for meaningful words. The programme is fully menu-driven and thus also suitable for users with limited computer practice. The programme was written in TurboPascal and may be run on IBM-AT compatible computers with EGA graphics.

ACCURACY OF THE ASSESSMENT OF VENTILATION FROM THE HEART RATE DURING PHYSICAL ACTIVITY IN CHILDREN. *J. Heller,* Biomedical Research Centre, Faculty of Physical Education and Sports, Charles University, Prague.

A simple method for assessing ventilation during exercise in children is being demonstrated by physical education teachers in order to restrict adequately the intensity of exercise within the recommended limits during smog emergency situations. Ventilation (V) and heart rate (f_H) in various types of physical education lessons and spontaneous physical activity were measured in 50 boys and 16 girls aged 6-14 years. Multiple regression analysis showed the following formulas: $V = 0.46.f_H + 0.48.weight - 58.1$, $R^2 = 0.81$, $SEE = 7.8 \text{ l.min}^{-1}$ (25 %) for boys and $V = 0.52.f_H - 55.6$, $R^2 = 0.76$, $SEE = 7.3 \text{ l.min}^{-1}$ (29 %) for girls in physical education lessons and $V = 0.28.f_H + 1.65.age + 0.40.weight - 44.5$, $R^2 = 0.70$, $SEE = 7.2 \text{ l.min}^{-1}$ (21 %) in boys during spontaneous physical activity. The error of stimulation was lower than when calculated from laboratory f_H and V values during bicycle ergometry (30-40 %). Both f_H and V increase with the intensity of exercise, however, the results suggest that the accuracy of indirect assessment of ventilation by f_H during physical activity in children shows an error of 20-50 %.

II. Physiology of work and sports

EFFECT OF PHYSICAL STRAIN, NOISE AND HOT ENVIRONMENTAL CONDITIONS ON MAN. *I. Borský, L. Hubáčová, K. Hájár, M. Bašnák, M. Janoušek, J. Baláž, R. Tóth,* Institute of Preventive and Clinical Medicine, Bratislava, Slovak Republic.

The physiological response was evaluated in 20 healthy men (25.5 years old), exposed to combined noise (90 dB), muscle (100 W) and thermic (air temperature 21 °C and 33 °C) load. Eight model load situations were used. During examinations lasting 1 hour we registered indices of cardiovascular and thermoregulation functions and by the "ante-post" method we performed audiometric, stabilometric and biochemical (catecholamines and ketosteroids in the urine) examinations. The highest adrenaline increase was found during the isolated noise load, in the case of noradrenaline only during the physical load. 17-keto-steroids reacted only during exposure by the noise load. Noise was found to affect most the auditory organ. A shift in the hearing threshold was apparent in all the four load situations in the case of noise. The system of postural regulation reacts less unambiguously. The action of noise alone evoked the most negative reactions and, paradoxically, improvement was caused by the combined effect of all three load factors.

COLD ADAPTATION AND BIOELECTRICAL IMPEDANCE. *R. Dlouhá,* Biomedical Research Centre, Faculty of Physical Education and Sports, Charles University, Prague.

The purpose of this study was to determine the effect of changes in bioelectrical impedance (BIA) upon cold adaptation. Ten healthy men underwent the test in which they were immersed in water at 13 °C for one hour. The BIA test was performed with four electrodes which were placed a) on the right hand dorsally between the second and third metacarpal bones, b) the wrist, c) on the right foot above the second toe and d) above the crucial joint at the level of and between the medial and lateral malleolus. The body weight after immersion was 0.77 kg lower ($p < 0.002$). The paired t-test revealed that the changes in BIA significantly differed between the pre- and postimmersion values ($p < 0.002$). When incorporated into existing bioelectrical prediction equations of body fat, the observed BIA difference (38 ohms) showed an increase of body fat by 2.3 % ($p < 0.002$). These results indicate that there is a significant relationship between pre- and postimmersion BIA values ($r = 0.93$, $p < 0.001$).

III. Endocrinology

NONINVASIVE DETERMINATION OF ANAEROBIC THRESHOLD IN MIDDLE-AGED MEN. *V. Bunc, J. Heller,* Faculty of Physical Education, Charles University, Prague.

The anaerobic threshold (AT) was determined noninvasively during incremental exercise on a bicycle ergometer in two groups ($N_1 = 22$, $N_2 = 16$) of healthy, untrained middle-aged men (mean age, 31.5 ± 4.8 and 51.8 ± 5.4 years respectively); mean maximal oxygen uptake (VO_{2max} , kg^{-1}) was 43.5 ± 7.8 and $34.4 \pm 8.0 \text{ ml.kg}^{-1}.\text{min}^{-1}$) using two testing methods simultaneously, namely the ventilatory threshold and threshold of the heart rate (HR) response (the modified Conconi test). The value of selected functional parameters at AT determined by either method showed no significant difference between the two determinations either in absolute or relative terms. Significant correlation was found between the values of the functional parameters at the AT estimated by the two methods ($p < 0.005$ in all cases). AT determination may also be performed in older subjects from the HR response (with about a 93 % success rate) under laboratory and field conditions. When the point where HR departs from linearity is difficult to determine (AT), the percentage of HR_{max} could be used. The percentage value of HR_{max} at the AT level should be in the range of 88-91 % HR_{max} .

CATECHOLAMINE LEVELS AND ACTIVITY OF MONOAMINOXIDASE IN THE HYPOTHALAMUS AND HYPOPHYSIS OF EWES AFTER SERUM GONADOTROPINE STIMULATION. *B. Pástorová, J. Halagan, J. Vrány, V. Eliáš,* University of Veterinary Medicine, Košice.

The effect of gonadotropine stimulation on catecholamine levels and activity of monoaminooxidase (MAO) have been studied by radiochemical methods in the hypothalamus (area preoptica, corpus mamillare) and hypophysis during the oestrous period. Superovulation was induced by a single administration of 2000 IU PMSG. The results indicate that gonadotrophine administration enhance decreasing norepinephrine levels in the studied hypothalamic areas. Significant reduction occurred in the corpus mamillare ($p < 0.001$). In the pituitary gland, increasing effects of PMSG on dopamine and epinephrine levels were found. MAO activity in the hypophysis decreased by 50 %, and this correlated with the increase of catecholamine concentrations in the pituitary. The results indicate that an hyperoestrogenous influence on hypothalamic and pituitary catecholamine metabolism is exerted and that it also alters MAO activity.

THE EFFECT OF GONADOTROPIC HORMONES ON THE AMINOACID CONTENTS IN THE BLOOD OF SHEEP DURING SYNCHRONIZED OESTRUS. D. Pavlová, V. Eliáš, I. Kronl, J. Halagan, J. Várady, Department of Normal Physiology, University of Veterinary Medicine, and ¹Institute of Clinical Experimental Medicine, Košice, Slovak Republic.

In our work the effect of the gonadotropic hormone FSH (Foliotropin, Spofa) on the aminoacid levels in the blood plasma of Slovak merino sheep was studied during synchronized oestrus. The sheep were synchronized with vaginal sponges (Agelin, Spofa) for 13 days. The experimental groups were given FSH in two doses (24 and 30 mg) on days 12-14. Amino acids were analysed by the method of column chromatography on an ion exchanger. After administration of 24 mg FSH in oestrus, the values of leucine, alanine and lysine significantly decreased ($p < 0.05$) in comparison to the control group. After administration of 30 mg FSH, the values of leucine, isoleucine, alanine, tyrosine and lysine significantly decreased ($p < 0.05$). Twenty-four hours after the last dose of the gonadotropic hormone a significant increase ($p < 0.05$) of alanine and histidine were recorded in the blood plasma.

THE COMPARISON OF SOME PARAMETERS IN EWES AFTER SUCCESSFUL AND UNSUCCESSFUL SYNCHRONIZATION AND STIMULATION FOR SUPEROVULATION. M. Molnárdová, J. Arendáčik, J. Przala, Department of Comparative Physiology, University of Veterinary Medicine, Košice, Slovak Republic and ART Olsztyn, Poland.

Ovarian reaction to superovulation are highly individual. To synchronize the ovarian cycle of the majority of animals in the flock, in order to increase the effectiveness of biotechnical methods, progestagene preparations are used. In our experiment, we used vaginal sponges impregnated with Ageline (chlorsuperlutine 20 mg/piece) inserted for 9 days. After removal, we stimulated the ewes by means of 1000 IU PMSG. The treatment by Antiserone (goats anti-PMSG) at intervals of 12, 24, 48 and 58 after it shortened the duration of the effect of PMSG by several hours. It decreased the mean number of ovulations which were not significantly different because of considerable individual deviations. We detected, however, significantly decreased mean values of 17-beta estradiol in the blood plasma after Ageline treatment. It was therefore confirmed that the phase of the ovarian cycle, in which synchronization was started, may also influence the successive superovulation stimulation, because the period of the natural development of the follicle is the limiting factor.

EFFECT OF DEXAMETHASONE (DXM) ON THE PERINATAL DEVELOPMENT OF THYROLIBERIN (TRH) CONCENTRATION AND TRH DEGRADING SYSTEMS IN THE RAT PANCREAS. J. Benický, M. Nikodémová, V. Šrbák, Institute of Experimental Endocrinology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

TRH concentration in the neonatal rat pancreas is high and it undergoes dramatic changes during ontogenesis. The goal of our experiments was to study the role of corticosteroids in the regulation of pancreatic TRH. Postnatal DXM treatment (1 µg/100 g BW/day) retarded the typical neonatal TRH changes by two days (the peak at day 5 instead of 3). Pancreatic TRH degrading systems were tested in 1- to 8-day-old pups. The level of the exogenous TRH did not decrease during 60 min incubation *in vitro* either with the cytosolic or particulate fractions of the pancreatic homogenate at this age period. However, if the decrease of immunoreactivity of exogenous labelled TRH (¹²⁵I-TRH) was measured, detectable TRH degrading activity was found at 5 and highly significant values were found at the age of 8 days. It is conceivable that maturation of TRH from the high molecular weight precursor took place during the incubation thus masking the concomitant degrading process. This new approach enabled us to study TRH degradation separately apart from the possible TRH synthesis during incubation. DXM did not affect TRH degradation.

MODULATION OF THYROID HORMONE ACTION ON THE LEVEL OF 3,5,3'-TRIIODO-L-THYRONINE (T₃) NUCLEAR RECEPTORS BY SELENIUM. J. Brtko, P. Filipčík, V. Šrbák, S. Hudecová, A. Brtková, Institute of Experimental Endocrinology, Slovak Academy of Sciences, Department of Molecular Biology, Faculty of Natural Sciences, Comenius University and Research Institute of Nutrition, Bratislava, Slovak Republic.

Since selenite (SEIV) is known to be a catalyst of the oxidation of SH groups, and the thyroid hormone receptor contains SH groups in the receptor molecule, the present study was undertaken to investigate the effect of selenite on a) nuclear T₃ receptors of both rat liver and pituitary tumour cells GH₄C₁ cells, b) nuclear T₃ receptor gene expression, c) cytoplasmic protein phosphorylation and d) prolactin secretion. In conclusion, the T₃ binding activity of the nuclear thyroid hormone receptor is reversibly inhibited by selenite (SEIV) but not changed by selenate (SEVI). Selenite at 5 µmol/l in GH₄C₁ cells markedly inhibits the gene expression of thyroid hormone receptors and it induces significant changes in cytoplasmic phosphorylation, and significantly diminishes prolactin secretion.

ESTABLISHMENT OF AN EXPERIMENTAL MODEL FOR INVESTIGATION OF TRIIODOTHYRONINE REGULATORY MECHANISM IN CELL CULTURES. P. Filipčík, J. Brtko, J. Bransová, Institute of Experimental Endocrinology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

The best way to study the finely controlled physiological responses to hormones is by cell cultures from functionally differentiated cells that are widely used in the new approach to organ physiology (1). We focused our attention on suitable models for the investigation of triiodothyronine (T₃) and its effects on the target cells. Two cell lines (of leukaemic and pituitary cells) with different growth rates were used and the following parameters were evaluated: the presence of T₃ receptors, cell growth, cytosolic protein phosphorylation, the T₃ binding capacity and the T₃ receptor down regulation. Furthermore, the relationship between thyroid hormone receptor occupancy and the magnitude of biological effects after T₃ addition was investigated. We found that all the events examined were very finely modulated by changes in the experimental conditions, the most important being the plating density at the beginning of the experiment and the quality and quantity of sera in the cultivation medium. The standardization of these two factors is essential for the reproduction of this kind of experiments.

1. Sato G.H.: Hormones, Cell Biology and Cancer: Perspectives and Potentials, Alan R. Liss, Inc. 1988, pp. 199 - 206.

THE EFFECT OF TRIIODOTHYRONINE ON cAMP-DEPENDENT AND ON cAMP-INDEPENDENT PROTEIN KINASE ACTIVITY IN THE RAT LIVER PROLIFERATING UNDER A CERTAIN NUTRITIONAL REGIMEN. J. Knopp, J. Brtko, Institute of Experimental Endocrinology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

The molecular signals controlling rat liver regeneration are becoming rapidly defined in more detail. We explored the differences of cAMP-dependent and cAMP-independent protein kinase (PK) activity in the rat liver proliferating under a certain nutritional regimen and treatment with 3,5,3'-triiodothyronine (T₃). The nutritional regimen itself increased both the activity of cAMP-dependent and cAMP-independent PK in the rat liver, however, only an effect of T₃ was observed on cAMP-independent activity. The kinetics of the enzyme revealed that the increase of cAMP-dependent PK activity in the proliferating liver was not caused by induction of the enzyme. The binding of T₃ to its nuclear receptors characterized by K_a and M_{BC} was decreased in fasted rats and had no relationship to either of the PK activities. These observations suggest that T₃ might be a modulator of liver cell proliferation via protein kinase tightly bound to DNA which is independent of cAMP.

THE EFFECT OF THYROXINE ADMINISTRATION ON INSULIN BINDING AND GLUCOSE TRANSPORT IN RAT ADIPOCYTES. *M. Ficková, L. Macho*, Institute of Experimental Endocrinology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Thyrotoxicosis is characterized by complex metabolic disturbances. Concomitant hyperglycaemia and increased plasma insulin levels indicate insulin resistance. Therefore insulin receptors (IR) and insulin-stimulated glucose transport (GT) after one week of treatment of the rats with i.p. daily dose of thyroxine ($50 \mu\text{g}/100 \text{ g b.w.}$) were studied in isolated adipocytes. Thyrotoxicosis of experimental rats was proved by the decline of body weight, increased activity of liver malic enzyme, decreased size of adipocytes and a significant increase of glycaemia and insulinaemia. We have found that exogenous administration of T_4 resulted in a large decrease of the insulin binding capacity (decrease of IR number) in adipocytes. The basal GT was lowered. Insulin-stimulated GT was significantly reduced in adipocytes of thyrotoxic rats. The decrease of the IR number is negatively correlated with insulinaemia (down regulation). The lower responsiveness to insulin-stimulated GT could result from both the decline of IR and ATP-dependent phosphorylation of active glucose transporters. We suggest that besides glucocorticoids, thyroid hormones represent regulatory factors in adipocytes influencing IR and insulin-controlled metabolic pathways.

CHARACTERIZATION OF THYROID HORMONE RECEPTORS IN PRIMARY CULTURES OF THE CHICK BROILER (SLOVAK) AND LAYING LINE (BROWN LEGHORN) EMBRYO MYOBLASTS FROM CHICK EMBRYOS. *P. Výboh, M. Vaneková¹, E. Jurániová*, Institute of Animal Biochemistry and Genetics, Slovak Academy of Sciences, Ivanka pri Dunaji and ¹Institute of Experimental Veterinary Medicine, Ivanka pri Dunaji, Slovak Republic.

We have detected the presence of nuclear 3,5,3'-triiodothyronine (T_3) receptors in primary cultures of the chick broiler (Slovak) and laying line (Brown Leghorn) embryo myoblasts. Cells were isolated from breast and thigh muscles of 11-day-old chick embryos and then incubated in MEM. The binding assay was performed in whole cells (1) with increasing concentrations of [^{125}I]- T_3 . Specific binding was evaluated by the Scatchard analysis. T_3 receptors of myoblasts of both chicken types showed a similar affinity ($K_d = 2.4$ and $1.2 \cdot 10^{-10} \text{ mol.l}^{-1}$ respectively) and limited binding capacity ($B_{\text{max}} = 0.32$ and $0.21 \text{ fmol} \cdot \mu\text{g}^{-1} \text{ DNA}$ respectively). The obtained results indicate the same character of binding sites in cells of both chicken types.

¹ Barlow J.W., De Nayer: Acta Endocrinol. (Copenhagen) 117: 327-332, 1988.

PINEAL N-ACETYLTRANSFERASE ACTIVITY, THYROTROPIN AND THYROID HORMONES IN LETHALLY IRRADIATED RATS. *E. Ahlersová, M. Kassayová, I. Ahlers*, Institute of Animal Physiology, Faculty of Science, Šafárik University, Košice, Slovak Republic.

Male Wistar rats after adaptation to an artificial light/dark cycle (LD 12:12) were exposed to whole body irradiation with 14.35 Gy gamma rays. Three groups of rats were examined: A. rats irradiated in the night and placed in the 12 h LD cycle, B. rats irradiated in the day-time and placed in the 12 h LD cycle, C. rats irradiated in the night and kept constantly in the dark. The analysis from 6 h to 4 days after exposure was carried out in the dark. Radiation enhanced the activity of pineal N-acetyltransferase 3-4 days after exposure in all groups, in group C significantly on day 4. Different light regimens during and after irradiation did not substantially influence the activity of this key enzyme of melatonin synthesis. A significant increase in serum thyrotropin levels after exposure was noted in group C on day 4. Ionizing radiation decreased the levels of serum thyroxine and 3,5,3'-triiodothyronine in all the three groups followed.

EFFECTS OF IMPAIRED INSULIN SECRETION ON PREIMPLANTATION MOUSE EMBRYO DEVELOPMENT. *J. Veselá, P. Rehák, J. Koppel*, Institute of Animal Physiology, Slovak Academy of Sciences, Košice, Slovak Republic.

To further investigate the significance of impairment of insulin secretion induced by subdiabetic streptozocin treatment on preimplantation embryo development, female mice received a single injection of streptozocin (65 mg/kg) 14-17 days before fertilization. Morphological analysis of preimplantation embryos collected on day 2 of pregnancy revealed no significant changes in the number of two-cell embryos recovered from streptozocin-treated females. Mean glycaemia did not differ significantly between streptozocin-treated and control groups. Morphologically normal two-cell embryos were transferred into the oviduct of pseudopregnant females and recovered 24-28 h later. Their morphological analysis revealed a significantly increased ratio of degenerated embryos originating from streptozocin-treated females. Insulin administered twice daily to streptozocin-treated mice improved the impaired development of transferred embryos. It could be concluded that the altered insulin secretion in female mice negatively influenced the growth of preimplantation embryos. It appears that morphologically normal two-cell embryos isolated from subdiabetic females are partly incapable of developing up to 8-cell embryos even in a healthy maternal environment. These delayed effects of altered insulin secretion might be hypothetically connected with activation of the mouse embryo genome at the two-cell stage.

IV. Cellular Physiology

ROLE OF EXTRA- AND INTRACELLULAR CALCIUM IN STIMULATED AND INHIBITED MAST CELLS. *K. Drábiková, R. Nosál, J. Pečivová*, Institute of Experimental Pharmacology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Stimulated histamine secretion from mast cells is calcium-dependent. We investigated the uptake of extracellular $^{45}\text{Ca}^{2+}$ and release of Ca^{2+} from internal stores during stimulation and inhibition of isolated rat mast cells (IRMC). Stimulation with compound 48/80 increased histamine secretion, promoted $^{45}\text{Ca}^{2+}$ influx from 3014 to 12 555 cpm/ 5×10^5 IRMC, and induced an increase in $[\text{Ca}^{2+}]_i$ from 93.3 to 236.2 nmol/l, as measured with the fluorescence indicator quin-2. Metipranolol (MET) did not change either histamine secretion, uptake of $^{45}\text{Ca}^{2+}$, or cytoplasmic calcium in unstimulated IRMC. On the other hand, after stimulation with compound 48/80, MET decreased histamine secretion, $^{45}\text{Ca}^{2+}$ uptake to 7028 cpm/ 5×10^5 IRMC as well as release of $[\text{Ca}^{2+}]_i$ from internal stores to 127 nmol/l. Our results indicate, that MET exerts its inhibitory effect on IRMC by interfering with extra- and intracellular calcium transport.

ROLE OF CALCIUM IONS IN BLOOD PLATELET AGGREGATION. *V. Jančinová, R. Nosál, M. Petriková*, Institute of Experimental Pharmacology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Calcium ions represent the most important messengers of platelet activation. The aim of the study was to investigate the involvement of various calcium pools in platelet aggregation. Rat platelets stimulated with calcium ionophore A23187 in the presence and in the absence of extracellular calcium were used. We found that A23187 stimulated aggregation occurred in Ca^{2+} -free medium; the mean effective concentration of the stimulus was $1.43 \mu\text{mol/l}$. The stimulatory effect of ionophore was potentiated by addition of 0.01 and 0.1 mmol/l calcium and inhibited when the calcium concentration was increased to 1 mmol/l. In the presence of EGTA, i.e. after lowering Ca^{2+} concentration in the plasma membrane, the aggregation was significantly decreased. The inhibitory effect of EGTA was reversible, as it was abolished by addition of calcium to the medium. The presented results suggest that, for platelet aggregation, platelet membrane bound calcium is crucial, while extracellular Ca^{2+} ions play only a regulatory role.

EFFECTS OF THE EXTERNAL DI- AND TRIVALENT CATIONS ON THE INTRASYNAPTOSOMAL FREE $[Ca^{2+}]$ IN ISOLATED RAT BRAIN NERVE TERMINALS MONITORED BY $^{45}Ca^{2+}$ AND FURA-2. R. Bottliková, J. Orlický, Institute of Molecular Physiology and Genetics, Slovak Academy of Sciences, Bratislava, Slovak Republic.

The effects of various di- and trivalent metal ions (Cd^{2+} , Ni^{2+} , Mn^{2+} , La^{3+} , Co^{3+}) on the ^{45}Ca influx and on the intrasynaptosomal free levels of $[Ca^{2+}]$ were compared in resting and depolarized rat brain nerve terminals by elevating external K^+ (30 mmol.l⁻¹) and/or by 4-aminopyridine (1 mmol.l⁻¹) in the external medium. It was shown that metal ions strongly reduced the $^{45}Ca^{2+}$ influx and the intrasynaptosomal FURA-2 signal in a dose-dependent manner (0.1–1 mmol.l⁻¹). The results suggest that the inorganic metal ions, owing to their ionic similarities with Ca^{2+} , affect a variety of interactions related to the membrane permeability and the FURA-2 fluorescence signal under basal and depolarizing conditions. These findings indicated that great caution should be taken when interpreting the effects of metal ions on the intrasynaptosomal Ca^{2+} levels estimated with FURA-2.

EFFECTS OF EXTERNAL ATP, Ca^{2+} , EGTA AND CALMODULIN ON THE Ca^{2+} MOVEMENTS AND PROTEIN PHOSPHORYLATION IN RAT BRAIN SYNAPTOSOMES: A COMPARATIVE STUDY BY FURA-2, $^{45}Ca^{2+}$ AND γ - ^{32}P -ATP. J. Orlický, R. Bottliková, Institute of Molecular Physiology and Genetics, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Using of radioisotope ($^{45}Ca^{2+}$ and γ - ^{32}P) and fluorescence (FURA-2) methods we have demonstrated the effects of extracellular ATP (20 μ mol.l⁻¹), Ca^{2+} (0–1 mmol.l⁻¹), EGTA (10 mmol.l⁻¹) and calmodulin (1–4 μ mol.l⁻¹) on Ca^{2+} movements and Ca^{2+} -dependent protein phosphorylation in rat brain synaptosomes under basal and/or depolarized conditions. The exposure of the nerve terminals to ATP, Ca^{2+} , EGTA and calmodulin increased intracellular (Ca^{2+}) and phosphorylation of some specific synaptosomal proteins. The depolarization of the synaptosomes by elevated external K^+ concentrations (30–140 mmol.l⁻¹ KCl) resulted in higher effects of the above mentioned compounds on the Ca^{2+} release and Ca^{2+} -dependent phosphorylation. Ca^{2+} responses were also observed in the absence of extracellular Ca^{2+} , suggesting that a part of Ca^{2+} was released from intrasynaptosomal storage by mechanisms which were not dependent on extracellular Ca^{2+} .

MODULATION OF FAST AND SLOW CALCIUM CURRENTS BY ADRENALINE AND FORSKOLIN IN SINGLE MUSCLE FIBRES OF THE CALCIUM ELECTROGENETIC TYPE. D. Zacharová, M. Henček, J. Pavelková, E. Lipská, Institute of Molecular Physiology and Genetics, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Modulation of the slow calcium channel (L-type) by catecholamines is well known. Data concerning their effect on the fast (T-type) Ca channel are, however, sparse. We followed their effects in "voltage-clamp" conditions in single muscle fibres of the crayfish. Under these conditions, it was possible to record isolated calcium currents and differentiate between their three components as they exhibit different kinetics of activation and inactivation. We found that adrenaline (6–10 μ mol/l), which shows a positive inotropic effect on contraction in these fibres, enhances the conductance of the slow Ca current component to 232.2 ± 27.6 % (from 100 %; $n=22$); the fast current component is increased to 131.8 ± 6.3 % only. Forskolin (10–60 μ mol/l), which also shows a positive inotropic effect on the contraction of intact fibres, mainly enhances the slow current component. Forskolin shows a two phase effect and namely within 2–6 min and 10–17 min respectively.

INOSITOL TRISPHOSPHATE-SENSITIVE CALCIUM STORE IS SUFFICIENT FOR RECEPTOR CONTROLLED INTRACELLULAR CALCIUM REPETITIVE SPIKES. J. Poledna, Institute of Molecular Physiology and Genetics, Slovak Academy of Sciences, Bratislava, Slovak Republic.

A simplified kinetic model is proposed to describe receptor controlled intracellular calcium oscillations. The model relies on quantitative measurements of calcium activation and inhibition of the inositol trisphosphate ($InsP_3$) receptor in the endoplasmic reticulum (1). In combination with Ca -ATPase activity for calcium uptake into the endoplasmic reticulum, the model demonstrates basic features of intracellular calcium signalling. The rate constants were selected to fit kinetic and equilibrium data. The qualitative analysis showed conditions which led to cytoplasmic oscillations in calcium concentration at a fixed $InsP_3$ concentration. These results suggest that a $InsP_3$ sensitive calcium release mechanism is adequate to explain the generation of intracellular calcium oscillations. This model may explain the experimental data from *Xenopus oocytes*.

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EXAMINATION OF GATING SCHEMES FOR THE CARDIAC Ca^{2+} RELEASE CHANNEL ACTIVATED BY CALCIUM. A. Zahradníková, I. Zahradník, Institute of Molecular Physiology and Genetics, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Single-channel studies of the Ca^{2+} release channel in planar lipid bilayers have revealed its complex gating behaviour. The measured closed and open times span from hundreds of microseconds to hundreds of milliseconds. Ashley and Williams (1) demonstrated that the minimal gating scheme of this channel has a resting state R, and cyclically interconnected two closed ($C1$, $C2$) and two open ($O1$, $O2$) states ($R-C1 < O1/O2 > C2$), if activated solely by Ca^{2+} . However, in a broad range of $[Ca^{2+}]$ the channel displays extra long closures requiring an additional, inactivated state (I) in the gating model. Using computer modelling of channel activation by Ca^{2+} and its inhibition with procaine, we have shown that only one of the possible gating schemes, namely the one with I connected only to $C2$ of the above mentioned scheme ($R-C1 < O1/O2 > C2-I$), gives open probabilities and open and closed times consistent with experimental data. Part of the work was performed in the laboratory of P. Palade, Department of Physiology and Biophysics, UTMB Galveston, TX, USA, and supported in part by the NIH grant DHHS 5R01 HL42527.

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DISTRIBUTION OF THE Ca^{2+} -MODULATING PROTEINS IN SARCOPLASMIC RETICULUM AFTER MUSCLE DENERVATION. J. Lehotský, G. Bezáková, P. Kaplan L. Racymaekers¹, Comenius University, Jessenius Medical School, Martin, Slovak Republic and ¹Catholic University, Leuven, Belgium.

The early response to denervation is associated, besides other changes, with altered Ca^{2+} homeostasis. Our study (on the basis of Western blotting) indicates that denervation influences the expression of some Ca^{2+} modulating proteins. Our results have brought for the evidence that the levels of calsequestrin and the putative ryanodine receptor are increased in parallel with a decrease in the total amount of the Ca^{2+} -pump protein. Unchanged Ca^{2+} -pump isoform expression and unaltered quantities of other non-junctional Ca^{2+} -binding proteins support the hypothesis that the early response to denervation is mainly an alteration at the junctional region of sarcoplasmic reticulum membranes.

THE EFFECT OF DILTIAZEM ON THE ELECTROPHYSIOLOGICAL AND CONTRACTILE ACTIVITY IN SINGLE MUSCLE FIBRES OF THE CRAYFISH. *M. Henček, D. Zacharová, E. Lipská, J. Pavelková*, Institute of Molecular Physiology and Genetics, Slovak Academy of Sciences, Bratislava, Slovak Republic.

The effect of diltiazem on the action potential and tension in intact fibres, as well as the calcium currents (both fast and slow, respectively) recorded from muscle fibre segments under "vaseline-gap voltage clamp" conditions was studied in single muscle fibres of the crayfish. We found that diltiazem already blocks both the fast and the slow calcium channel in concentrations 1-10 $\mu\text{mol/l}$. The twitch tension and the strontium action potential are blocked at much higher concentrations (100-200 $\mu\text{mol/l}$). At lower concentrations (1-5 $\mu\text{mol/l}$), the conductance of the slow channel is mainly enhanced during the first few minutes (2-3 min) of activity and not until then is it followed by inhibition of the channel. Transient facilitation is also observed in twitch and tetanus contractions, however, at concentrations one order of magnitude lower. The reversibility of the diltiazem effect is partial and slow. The blocked current is partially restored by increasing the holding potential (from -80 mV to -110 mV).

MEMBRANE PHOSPHOLIPID TURNOVER IN STIMULATED AND INHIBITED MAST CELLS. *J. Pečivová, K. Drábiková, R. Nosál*, Institute of Experimental Pharmacology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Stimulated secretion from mast cells is a complex event resulting in histamine liberation. We investigated the turnover of ^{32}P in plasmic membrane phospholipids (PL) in untreated, compound 48/80 stimulated and propranolol (PRO) treated isolated rat mast cells (IRMC). In control IRMC, the ^{32}P incorporation into the following PL was measured: phosphatidylcholine (PC=36.2 %), phosphatidylinositol (PI=19.2 %), phosphatidylethanolamine (PE=11.1 %), phosphatidylserine (PS=9.3 %), phosphatidic acid (PA=8.0 %) and nonidentified fraction (RES=16.2 %). Stimulation of IRMC significantly increased ^{32}P incorporation into the fractions PC and PI and decreased the incorporation into the fraction PA. Propranolol inhibited the 48/80 stimulated histamine liberation and decreased ^{32}P incorporation into the PI fraction while increasing it into the fraction PI. We assume that, concomitantly with the stimulation and inhibition of IRMC, histamine liberation is at least partially affected with membrane PL turnover.

MEMBRANE PHOSPHOLIPID PEROXIDATION IN STIMULATED AND INHIBITED BLOOD PLATELETS. *R. Nosál, M. Petríková, V. Jančinová*, Institute of Experimental Pharmacology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Activation of the arachidonate cascade along with membrane phospholipid peroxidation and subsequent malondialdehyde (MDA) formation are considered important mechanisms in thrombin-induced platelet stimulation. We found that the formation of MDA in isolated, thrombin-stimulated platelets was concentration-dependent between 1 and 40 NIH U/ml and developed within 10 to 40 s. The formation of MDA was followed by platelet aggregation and was parallel with the production of thromboxane B_2 . Betaadrenoreceptor blocking (BAB) drugs inhibited the stimulated MDA formation in a dose-dependent way in the following order of potency: propranolol > alprenolol > metipranolol > oxprenolol. In BAB treated platelets, correlation was established between the inhibition of thrombin-induced aggregation and MDA formation. Our results support the hypothesis concerning the inhibitory effect of BAB drugs on the activated phospholipase A_2 in blood platelets.

THE EFFECT OF HORMONES ON ORNITHINE DECARBOXYLASE ACTIVITY OF CHICK MYOBLASTS IN CULTURE. *M. Juráni, D. Lamošová, M. Vaneková, P. Výboh, E. Jurániová*, Institute of Animal Biochemistry and Genetics, Slovak Academy of Sciences, Ivanka pri Dunaji and ¹Institute of Experimental Veterinary Medicine, Ivanka pri Dunaji, Slovak Republic.

The activity of ornithine decarboxylase (ODC), an important marker for cell proliferation of myoblasts in culture, was studied after the action of the following hormones: testosterone (T), triiodothyronine (T_3), thyroxine (T_4), oestradiol (E) and corticosterone (C) during a 2, 4 and 24 h incubation. Myoblasts in culture were obtained from embryos of broiler hybrid Slovgal and laying line of Brown Leghorn. The myoblasts in culture from broiler hybrid exhibited higher activity of ODC preferentially during the first 4 hours. Hormones T, T_3 , T_4 significantly activated ODC, whereas E, C inhibited its activity in myoblasts. The results obtained indicate that the tested hormones have a direct effect on the proliferation of chick myoblasts.

SHORT-TERM INFLUENCE OF HORMONES ON THE PROTEOSYNTHETIC ACTIVITY OF CHICKEN EMBRYONAL MYOBLASTS. *D. Lamošová, M. Juráni, M. Vaneková, E. Jurániová*, Institute of Animal Biochemistry and Genetics, Slovak Academy of Sciences, Ivanka pri Dunaji and ¹Institute of Experimental Veterinary Medicine, Ivanka pri Dunaji, Slovak Republic.

The proteosynthetic activity of myoblasts isolated from 11-day-old chick embryos was compared with broiler (hybrid Slovgal) and laying (line Brown Leghorn). The following hormones were applied: testosterone (T), triiodothyronine (T_3), thyroxine (T_4), oestradiol (E) and corticosterone (C) to myoblasts. The hormones were separately given in physiological concentrations for 2, 4 and 24 hours. T was the most effective hormone affecting protein metabolism in both chick types. It increased proteosynthesis after 2 h, as well as the incorporation of labelled amino acid (^3H -leucine) into myoblasts after 24 h exposure. Thyroid hormones elevated myoblast proteosynthetic activity after 24 h. No significant effect of corticosterone was observed, whereas oestradiol decreased the proteosynthetic activity of myoblasts.

NEOFORMATION OF INTRAFUSAL FIBRES IN RAT MUSCLE SPINDLES DEFFERENTED AT BIRTH AND DENERVATED AT 4 WEEKS. *T. Soukup, M. Novotová, F. Pedrosa-Domellöf, L.-E. Thornell*², Institute of Physiology, Academy of Sciences of the Czech Republic, Prague, Czech Republic, ¹Institute of Molecular Physiology and Genetics, Slovak Academy of Sciences, Bratislava, Slovak Republic and ²Department of Anatomy, University of Umea, Sweden.

We studied the myoneogenesis after neonatal deafferentation in which the right sciatic nerve was transected at 4 weeks. We found an increased number of intrafusal fibres per spindle cross-section after one to 4 months in comparison to the usual 4 fibres in control spindles. Additional intrafusal fibres originated from activated intrafusal myosatellite cells and by different forms of fibre division, similarly as was observed in deafferented spindles with preserved sensory innervation. The supernumerary intrafusal fibres were found predominantly in the A region in close spatial relation to the original nuclear bag or chain fibres. On the basis of mATPase activity and the pattern of expression of MHC isoforms the majority of supernumerary fibres could be classified as nuclear bag₁, bag₂ or chain fibres; some supernumerary fibres exhibited transitional properties or they did not fit any of these fibre types. Our results demonstrate that neoformation of supernumerary intrafusal fibres does not depend on the presence of sensory innervation after the 4th week after birth.

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V. Cardiovascular Physiology

EFFECT OF THE CURVATURE OF VENTRICULAR WALLS ON THE RESULTANT HEART VECTORS. *V. Szathmáry*, Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

A realistic computer model of the propagation of ventricular activation was used to study the effect of varying curvature of the ventricular walls on the resulting heart vectors. The parameter C_{AB} , quantitatively characterizing the apical-basal curvature of the myocardium, was defined as the reciprocal value of the radius of a best fitting circle, approximating the ventricular wall in the region of their maximal lateral width, at its frontal cross-section. During the series of model experiments the value of C_{AB} varied from 6.0 to 40.0 m^{-1} . The mean value of C_{AB} for the normal human heart is $14.0 \pm 4 m^{-1}$. Changes of the C_{AB} up to the value of $18 m^{-1}$ had a minimal influence on the spatial vectorcardiographic loop. Changes above this value, led to an increase of laterally oriented vectors, as well as to a rapid decrease of posteriorly and to the right oriented terminal vectors.

LEFT VENTRICULAR PERFORMANCE IN CARDIOMEGALY DUE TO A PRESSURE OVERLOAD INDUCED IN NEONATAL RATS. *F. Koldř, F. Papoušek, V. Pelouch, J. Procházka, B. Ošťádal*, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.

A gradual pressure overload was induced in 6-day-old (B6) and 2-day-old (B2) rats by banding the abdominal aorta to a template of 0.45 and 0.25 mm diameter, respectively. At 60 days of age, the systemic arterial pressure increased by 28 % in the B6 and by 67 % in the B2 groups. The increase of the relative left ventricular (LV) weight by 34 % in the B6 and by 83 % in the B2 groups closely correlated with the degree of pressure overload ($r=0.80-0.88$). The myocardial concentration of collagen remained unchanged. The LV enlargement was associated, in both banded groups, with a moderate increase of the maximum LV systolic pressure and the maximum $+dP/dt$, as assessed on pump-ventilated open-chest animals after an acute pressure load (ligation of the ascending aorta). While the values of maximum $+dP/dt$ after the load positively correlated with the degree of LV enlargement ($r=0.82$), in the B6 group, negative correlation was observed in the B2 group ($r=-0.61$). Moreover, unlike the B6 group, the B2 animals exhibited significant elevation of the right ventricular weight (by 23 %). These data show that the transition from compensated to decompensated cardiomegaly, induced by aortic banding in neonatal rats, depends on the onset and degree of the pressure overload.

PASSIVE ELASTIC PROPERTIES OF THE ATROPHIC RAT HEART. *F. Papoušek, F. Koldř, C. MacNaughton¹, V. Pelouch, B. Korecký¹*, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague, and ¹Department of Physiology, University of Ottawa, Canada.

Our aim was to evaluate the passive elastic properties of the heart undergoing extreme atrophy due to haemodynamic unloading. Heterotopic heart-lung transplantation, performed in inbred Lewis rats by attaching the stump of the aorta of the donor heart end-to-side to the abdominal aorta of the recipient, was employed as an experimental model. The elasticity was evaluated from a pressure volume (P-V) relationship of the isolated perfused heart. Within 28 days after surgery, the left ventricular (LV) weight of the transplant decreased to 39 %, and the concentration of collagen increased to 225 % of the corresponding recipient values. The LV chamber stiffness constant (α) and myocardial stiffness constant (K) were derived from the P-V and stress-strain curves, respectively, assuming thick-walled spherical geometry. While the constant α of the atrophic LV increased by 114 %, as expected, the K values decreased by 23 %. This means that these two parameters may be altered in opposite directions, when the LV size undergoes extreme changes. Furthermore, the inverse relationship between the constant K and collagen concentration indicates that the degree of fibrosis is not the only determinant of myocardial stiffness.

DEFORMATION OF CONDUIT CORONARY ARTERY DURING INCREASED AFTERLOAD. *M. Gerová, V. Stoev, M. Kittová¹, J. Koska*, Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, and ¹Institute of Physiology, Medical Faculty, Comenius University, Bratislava, Slovak Republic.

Deformation of individual cells in the coronary wall has been suggested as a trigger for increasing the RNA content during a rising preload and/or afterload lasting for a period of hours. The individual components, supposed to participate in the deformation of the coronary artery, namely their diameter and segment length, were monitored by the ultrasound technique during a shortlasting pressure overload. In 6 anaesthetised dogs, the increase in BP was induced by constriction of the aorta just above the diaphragm. The increase in mean BP from 145.7 ± 8.3 to 191.4 ± 8.4 mm Hg ($P<0.001$) increased the diameter of ramus interventricularis anterior (105.3 ± 2.4 %, $P<0.001$) and prolonged its segment length (107.8 ± 2.9 %, $P<0.001$). Moreover, the increase in coronary blood flow (152.2 ± 6.7 %, $P<0.001$) induces changes in the shear stress namely affecting the pattern and/or function of the endothelium.

INCORPORATION OF [¹⁴C]LEUCINE INTO THE CORONARY ARTERY AFTER SHORTLASTING PRESSURE OVERLOAD OF THE HEART. *I. Bernátová, O. Pecháňová, M. Gerová, V. Stoev, M. Kittová¹*, Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, and ¹Institute of Physiology, Medical Faculty, Comenius University, Bratislava, Slovak Republic.

An increase in the RNA content both in the coronary artery and myocardium accompanies pressure overload of the heart. To characterize the initial links of protein synthesis in five anaesthetised dogs, the mean BP was increased by partial aortic constriction for 4 hours from 147.3 ± 11.1 to 204.6 ± 11.4 mm Hg. Protein synthesis was assessed by measuring [¹⁴C]Leu incorporation. After 4 hours of the BP increase the [¹⁴C]Leu incorporation rose by 48.4 ± 6.7 % in the ramus interventricularis anterior ($p<0.05$), by 27.0 ± 8.1 % in ramus circumflexus ($p>0.05$) and by 53.6 ± 7.6 % in the myocardium ($p<0.01$). In three dogs, the increased BP was maintained for 4 hours. After this the aortic constriction was released and BP reached 88.6 ± 7.6 % of the resting value while the incorporation of [¹⁴C]Leu decreased significantly in RIA (by 31.6 ± 5.5 %), in RC (by 28.7 ± 4.2 %) and in the myocardium (by 32.4 ± 4.1 %).

THE TURNOVER OF THE ADENOSINE IN THE CORONARY ARTERY AFTER A SHORTLASTING PRESSURE OVERLOAD OF THE HEART AND RECOVERY. *O. Pecháňová, I. Bernátová, M. Gerová, V. Stoev, M. Kittová¹*, Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, and ¹Institute of Physiology, Medical Faculty, Comenius University, Bratislava, Slovak Republic.

The coronary artery and namely its endothelial layer are characterized by active metabolism of adenosine nucleotides. We found an early increase in the total RNA content in the coronary wall after a BP increase. As the next step, the turnover of adenosine was assessed by measuring [¹⁴C]adenosine incorporation into adenosine nucleotides and RNA. In 9 anaesthetised dogs, the mean BP was increased from 128.6 ± 7.3 to 162.0 ± 5.8 mm Hg for 4 hours. An increase in the radioactivity of adenosine nucleotides was found in the ramus interventricularis anterior (by 236 ± 14 %, $p<0.001$), the ramus circumflexus (by 110 ± 12 %, $p<0.05$), the myocardium (by 197 ± 13 %, $p<0.001$) and in the total RNA of RIA and myocardium. In 3 dogs the aortic constriction was released after 4 hours. Two hours later, the BP reached 88.6 ± 7.6 % of the resting value and was accompanied by a significant decrease of [¹⁴C]adenosine incorporation in all samples.

EARLY POSTNATAL DEVELOPMENT OF THE INOTROPIC RESPONSE TO LOW EXTRACELLULAR SODIUM IN PERFUSED RAT HEART. I. Ošřádalová, F. Kolář, B. Ošřádal, J. Rohlíček, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.

Low extracellular sodium (LES, 35 mmol/l, replaced by lithium) induces a transient triphasic inotropic response in the adult rat heart: an initial increase (I), depression of contractions (II), and delayed increase (III) (1). The purpose of the present study was to ascertain whether this response differs during early postnatal development. This contractile force was measured in isolated perfused rat hearts on day 1, 2, 4 and 7 after birth. The initial increase (I) was the highest on day 1 and the lowest on day 4. In 1- and 2-day-old hearts, phase I was followed by a slow continual decrease of contractions. The triphasic response, characteristic for adults, appeared for the first time on day 4 and was more pronounced on day 7, suggesting an increasing sensitivity to a calcium overload. It may be assumed that these significant day-by-day changes of the LES-induced inotropic response reflect the development of mechanisms involved in myocardial calcium handling during the first week of life in the rat.

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INSTRUMENTATION OF AN ARTERY PRODUCES NEITHER INTIMAL THICKENING NOR INFLAMMATORY INFILTRATION. S. Doležel, M. Gerová, J. Nečas, M. Dostál, Institute of Pathological Physiology, Masaryk University Brno, Czech Republic and Institute of Normal and Pathological Physiology Slovak Academy of Sciences, Bratislava, Slovak Republic.

Several authors (1) have shown that a causal relationship exists between cuff-induced intimal thickening, inflammatory infiltration and injury to vasa vasorum. They have suggested that experimental atherosclerosis can be produced by a cuff. While studying the innervation of the heart, we implanted a methacrylate ring around the coronary artery in 10 dogs for 7 days which induced denervation of the distal myocardium and arteries. Intimal thickening was never found in the segment covered with the ring. The vascularization of the arterial wall and of the perivascular space was preserved. Acute vasculitis was detected in one animal only in which a pyaemic abscess developed in the wound within 3 days after the surgery. The abscess was drained and treated with Rivanol. Thus, we tend to explain the inflammatory infiltration and the intimal thickening by the incompatibility of the material of the cuff (polyethylen, silastic) and by secondary infection.

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COOLING AND POSTSYNAPTIC ALPHA-ADRENERGIC RESPONSES IN MESENTERIC AND PULMONARY ARTERIES. J. Török, J. Kolárik, Institute of Normal and Pathological Physiology Slovak Academy of Sciences, Bratislava, Slovak Republic.

Experiments were performed to determine the effects of cooling from 37 °C to 24 °C on postsynaptic α_1 and α_2 -adrenergic receptors in isolated rings of rabbit mesenteric and pulmonary arteries. In the mesenteric arteries cooling enhanced isometric contractions induced by exogenous noradrenaline. It also enhanced the weak contractions elicited by the α_1 -adrenergic agonist clonidine in a partially depolarized solution. The contractions evoked by phenylephrine and KCl were not significantly affected. On the other hand, the contractions induced by all the tested agonists (noradrenaline, phenylephrine, clonidine, KCl) in the pulmonary artery were significantly depressed by cooling. These results show that activation of α_2 -adrenergic receptors found in the mesenteric artery may be responsible, at least in part, for the enhancement of noradrenaline-induced contractions by cooling.

THE EFFECT OF HAEMORRHAGIC HYPOVOLAEMIA ON REGIONAL BLOOD FLOWS DURING STIMULATION OF AFFERENT FIBRES IN THE SCIATIC NERVE. I. Bračková, M. Murín, Š. Kujaník, I. Linder, Department of Physiology, Medical Faculty, Safarik University, Košice, Slovak Republic.

Haemorrhagic hypovolaemia immediately shifts the vegetative balance in favour of sympathetic dominance, in consequence of which the extent, but also the quality of the blood pressure response to electrical stimulation of afferent fibres of sciatic nerve are changed. Local regulatory mechanisms are also involved in the blood re-distribution to the vital organs, together with reflex and hormonal regulatory mechanisms. In order to analyze these mechanisms, we studied the regional changes of blood pressure and blood flow in the common carotid artery (c.c.a.) and in the femoral artery (f.a.) during stimulation (1 mA) of afferent fibres of the sciatic nerve in normal animals and immediately after a loss of 10-20 % of total blood volume. The results of our experiments showed that the stimulation of the sciatic nerve in normal animals is accompanied by a decrease of blood pressure (-15 %), a decrease of c.c.a. (-20 %) and by an increase of f.a. blood flow (+13 %). After a 20 % loss of total blood volume, the pressure increased (+18 %), c.c.a. blood flow increased (+30 %) and f.a. blood flow decreased (-60 %), mainly in consequence of the prevalence of neuroreflex regulatory mechanism.

DYNAMICS AND COMPOSITION OF THE LYMPH IN DOGS WITH EXPERIMENTAL HYPERTENSION. M. Mojžešová, I. Béder, M. Kittová, A. Matášeje, Department of Physiology, Faculty of Medicine, Comenius University, Bratislava, Slovak Republic.

The lymphodynamics and the qualitative contents of the lymph withdrawn from the thoracic duct were studied in dogs with renovascular (n=14) and salt (n=11) hypertension. In comparison with the controls (n=24), the mean arterial blood pressure was significantly increased ($p<0.001$), in the group with renovascular hypertension by 67 % and in the group with salt hypertension by 28 %. The concentration of lymph-chlorides was increased significantly in the group with renovascular hypertension ($p<0.01$), the lymphatic concentrations of sodium, potassium and calcium were unchanged in both experimental groups. During experimental hypertension, the increased arterial blood pressure and unchanged oncotic pressure in the blood and in the lymph could be the cause of changes in pressure-oncotic balance and transcapillary exchange of fluids and electrolytes in each of the compartments.

EFFECT OF SHORT, REPEATED CORONARY ARTERY OCCLUSIONS ON ISCHAEMIC TOLERANCE OF THE DOG HEART. J. Snyk, I. Gabauer, V. Trégerová, D. Pancza, P. Kneppo, A. Ziegelhöffer, J. Slezák, Institute for Heart Research, Slovak Academy of Sciences and Institute of Measurement, Bratislava, Slovak Republic.

Multiple brief episodes of ischaemia followed by reperfusion, render the myocardium more resistant to subsequent severe ischaemia. This phenomenon has been termed ischaemic preconditioning (IP). Although the precise mechanism underlying IP is still to be established, there are already several reports suggesting its relevance for clinical practice. The authors observed that IP stabilized coronary outflow, decreased the incidence of ventricular arrhythmias by 30 %, ventricular fibrillation by 34 % and reduced the extent of the ischaemic area by 36 % after 3 repeated cycles of coronary artery occlusion (CAO)/release and subsequent test period (40 min CAO + 60 min reperfusion).

COMPOSITIONS OF CARDIAC PHOSPHOLIPIDS IN RATS ACCLIMATIZED TO INTERMITTENT HIGH ALTITUDE (IHA) HYPOXIA. O. Nováková, V. Pelouch, F. Novák, Department of Animal Physiology, ²Department of Biochemistry, Faculty of Natural Sciences, Charles University and ¹Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.

The purpose of our study was to estimate the changes of phospholipids in the chronically hypoxic myocardium. Adult male Wistar rats (70 days old) were exposed to IHA hypoxia (barochamber, stepwise up to 7000 m, 8 h a day, 5 days a week, total number of 32 exposures); phospholipids were estimated by two-dimensional TLC. IHA induced marked hypertrophy of the right ventricle (RV) and a significantly smaller left ventricular (LV) hypertrophy. The IHA-induced decrease of the concentration of total phospholipids was due to a decrease of phosphatidylcholine (PC) and diphosphatidylglycerol in both ventricles. Furthermore, the plasmalogen component of PC was increased in both ventricles (in RV by 79 %, in LV by 108 %). It seems that the IHA-induced changes of phospholipids together with protein remodelling contribute to the changes in functional performance of the hypoxic heart.

REPERFUSION-INDUCED ARRHYTHMIAS; AN INDEX OF CELLULAR DAMAGE OF VIABILITY OF CARDIOMYOCYTES ? T. Ravingerová, N. Tribulová, J. Slezák, Institute for Heart Research, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Reperfusion arrhythmias after 4 h of regional ischaemia in isolated rat hearts perfused with crystalloid solution (Langendorff technique) were characterized by mild symptoms (low VT and no VF). Coronary flow upon reperfusion recovered only partially (no-reflow). Electron microscopic investigation after 4 h of ischaemia revealed extensive deterioration of myocardial ultrastructure in the ischaemic zone as well as severely depressed intracellular enzymes activities detected histochemically, which were not restored during reperfusion. Oedema and damage to capillary endothelial cells could also be observed. On the contrary, reperfusion after 10 min of ischaemia resulted in a high incidence of arrhythmias (100 % of VT and VF), a hyperaemic response and preservation of ultrastructure. It may be concluded that low arrhythmogenesis could be related to irreversible tissue injury during 4 h ischaemia with subsequently impaired recovery of the heart function and the loss of intrinsic arrhythmogenicity in the myocardium upon reperfusion.

PARTICIPATION OF H₂O₂ IN MYOCARDIUM DURING THE RECOVERY PERIOD OF REPERFUSED ISCHAEMIC MYOCARDIUM. J. Slezák, N. Tribulová, J. Pristačová, B. Uhrík, P.K. Singal, Institute for Heart Research, ¹Institute of Molecular Physiology and Genetics, Slovak Academy of Sciences, Bratislava, Slovak Republic and ²St. Boniface Research Centre, Winnipeg, Canada.

Oxygen-derived free radicals (OFR), if accumulated, can be implicated as a cause of damage during reperfusion of the reversibly ischaemic myocardium. Injury to the heart muscle originating from a release of OFR can be reflected by sudden transitional depression in myocardial contractility during the first 2-3 min of the recovery period which is latter followed by gradual improvement of contractility after reaction of OFR with the endogenous defense system of the myocardium. The cytochemical study points to a more generalized localization of hydrogen peroxide in the ischaemic and/or reperfused myocardium. A specific fine granular precipitate of cerium perhydroxyde can be found randomly distributed throughout the myocytes and endothelial cells with the highest density confined to the glycocalyx of myocytes and abluminal surface of endothelial cells. The increased release of OFR in the early reperfusion period was shown cytochemically and by X-ray microanalysis by a greater density of cerium perhydroxyde deposits in the reperfused myocardium in comparison with normal or ischaemic tissue.

ENALAPRIL-INDUCED REDUCTION OF CARDIAC COLLAGEN IN CHRONICALLY HYPOXIC RATS. V. Pelouch, F. Kolář, F. Papoušek, B. Ošťádal, M. Milerová, J. Procházka, R. Čiháček, J. Widimský, Institute of Physiology, Academy of Sciences of the Czech Republic and ¹Institute of Postgraduate Medical Education, Prague.

The aim was to determine, whether long-term treatment with enalapril (an ACE inhibitor) can reduce the ventricular content of collagen during the period of spontaneous regression of cardiac hypertrophy, induced by high altitude hypoxia (IHA). Adult male Wistar rats were acclimated (A) to IHA (barochamber, stepwise up to 7000 m, 8 h per day, 24 exposures), then transferred to normoxic conditions and divided into two groups: a) treated with enalapril (100 mg.kg⁻¹ per day in drinking water) for 60 days and b) without enalapril treatment. The control (C) groups were subject to the same scheme. It has been found that enalapril significantly decreased systemic arterial pressure, the heart rate and left ventricular weight both in C and A rats. On the other hand, right ventricular pressure and weight were not affected. Furthermore, enalapril significantly reduced the content of collagen in both ventricles in C and A animals. Our results suggest that while the enalapril-induced decrease of the left ventricular weight is due to haemodynamic unloading, the reduction of ventricular fibrosis seems to be load independent.

INFLUENCE OF CALCIUM ANTAGONISTS ON RAT HEART SARCOLEMMA ATPases. A. Džurba, N. Vrbjar, A. Ziegelhöffer, Institute for Heart Research, Slovak Academy of Sciences, Bratislava, Slovak Republic.

The effect of Ca-antagonists, nitrendipine and flunarizine, on Mg²⁺, (Na⁺K⁺)- and (Mg²⁺,Ca²⁺)-ATPases was studied in the cardiac sarcolemma. Nitrendipine (10⁻⁶ mol.l⁻¹) exerted a stimulatory effect on the (Na⁺,K⁺)-ATPase activity. Kinetic analysis revealed a two-fold rise in V_{max} value and a lowered K_a value (by 50 %) for activation of the enzyme by sodium ions. Flunarizine (10⁻⁷–10⁻⁵ mol.l⁻¹) behaved as a non-specific inhibitor of all investigated sarcolemmal ATPases, but at the concentration 10⁻⁶ mol.l⁻¹ this drug only inhibited the (Na⁺,K⁺)-ATPase. These observed effects of the above drugs, particularly that of nitrendipine, might be of potential physiological relevance.

COSINOR ANALYSIS OF 24-HOUR BLOOD PRESSURE MEASUREMENTS IN HYPERTENSIVE PATIENTS WITH ENALAPRIL THERAPY. J. Dušek, J. Siegelová, B. Fišer, F. Halberg, G. Cornelissen, Third Department of Medicine, Department of Pathophysiology, Medical Faculty, Masaryk University, Brno and Chronobiological Laboratories, University of Minnesota, Minneapolis, USA.

Cosinor analysis (Halberg) of 24-hour blood pressure records (Accutacker II) was performed in 11 controls (C), in 9 patients with essential hypertension (EH) without therapy and in 8 patients with EH under enalapril treatment 10-20 mg/day (EH+E). Mean mesor (± S.D.) of systolic blood pressure was 122±8.1 in C, 146±8.6 in EH and 130±7.6 in EH+E, mean circadian amplitude was 11±7.4 in C, 13±7.5 in EH and 8.3±4.6 in EH+E (mm Hg). Correlation between mesor and amplitude in EH+E (R=0.65) was significant (p<0.05). The differences of diastolic blood pressure and heart rate were smaller. It is concluded that enalapril decreased not only the mean 24-hour value of blood pressure but also the amplitude of circadian variations.

24-HOUR BAROREFLEX SENSITIVITY MEASUREMENTS IN PATIENTS WITH ESSENTIAL HYPERTENSION. J. Siegelová, B. Fišer, J. Dušek, G. Cornelissen, F. Halberg, Department of Pathophysiology, Department of Physiology, Third Department of Medicine, Medical Faculty, Masaryk University, Brno and Chronobiological Laboratories, University of Minnesota, Minneapolis, USA.

The aim of the study was to examine baroreflex heart rate sensitivity (BRS) by computing the power spectral density of cardiac interval (I), systolic (SBP) and diastolic (DBP) blood pressure (the Peňáz method). We examined 8 patients with essential hypertension (I, WHO) (EH) and 10 controls (C) every 4 hours during a 24-hour period in the awake state. We found a decrease of SBP and DBP during the night in both groups (Wilcoxon, $p < 0.05$). Mean (\pm S.D.) BRS (ms/mm Hg) in C was 16.6 ± 2.3 during day, 21.9 ± 2.3 during night (significant increase in 4 subjects only), t-test, $p < 0.05$). BRS in EH was 17.1 ± 1.6 during the day, 15.4 ± 1.6 during the night. We conclude that a circadian variability of BRS in the awake state was not observed in EH patients.

NONINVASIVE DETERMINATION OF BAROREFLEX SENSITIVITY IN PATIENTS WITH MYOCARDIAL INFARCTION. N. Honzík, B. Fišer, B. Semrád, Department of Physiology, First Internal Clinic, Faculty of Medicine, Masaryk University, Brno.

The baroreflex heart rate sensitivity (BRS) was noninvasively determined by spectral analysis of cardiac intervals (I) and systolic blood pressure fluctuations (pressure recorded indirectly by the Peňáz method). Seven patients (P) 7-14 days after first signs of myocardial infarction and 14 healthy subjects (C) at rest and C after light exercise (0.5 W/kg body weight) were examined. Mean BRS (ms/mm Hg, \pm S.D) was 16.2 ± 4.8 and mean I (ms) 778 ± 7 in C at rest. Both BRS (4.0 ± 2.3) and I (695 ± 177) were significantly lower in P (Wilcoxon, $p < 0.05$). BRS and I decreased in C during exercise (BRS: 5.8 ± 3.3 ; I: 618 ± 52). The difference of BRS between P at rest and C after exercise is not significant, but in some P BRS was lower than 2 ms/mm Hg despite a relatively long I. It is concluded that the lower BRS in P is related to the increase of heart rate but, in some cases, a low BRS at relatively low heart rate could be observed.

NEONATAL BP AND HR RESPONSES TO UPRIGHT AND PRONE POSITION IN RELATION TO THEIR RESTING VALUES. O. Andrásyová, E. Kellerová, Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

With the aim to analyse the character of BP and HR responses to a change of body position in relation to their basal values 186 full-term neonates, birth weight 3387 ± 486 g, aged 2 days were investigated. The BP and HR were measured respectively in the supine and prone positions and during the first minute after lifting the baby in the upright position. The analysis of the BP and HR reactions to both changes in body position showed that 64 % of babies reacted by an increase, 30 % by a decrease of at least one of the investigated parameters on the average. No changes were found in 6 % of the neonates. The resting basal values of BP, 62, BP_{avg} 35 mm Hg and HR $119 \cdot \text{min}^{-1}$ were lower on the average ($P < 0.001$) in neonates reacting by an increase, in comparison to BP 70 and 40 mm Hg (values close to the 90th percentil) and HR $127 \cdot \text{min}^{-1}$ in those who reacted by a BP and HR decline. The simultaneous positional rise of all indexes was observed in 33 % and a decline only in 4 % of subjects. We conclude that, in the early postnatal period, the hypertonic type of reaction to head-up and prone position predominates and that the character of the reaction is related to the resting BP and HR.

VI. Neuroopathology

GALVANIC VESTIBULO-POSTURAL RESPONSES INFLUENCED BY VIBRATORY STIMULATION OF LEG MUSCLES. F. Hlavačka, M. Křížková, O. Bodor, Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Body tilts induced by galvanic stimulation of the vestibular system in human stance were recorded with a stabilometric force platform. Vector directions of these reproducible postural responses were modified by artificial changes of proprioceptive information from leg muscles. Bipolar binaural galvanic stimulation with single sinusoidal pulses (intensity 2 mA, $f = 0.3$ Hz) was used during stance. Vibratory stimulation (step $t = 5$ s, $f = 90$ Hz, $\text{ampl. } 1$ mm) of lower leg muscles was used to change the proprioceptive input. The results showed that the orientation of the evoked body tilts was determined by proprioceptive and vestibular inputs. In the presence of leg muscle vibration, the direction of the galvanic postural responses was changed and their amplitudes were increased. The body tilt vector induced by combined vibratory and galvanic stimulation could be considered as vector summation of the responses evoked by galvanic and vibratory stimulation alone. Within a limited range, the results showed some indications of a linear interaction of vestibular and proprioceptive inputs in the spatially oriented action of the equilibrium control system.

PARAMETERS OF STABILOMETRY WITH GALVANIC VESTIBULAR STIMULATION IN PILOTS. M. Sázel, Institute of Aviation Medicine, Prague.

Results of stabilometric measurements of upright posture have been studied in 69 young aviators. The subjects stood on a 10 cm thick foam rubber on a stabilometric platform. Later galvanic vestibular monoaural monopolar sinusoidal stimulation was applied (± 1 mA; 0.2 Hz; 40 s). Differences were found between responses without stimulation and normal stabilometric parameters (1) in the sagittal axis of movement. The differences are apparently caused by intensive vestibular training in aviation practice. The effect of the frequency of stimulation on the stability of the response were considerable ($p < 0.00001$). The coherence between parameters with or without galvanic stimulation was significant (min. $p < 0.002$). The results are also compared with those in a flight simulator (2).

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A STABILOMETRIC STUDY OF HEALTHY SUBJECTS. D. Valová, B. Tydlitát, Faculty of Physical Education and Sports, Charles University, Prague.

Five Romberg tests were performed in each investigated subject for a stabilometric study (in a wide, standard and close double feet posture, in single feet postures). Two studies were made of the recorded data with the aim to obtain mean values of the parameters in healthy subjects and to specify in two subgroups differences the using stepwise discriminant analysis. A set of 52 healthy subjects was subdivided in the first study into two groups according to sex and in the second study also into two groups according to age (age below 30 and above 30 years). From the scatter-plot of the first two canonical variables it follows: that in the first study, the described groups should be separable in single foot postures, where the female group parameters have lower values (better stable properties) in these postures. In the second study described, the groups should be separable in the double feet close posture test, with better stable properties of the younger subjects.

RESPONSES OF NEURONES IN THE INFERIOR COLICULUS OF THE GUINEA-PIG TO VOCALIZATION SIGNALS. *L. Aitkin, J. Syka¹, J. Popelář¹, E. Kvašňák¹*, Department of Physiology, Monash University, Melbourne and ¹Institute of Experimental Medicine, Academy of Sciences of the Czech Republic, Prague.

Responses of neurones in the inferior colliculus (IC) to different acoustic stimuli were evaluated in ketamine-xylazine anaesthetized guinea-pigs. Pure tone pips, white noise pips and four types of guinea-pig natural calls were used. About two thirds of the neurones responded to tones or noise stimuli with a sustained type of response, the remaining third had an onset response. In almost 60 % of units, nonmonotonic rate/level functions (RLF) were present when pure tones were used, the nonmonotonic type of RLF was less pronounced to white noise. One half of neurones responded to all four types of calls. About 25 % responded to 3 calls and 16 % reacted to 2 calls only. Units localized in the external cortex of the IC usually reacted more frequently to purr than the neurones in the central part of the IC.

FUNCTIONAL MAPPING IN THE INFERIOR COLICULUS OF THE GUINEA-PIG. *J. Syka, J. Aisl, J. Popelář, R. Druga¹*, Institute of Experimental Medicine, Academy of Sciences of the Czech Republic and ¹Department of Anatomy, First Medical Faculty, Charles University, Prague.

Electrophysiological mapping has been used to study the frequency representation and distribution of response characteristics to acoustic stimulation in the inferior colliculus (IC) of the guinea-pig. The central nucleus, dorsal and external cortices of the IC are tonotopically organized according to a relatively uniform plan. The isofrequency layers tilt from medial to lateral and from caudal to rostral. Independently of the CF, most sharp tuning curves (with the highest Q_{10} values) occupy the central parts of the IC. The lowest values of Q_{10} were observed in the external and dorsal cortices. Similarly, the longest latencies to CF stimuli were observed among neurones of the dorsal and external cortices. Neurones with the excitatory-inhibitory type of binaural interaction were present more frequently among high-frequency neurones (i.e. in the more ventral and medial parts of the IC). Tonotopic organization of the IC has been correlated with the distribution of cytochrome oxidase activity.

AUDITORY CORTEX EVOKED RESPONSES TO ELECTRICAL STIMULATION OF THE COCHLEA IN THE CAT. *J. Popelář, J. Syka, R. Hartmann¹, R. Klinke¹*, Institute of Experimental Medicine, Academy of Sciences of the Czech Republic, Prague and ¹Zentrum der Physiologie, J.W. Goethe Universität, Frankfurt am Main, Germany.

Auditory cortex evoked responses (ACER) to electrical stimulation (ES) of the inner ear were recorded in anaesthetized cats. The ES threshold decreased with increasing frequency in normally hearing animals and increased in deaf animals. The shape and amplitudes of ACER to acoustical stimulation were dependent on the frequency of the acoustical stimuli and at the recording place of the auditory cortex. Similar place-frequency dependent responses were obtained with electrical stimulation of the intact ear. After sensory hair cell destruction by neomycin, the ACER to extracochlear electrical stimulation were almost uniform when recorded at different cortical places and to different ES frequencies. However, the differences in ES thresholds, waveshape morphology and amplitude-intensity functions were observed with bipolar ES using multichannel intracochlear implant. It is assumed that the recording of the cats ACER can be used for more detailed investigation of the stimulus coding strategies with multichannel intracochlear prostheses.

DOES SPATIAL INFORMATION ENTERED INTO THE COGNITIVE MAP INFLUENCE THE RAT'S NAVIGATION IN A CHARTED ENVIRONMENT ? *O. Burešová, J. Bureš*, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.

Place navigation is believed to be implemented by neural representation of the complex relationships between the animal, goal and external landmarks. The possibility to improve the rat's navigation by showing it the position of the target on a map of the environment was tested. In Experiment 1, a water deprived rat was trained to find a water spout in an array of 9 covered wall openings. After learning this task, the rat had to find the target in an open field with a similar array of 9 covered drinking cups. In Experiment 2, the rat learned to find the baited cup in a small open field and was then transferred into a larger open field with the same configuration of 9 cups. Whereas no transfer from the vertical "map" to the horizontal "world" was found in Experiment 1, the improvement of the rat's capability to find the target was inversely related to the change of scale in Experiment 2. It was maximal for the map-world ratio of 1:1.2 but approached random choice when this ratio increased to 1:2.5. The above result can be explained by a conflict between the mapping and snapshot memory based navigation modes.

A NON-VISUAL COMPONENT OF THE PERFORMANCE IN THE MORRIS WATER MAZE. *L. Nerač, M.P. Arolfo¹, J. Bureš*, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague and ¹Departamento de Farmacología, Universidad Nacional de Córdoba, Argentina.

Rats swimming in the Morris water maze can learn to find the underwater escape platform by three mechanisms: 1. Under constant light conditions and a variable place of release the rats establish and use a cognitive map. 2. Under conditions of fixed points of release the rats can learn visual cues for a guided swim and/or 3. tactual cues for bouncing off from the wall in the right direction. In case of learning the task in the light and the test carried out in the dark, the question arises as to how much of incidental tactual learning had occurred in the light. Ten rats were trained for 11 days (12 trials/day) with the visual cues were available at the time of release from four places on the wall. The position of the platform was constant. On the last day of training they did not miss the platform during the initial direct swim after the release in 9.1 ± 0.8 (mean \pm S.E.M.) out of 12 trials. On the test day (in the dark), their hit rate dropped to 4.3 ± 0.7 . This difference was significant at a level of $p < 0.001$. More importantly, the performance of these animals was above the level achieved for a novel platform position in the dark (2.2 ± 0.4 , $p < 0.005$). We conclude that the navigation task with constant points of release leads to learning of a non-visual, map-independent, solution. The extent to which this kind of response is employed depends on the availability of visual cues at the time of release.

DIFFERENTIAL EFFECT OF THE BLOCKADE OF NMDA GATED CHANNELS ON VARIOUS PHASES OF CONDITIONED TASTE AVERSION LEARNING. *E. Bieleuská, J. Bureš*, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.

The universality of the role of NMDA-gated channels in plastic phenomena was examined in case of conditioned taste aversion (CTA). An i.p. injection of the non-competitive NMDA antagonist ketamine prevented the formation of CTA to systemically applied saccharin (2 % solution, 1 % b.w. i.p.) followed 2 h later by LiCl (0.15 M, 2 % b.w.) at 25 to 200 mg/kg but not at 6 or 12 mg/kg. The CTA acquisition was not disrupted when ketamine anaesthesia (100 mg/kg/h) was elicited after saccharin drinking, but before LiCl injection and maintained during 3 h. Infusion of ketamine (1 or 5 %, 8 μ l/2h) into the parabrachial nucleus (PBN) did not prevent CTA formation when applied between the gustatory CS (0.9 % NaCl) and the visceral US (LiCl). Similarly ineffective was the PBN injection of MK-801 (1 to 2 μ l of 0.1 % solution) applied through chronically implanted cannulas either 10 min before or 10 min after the gustatory CS. It is concluded that the NMDA receptor gated channels contribute to the formation of the short-term gustatory trace but are not indispensable for its association with the visceral signals of poisoning.

OSCILLATIONS OF THE VELOCITY OF OPTOKINETIC NYSTAGMUS PURSUIT COMPONENT AT CONSTANT VELOCITIES OF VISUAL STIMULI MOTION. *V. Zikmund, F. Jagla, J. Kunderát*, Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Optokinetic stimuli with velocities of either 30° s^{-1} (4.0, 2.0 and 1.0 Hz respectively) or 50° s^{-1} (6.6, 3.3 and 1.7 Hz) moving either to the right or to the left were presented to a group of subjects with normal vision. Each combination of stimuli lasted 4 min with about 20 s breaks in each subject. The angular velocity of the tape recorded optokinetic nystagmus (OKN) component was evaluated at 1, 3, 5 and 10 s intervals, respectively, by means of the ANALOKN ver. 01 Programme elaborated by the third author on the type PC/AT computer. A marked decrease of the OKN pursuit component velocity was found during the first 30 s of stimuli perception and it was followed by more or less pronounced oscillations. The angular velocities of the OKN pursuit components were markedly lower at the end of approximately 50 min lasting examination as compared to its beginning. The results are discussed from the point of view of the visual attention level oscillations.

THE PREDICTION OF A VISUAL STIMULUS UPON SACCADIC EYE MOVEMENT RELATED POTENTIALS. *F. Jagla, V. Zikmund*, Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

The potentials related to horizontal saccadic eye movements evoked by a visual stimulus (0.5° target) were registered over the occipital, parietal, central and frontal cortical areas (17, 7, 4 and 8 areas respectively) of both hemispheres separately in a group of pronounced right-handers with normal vision. The correlates of the preparation and programming of the saccades (PMN, PMP), of their proper execution (MEP), and of the primary encoding of new visual stimuli (LR) were evaluated. The results were compared under two experimental conditions: 1. during the rhythmical presentation of the visual target (2 s intervals) and 2. by its irregular presentation (2-5 s intervals). As the most pronounced difference, the appearance of premotion negativity (PMN) was found mainly over the frontal areas when the visual target was presented at irregular intervals.

RECOVERY CYCLE OF MUSCLE REFLEX RESPONSES. *F. Podivinský, V. Konček, M. Jergelová*, Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Short (SLRs) and long latency muscle reflexes (LLRs) from a weakly active interosseus dorsalis I muscle were recorded after paired bifocal peripheral nerve stimulation with varying interstimulus time intervals (ISI) from 1 to 5000 ms in healthy human subjects. An electrical conditioning stimulus was applied to the index finger and test stimulus to the median nerve at the wrist. With intervals from 1 to 5 ms, the amplitude of the SLR and LLRs following the second stimulus varied around that evoked by a single stimulus, possibly due to transmitter depletion at these short ISIs. With intervals of 10 ms and longer, the test responses progressively became greater, probably due to temporal summation and some release of the transmitter substance after the conditioning cutaneous stimulus. All the recovery curves returned to the control value at 2000 ms and 3000 ms ISI, respectively. These results indicate that the interaction phenomena did not take place when paired stimulation was applied bifocally.

ROLE OF DEPOLARIZATION AND CALCIUM IONS IN THE INHIBITION OF ACETYLCHOLINE RELEASE BY PRESYNAPTIC MUSCARINIC AUTORECEPTORS. *V. Doležal, S. Tuček*, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.

Presynaptic muscarinic autoreceptors on cholinergic nerve terminals are known for their ability to inhibit the release of acetylcholine (ACh) but the mechanism of their action is unknown. It has been suggested that they act by inhibiting the influx of Ca^{2+} into the terminals. We have measured the effect of muscarinic agonist oxotremorine (OT) on the release of $(^{14}\text{C})\text{ACh}$ from rat cerebrocortical prisms at different concentrations of Ca^{2+} . The inhibitory effect of OT on the release induced by 14 or 26.5 mmol/l K^+ could not be overcome by raising the concentration of Ca^{2+} to high levels. The effect of OT was absent at any Ca^{2+} concentration when 65 mmol/l K^+ was used to stimulate the release. Our observations suggest that the restriction of Ca^{2+} entry is not the sole mechanism of receptor-mediated inhibition of ACh release; an additional voltage-dependent mechanism is apparently involved.

COMPARISON OF EFFECTS OF DENERVATION AND NEUROTOXINS (BoTX, TTX) ON ACETYLCHOLINE RECEPTOR EXPRESSION ALONG THE MUSCLE FIBRE IN RATS. *G. Bezáková, T. Lömo*, Department of Biochemistry, Jesenius Medical School, Comenius University, Martin, Slovak Republic and ¹Institute of Neurophysiology, University of Oslo, Norway.

The way in which motor nerves control the properties of muscle fibres outside the neuromuscular junction region has been extensively studied. However, careful quantitative comparisons along the muscle fibre in denervated and neurotoxin-treated muscles have not been done. We have found an increased AChR expression around the neuromuscular junction after denervation *in vivo* (surgical denervation) and *in vitro* (organ culture). However, the AChR expression in the proximity of the neuromuscular junction after application of neurotoxins was much lower. These differences in the effects of denervation and neurotoxins might have been either due to the liberation of a trophic substance from the motor nerves in the neurotoxin-treated muscles or due to some factor associated with the presence of degenerating nerves.

DECREASE OF EXTRACELLULAR CATECHOLAMINE CONTENT IN THE RAT BRAIN CORTEX DURING EPILEPTIC ACTIVITY AS EVIDENCED BY *IN VIVO* VOLTAMMETRY. *J. Pavlášek, P. Mareš, M. Haburčák, C. Mašánová*, Institute of Normal and Pathological Physiology, Slovak Academy of Sciences, Bratislava, Slovak Republic and ¹Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.

Differential pulse voltammetry was used in anaesthetized rats to test the influence of epileptic activity (AE) induced by Penicillin-G-Natrium (PNC-G-Na) on the catecholamine (CA) content in the parietal cortex (PC). After application of PNC-G-Na and during EA (verified by electrocorticography), the nonlinear decrease of CA (logarithmic time course: $f(t) = a + b \ln(t)$, $a = 95$, $b = -5.75$) to about 76-80 % of the baseline (experiments without application of PNC-G-Na) was observed. 2-3 min after the PNC-G-Na application, all voltammetric values were significantly different ($P < 0.05$, $n = 4$). Our results are in accord with the observations made in the corpus striatum (1).

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AMNIOTIC FLUID CHOLINESTERASES AS THE DIAGNOSTIC MARKER OF CONGENITAL NEURAL TUBE DEFECTS. Ž. Malatová, Š. Lukačín¹, M. Čelovský¹, B. Fialová¹, Institute of Neurobiology, Slovak Academy of Sciences and ¹Department of Obstetrics and Gynaecology, Faculty of Medicine, Šafárik University, Košice, Slovak Republic.

Alpha-feto protein (AFP) measurement in amniotic fluid (AF) is the generally accepted diagnostic test for neural tube defects (NTD). Because of its nonspecificity and occasional false positiveness, acetylcholinesterase (AChE) activity in AF, an enzyme of neuronal origin, has been shown to be a specific marker for NTD. The parallel assay of nonspecific butyrylcholinesterase is also of diagnostic value. The AChE/BChE ratio could distinguish among NTD, ventral wall defects, other foetal defects and pregnancy problems. Samples of 260 AF were investigated after 16 weeks gestation. Six cases of NTD were positively found by AChE, BChE and AFP, including 3 cases of anencephaly, one open spina bifida, one acranium and one meningomyelocele. The diagnosis of NTD with a positive AChE result was 100 %. In 2 cases, a positive AFP test and high BChE activity were associated with ventral wall defects. The results indicated that the determination of AChE and BChE activities in AF samples could serve as a routine screening method for the detection of NTD.

STIMULATORY AND INHIBITORY EFFECTS OF IVERMECTIN ON GABA-INDUCED Cl^- CURRENTS IN EMBRYONIC MOUSE HIPPOCAMPAL CELLS. H. Zemková, J. Kráček, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.

The anthelmintic drug ivermectin has been shown to stimulate GABA-induced chloride currents in voltage-clamped *Xenopus oocytes* injected with mRNA from the chick brain (1). We studied the effect of ivermectin, a synthetic derivative of avermectin B_{1a} , on GABA-induced Cl^- currents in cultured embryonic hippocampal cells using the patch clamp technique in whole cell configuration. After 60 s of 10^{-7} M ivermectin application the responses to 2 μM GABA were enhanced to 273.0 ± 45.7 % of control values, but the maximal currents induced by high doses of GABA were slightly reduced to 83.6 ± 9.2 %. The value of K_D for GABA was lowered from 11.9 ± 4.7 μM to 2.4 ± 1.5 μM . After 10 min of ivermectin action, the 2 μM GABA responses were enhanced only to 146.2 ± 52.1 % and the maximal GABA-induced Cl^- current was reduced to 42.6 ± 19.8 %. The value of K_D for GABA did not change further. Both the potentiating and the inhibitory effects were irreversible.

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HETEROGENEITY IN THE MEMBRANE CURRENT PATTERN OF IDENTIFIED GLIAL CELLS IN RAT SPINAL CORD SLICES. A. Chvátal, A. Pastor¹, M. Mauch¹, E. Syková, H. Kettenmann¹, Institute of Experimental Medicine, Academy of Sciences of the Czech Republic, Prague and ¹University of Heidelberg, Heidelberg, Germany.

Using the whole-cell patch-clamp technique, membrane current properties of glial cells were studied in spinal cord slices of 5 to 12-day-old rats. Based on the membrane current pattern, we distinguished four glial cell types. The first was characterized by passive K^+ currents activated both in the depolarizing and hyperpolarizing directions. A second population exhibited a similar current pattern, but with a decay of the current. In a third population, the decaying passive currents were superimposed with a delayed rectifier outward current. The fourth population expressed delayed rectifying outward currents and fast inward currents activated by depolarization. All types of cells expressed GABA-activated Cl^- currents. The third and fourth populations exhibited the A-current. The fourth population of glial cells expressed voltage-gated Na^+ currents. To identify the glial cells, they were filled with the fluorescent dye, Lucifer Yellow, and examined morphologically in the optical fluorescent microscope. The first and second types of cells showed astrocyte and oligodendrocyte-like morphology respectively, while the fourth type of glial cells expressed oligodendrocyte precursor morphology.

CHANGES IN PROPERTIES OF GLIAL CELLS IN WHITE MATTER DURING POSTNATAL DEVELOPMENT COINCIDE WITH THE CHANGES IN EXTRACELLULAR SPACE VOLUME. E. Syková, T. Berger¹, A. Chvátal, A. Lehmenkühler², H. Kettenmann¹, Institute of Experimental Medicine, Academy of Sciences of the Czech Republic, Prague, Czech Republic, ¹University of Heidelberg, Heidelberg and ²University of Münster, Münster, Germany.

Rat corpus callosum slices were used as a model of CNS white matter. The time course of the extracellular space (ECS) volume reduction and the changes in the physiological properties of glial cells were studied during postnatal development, i.e. in the myelinated versus the unmyelinated tissue. Diffusion parameters were studied by quantitative analysis of concentration-time profiles of TMA⁺ and glial cell properties by the whole-cell patch-clamp technique. The large ECS volume fractions $\alpha = 0.38 \pm 0.02$ ($n=29$) were found in 10-day-old animals. In 20-day-old rats the $\alpha = 0.19 \pm 0.01$ ($n=14$). Oligodendrocytes on day 20 were characterized by passive, decaying currents and large tail currents after the offset of a voltage jump. The decay was due to a change in the transmembrane K^+ gradient. On the other hand, glial precursor cells were predominantly characterized by a delayed rectifier K^+ current. We conclude that membrane de- or hyperpolarizations of oligodendrocytes, but not precursor cells, are accompanied by rapid changes in the K^+ gradient due to K^+ changes in ECS. This implies that the membrane potential of the oligodendrocytes can control the K^+ homeostasis in ECS.

CENTRAL EFFECT OF DOPAMINE ON THE RAT EEG SPECTRUM. J. Mysliveček, J. Záhřava, J. Barcal, Institute of Pathological Physiology, Medical Faculty, Charles University, Plzeň, Czech Republic.

The central effects of monoamines, namely dopamine, have repeatedly been studied in the literature (cf. 1, 3). The effect of dopamine on memory processing in the rat during the early postnatal period was described by us (2). The effect of dopamine (in microgram doses) given into a lateral cerebral ventricle on the EEG spectrum in adult conscious immobilized rats (a local anaesthetic Procain, Spofa, was applied every 40-50 min to all wounds during the experiment), or in rats under equithesine anaesthesia, is described here. The EEG response on the side of application and on the contralateral side were compared. A rise of the frequent components of the EEG spectrum (beta waves) with an amplitude increase by the 10th minute after dopamine administration was the main finding. With a higher dose, a further frequency increase took place between the 45th and 60th minute. Possible mechanisms of this action are being considered.

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THE INTERACTION OF NMDA AND Na^+ -NITROPRUSSIDE DURING ACTIVATION AND DEPRESSION OF SPONTANEOUS MOTILITY IN CHICK EMBRYOS. J. Sedláček, Institute of Physiology, First Faculty of Medicine, Charles University, Prague.

A) In the generator of spontaneous motility (spinal and supraspinal) of chick embryos a NMDA-sensitive mechanism develops which evokes a paroxysmal activation of motility. B) Na^+ -nitroprusside (Nssp) (20 mg/kg e.w. systemic administration) as a donor of NO significantly depressed spontaneous motility. This effect is age-dependent. C) Nssp blocked the effect of NMDA in all cases of co-administration (successively in 10 min interval or simultaneously), mostly if it precedes NMDA. D) The marked effect of Nssp is further evidence of the development and existence of a NMDA-sensitive mechanism in the embryonic CNS, on the other hand it is the first proof of the functional activity of a mechanism operated with NO synthesis in embryonic brain tissue.

COMPARISON OF EFFECTS OF DISCRETE MOTOR AND SOMATOSENSORY CORTEX LESIONS ON REACHING IN RATS. *M. Šaling, T. Siďurov, Institute of Normal and Pathological Physiology, Bratislava, Slovak Republic.*

Ablation of the sensorimotor cortex in rats results in a persistent motor deficit in reaching (1). The aim of our study was to examine the effects of discrete somatosensory (SC) and motor (MC) cortex lesions on reaching in rats. The coordinates for the SC lesion were: anterior-posterior to bregma -1 mm and +1.5 mm, lateral to midline 3-4.5 mm; for the MC lesion AP 0.5-3 mm, L 1.5-3.5 mm. Reaching was analyzed by continual monitoring of movement using magnetic induction. The MC lesion impaired forelimb extension and the ability to penetrate into the tube accompanied by "mirror" movements of the non-preferred forepaw. Modulation of reaching behaviour by grasping success was impaired by the SC lesion. After a period of prolonged duration of the grasping phase, the preference of some variant of reaching behaviour (double or a series of attempts) have been seen. Reaching control was characterized by anticipatory signs. The obtained results showed that the execution and control of reaching was differently influenced by the SC and MC lesions.

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CAPSAICIN-INDUCED MEMBRANE CURRENTS IN RAT CULTURED SENSORY NEURONS. *L. Vyklick, V. Vlachov, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague.*

Membrane currents induced by capsaicin (8-methyl-N-vanillyl-6-nonanamide) were studied in rat cultured sensory neurones. Responses to capsaicin (10 μ M) were found in smaller, usually bipolar or tripolar neurones in which GABA (30 μ M) induced a small or no response. In contrast to GABA, responses to capsaicin exhibited a slow rise and slow decay and a marked decrease after repeated capsaicin applications at high concentrations. The slope of the ascending phase was concentration dependent with an apparent association rate constant $K_1 = 9 \times 10^4$ [M \cdot s $^{-1}$], while the time constant of the decay was concentration independent. The single channel conductance of capsaicin gated channels was 28 pS. It is suggested that the capsaicin gated channels represent either receptors with a very high affinity or the channels are controlled by membrane bound protein(s) which do not depend in their function on a fast supply of GTP or other intracellular metabolites.

THYROLIBERIN (TRH) SECRETION BY MEDIAN EMINENCE (EM) AND HYPOTHALAMIC PARAVENTRICULAR NUCLEUS IN VITRO. *M. Nikodmov, V. Šrbk, Institute of Experimental Endocrinology, Slovak Academy of Sciences, Bratislava, Slovak Republic.*

To investigate specific hypothalamic functions we have developed an original method for the study of TRH secretion from the EM and PVN *in vitro*. Our approach is based on the fact that TRH, involved in thyrotropin regulation, is synthesized in the PVN and released into portal blood at the level of the EM. After decapitation (male Wistar rats, BW 240-300 g) the brain was removed and the EM was dissected free. After frontal section at the level of the optic chiasma, the PVN on the one side was cut free with the help of microscissors under a microscope. The rest of the brain served for histological control. After a 30 min preincubation period the tissues were incubated 4 times 30 min in the Locke's solution at 37 °C. The amount of released TRH increased with the number of PVN or EM present in the incubation medium. Depolarization induced by 56 mM KCl in the 2nd and 4th incubation increased the release of TRH abruptly. The release of TRH studied by this approach was 10 times higher compared to that determined by traditional incubation of hypothalamic fragments.

THE PRINCIPLE OF ALLOMETRY IN ORGANIZATION OF THE VOCABULARY OF NEURONAL ACTIVITY. *D. Svorad, A. Pľvanov, Institute of Molecular Physiology and Genetics, Slovak Academy of Sciences, Bratislava.*

1. Huxley has proposed a method of studying the growth of organs or parts of an organism, which consists of plotting the logarithm of some measurement of the organ or a part, Y, against the logarithm of a measurement of the whole, the remainder, or another part, X, ($Y=bX^k$). The slope of the resulting curve, $d \log Y/d \log X$, is termed the allometric coefficient (cf. 3). This study attempts to apply this principle to the vocabulary of neuronal activity (VNA; 2). 2. Interimpulse intervals of unit activity (extracellular recording of the rat caudate nucleus) were extracted and used for construction of a frequency VNA. 3. The slope of the resulting rank-size curve of the VNA is allometric which differs from the isometric shape of a language vocabulary (1).

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VII. Immunology

IMMUNE RESPONSE IN COLD EXPOSED AND COLD ADAPTED MEN. *L. Jansk, H. Jankov, S. Honzov, P. Šrmek, Faculty of Science, Faculty of Physical Education and Sports, Charles University, and Faculty Hospital, Prague.*

Changes in humoral and cell immunology parameters were studied in a group of 10 young sportsmen following headout immersion to cold water (15 °C for 1 hour) (cold exposure - CE) and following repeated immersion performed 3 times a week during a period of 6 weeks (cold adaptation - CA). CE induced a small (10-20 %) increase in antibody production (IgM, IgA, IgG) and in total leukocytosis. The amount of immunocompetent cells was increased and the complement system (C_3 , C_4) was activated to a similar extent. Other parameters of clinical immunology were not influenced. After CA, the resting level and the cold-induced antibody production were further potentiated. System of the complement was not further activated by CA, however. It is concluded that the intensive cold stress can induce small activation of the immune response in healthy men. Repeated stress further activates the immune response.

THE PROLIFERATIVE RESPONSE OF LYMPHOCYTES IS MODULATED BY SHORT-TERM ENHANCEMENT OF NOREPINEPHRINE BUT NOT GROWTH HORMONE AND PROLACTIN IN THE PLASMA OF NORMAL MEN. *E. Jurnkov, D. Jeřov, M. Vigař, Institute of Experimental Endocrinology, Slovak Academy of Sciences, Bratislava, Slovak Republic.*

The effects of selective short-term enhancement of plasma prolactin, growth hormone and norepinephrine on the proliferative response of lymphocytes were studied in healthy male volunteers using whole blood mitogen assay. We failed to demonstrate any effect of elevated plasma growth hormone levels after clonidine challenge on the capacity to proliferate *in vitro* in response to mitogens. Similarly, our results did not reveal any effect of elevated plasma prolactin concentrations induced by domperidone administration on the immune test. The exposure of volunteers to cold resulted in an elevation of plasma norepinephrine levels without changes in growth hormone, epinephrine or cortisol secretion. After the cold exposure, a reduction of the lymphoproliferative response was found to suboptimal doses of PHA. The reduction was significant 180 and 240 min after the exposure. These results support the hypothesis that stress-induced norepinephrine release in man has an immunomodulatory effect.

DEVELOPMENT OF HELPER (CD4) AND SUPPRESSOR (CD8) T LYMPHOCYTE SUBPOPULATIONS IN PIG FOETUSES. F. Kovář, H. Kovář, Z. Fišar, J. Filka, Institute of Physiology, School of Veterinary Medicine, Brno, ¹Institute of Animal Physiology and Genetics, Academy of Sciences of the Czech Republic, Liběchov and ²Research Institute of Psychiatry, Faculty of Medicine, Charles University, Prague.

We analyzed the distributions of individual T lymphocyte subpopulations during pig foetal development using flow cytometry (FACS) and immunofluorescent microscopy with monoclonal antibodies and subsequent detection by FITC or PE conjugates. In the thymus, we demonstrated the presence of CD4⁺ and CD8⁺ on day 51 of gestation with a marked increase in their number as a function of foetal age. On the other hand, in the spleen only CD2⁺ lymphocytes were demonstrated on day 51. CD4 and CD8 phenotype expression was found on spleen lymphocytes starting on day 60 with a rapid increase of their number with age (whether expressed in relative or absolute terms). The CD4/CD8 ratio of T lymphocytes in both the spleen and thymus decreased during development its value being around 1 at the time of delivery, with a slightly dominant CD4 lymphoid subpopulation. In lymph nodes, CD8 lymphocytes were dominant at the time of birth (CD4/CD8 index = 0.85) which is typical for T lymphoid population in adult pigs.

EFFECT OF MORPHINE ON LEUKOCYTE DIAPEDESIS IN RATS. J. Luža, Institute of Physiology, Faculty of Medicine, Palacký University, Olomouc, Czech Republic.

Nonspecific immune functions of leukocytes (WBC), monocytes (MO) and polymorphonuclears (PMN) take place mainly extravascularly in tissues, so that the ability of diapedesis is a prerequisite for the development of processes of nonspecific immunity. In our previous papers (1) we reported on the immunomodulatory effect of morphine *in vitro*. In the present report, the effect of morphine has been studied on the initial phase of inflammation *in vivo*. Polyurethane sponges (circular disks 12x5 mm) soaked in either 0.9 % saline or morphine (0.5 %) dissolved in 0.9 % saline were implanted s.c. in rats (330±50 b.wt.), and after 4 h, the count of WBC was determined in exudates, and their type characteristics, phagocytic activity and adherence were examined. Morphine was found to affect diapedesis of PMN negatively (a decrease by 40 %) and also to decrease the adherence PMN. The phagocytic activity of PMN and MO was not decreased in the exudate.

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VIII. Physiology of Respiration

EFFECTIVE DEAD SPACE AND VOLUNTARY CHANGES OF TIDAL VOLUME. V. Šmejkal, J. Radvanský, Institute of Pathological Physiology, and ¹Clinic of Sport Medicine, Second Faculty of Medicine, Charles University, Prague.

To estimate the influence of cortical control of breathing on the values of effective dead space (V_D) (1) we measured the tidal volume (V_T), rate of breathing, expiratory and end-tidal partial pressure of CO₂ (Oxycon Beta Mijnhardt) in 11 healthy subjects of both sexes during control respiration and during 2 min of respiration with V_T voluntarily increased or decreased. Voluntarily increased V_T rose to 435 % of its control value in men and to 429 % in women. With deeper V_T the absolute value of V_D increased, with shallower V_T it decreased. Control V_D/V_T ratio was 26 % in men and 28 % in women, with voluntarily higher V_T it was 20 % in both sexes, with voluntarily lower V_T 37 %.

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HIGH FREQUENCY JET BRONCHOALVEOLAR LAVAGE (HFJL). A. Čalkovská, K. Javorka, V. Škoda, O. Brychta, V. Záborský, Department of Physiology, Jesenius Faculty of Medicine, Comenius University, Martin, Slovak Republic, ¹Regional Hygienic Institute, Ostrava, ²Medinex, Trenčín and ³Institute for Care of Mother and Child, Prague.

Effect of HFJL was tested by intrapulmonary instillation of silica particles. The silica particles (5 µm in diameter, 20 mg/kg b.w.) were introduced through a tracheal cannula into the lungs in saline by the impulsion effect of HFJ ventilation in 50 anaesthetized rabbits. The next day, the same amount of saline (without silica) was applied into the lung by the impulsion regime and then the animals were ventilated at different inspiratory : expiratory time ratio of HFJV for 30 min. The 1st and the 2nd groups were ventilated with ti=0.7 (expulsion regime), the 3rd with ti=0.5 (neutral regime), the 4th with ti=0.3 (impulsion regime) for 30 min. The last (5th) group was not treated further on the second day. The rabbits of the 2nd group were immediately sacrificed after HFJL. The remaining animals were sacrificed after they had survived for the next 24 h and then their lungs were examined. The percentage of eliminated silica in the 1st group was 26.5±4.5, in the 2nd – 17.9±2.8, in 3rd – 18.8±4.9, in the 4th – 11.1±4.5 and in the 5th – 17.4±3.6 %. All groups with the instillation of saline on the 2nd day had a decreased concentration of phospholipids in the lungs. The results indicated that HFJL is an effective method for cleaning the bronchoalveolar compartments.

FACTORS INFLUENCING O₂-DISSOCIATION CURVE DURING BREATHING FROM NON-RELAXATION BREATHING LEVELS. O. Slezdková, J. Hájek, E. Schniererová, A. Matášeje, A. Kurtanský, Institute of Physiology, Faculty of Medicine, Comenius University, Bratislava, Slovak Republic.

Breathing from inspiratory and expiratory levels provides different conditions for O₂-transport. They differ in the initial lung volume, breathing patterns, pulmonary blood flow, and the extent of using stored erythrocytes (Er). The concentration of haemoglobin (Hb) is higher at the expiratory level, while arterial and venous O₂-contents are almost identical with those at the inspiratory level. For these reasons, the following variables were compared in 10 mongrel dogs breathing from the two levels: blood pressure of CO₂ (P_{CO₂}), pH, body temperatures (BT) and 2,3-diphosphoglycerate (2,3-DPG). The results obtained were as follows (first numbers belong to the inspiratory level): 1. PaCO₂ 4.935–4.330 kPa, P<0.05, 2. pH 7.345–7.387, P<0.05, 3. BT 35.80–34.93, P<0.05, 4. 2,3-DPG in the whole blood 1.687–1.821 mmol.l⁻¹ and in Er 4.016–4.087 mmol.l⁻¹. A mild shift in the O₂-dissociation curve to the left at the expiratory level prevented oxygenated Hb from deeper O₂-unloading so that stored Er must have been mobilized.

EFFECT OF AIR EMBOLISATION OF THE PULMONARY ARTERY ON HAEMODYNAMIC AND RESPIRATORY CHANGES. M. Murin, I. Bračoková, S. Kyjanič, J. Bomba, Department of Physiology, Medical Faculty, Safarik University, Košice, Slovak Republic.

The haemodynamic and respiratory changes during embolisation of the pulmonary arterial bed were studied under pentobarbital anaesthesia in 20 rabbits. The air (0.446–0.862 ml/kg of body weight) was insufflated into the auricular vein to produce the circulatory and respiratory changes. The initial values were: the blood pressure (BP) in common carotid artery 12.09±0.72 kPa, right atrial BP – 1.86±0.22 kPa, aortal blood flow 0.89±0.016 l/min and the interpleural pressure –0.33 kPa during inspiration, 0.13 kPa during expiration, heart rate 259±4.6 c/min and breathing rate 92±12 c/min. The circulatory changes after embolisation were manifested by a decrease in arterial BP, by an elevation of right atrial BP and a decrease in the aortal blood flow to zero. In the preterminal period a series of rapid and deep inspiratory movements was followed by terminal apnoea, cardiac arrest, a fall in BP in the aorta and pulmonary arteries to zero which resulted in death. We suggest that the main cause of these alterations is the hypoxaemia. Other factors cannot also be excluded, namely the mechanical, reflex and humoral ones which may affect vital functions, especially their central regulatory mechanisms.

IX. Metabolism

TRIGLYCERIDAEMIA, GLUCOREGULATION AND BLOOD PRESSURE IN SOME RAT STRAINS. A. Vrána, L. Kazdová, Z. Dobešová, V. Křen, J. Kuneš, Institute of Clinical and Experimental Medicine, ¹Institute of Physiology, Academy of Sciences of the Czech Republic and ²Institute of Biology, First Faculty of Medicine, Charles University, Prague.

Previously we established a relation between hypertriglyceridaemia, hyperinsulinaemia (HI), insulin resistance (IR), impaired glucose tolerance (GT) and increased blood pressure (BP) in a hypertriglyceridaemic (HTg) rat strain (1,2). Subsequent studies were conducted to determine whether the same association can be demonstrated in other rat strains. For this purpose, triglyceridaemia, GT, insulinaemia, IR and BP were monitored in PD, BN, Choco, SHR, and HTg rats. Results can be summarized as follows: All the parameters were normal in BN; only an increase in BP could be found in Choco. All the above disorders were demonstrated in the HTg strain, the PD strain was similar with the exception that no rise in BP was observed. Besides being markedly hypertensive, SHR resembled BN, serving as controls, in all the other parameters investigated. The study revealed a dissociation among the changes observed, thereby demonstrating that there is no causal relationship among them.

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GLUCOREGULATION IN THE PRAGUE HYPERTENSIVE RAT. M. Tutterová, L. Kazdová, A. Vrána, J. Heller, Institute for Clinical and Experimental Medicine, Prague.

A association between hypertension (HT) and impaired glucoregulation (GR) has often been reported both in man and in experimental models of hypertension. With this in mind, we monitored some parameters of GR in a new model of HT (1) called the Prague Hypertensive Rat (PHR); normotensive rats (PNR) were used as controls. The results can be summarized as follows: 1. Changes in blood pressure but, mainly, in GR depend on the animal's age. While PHR are markedly hypertensive at 3 months, their GR is not impaired. No glucose tolerance impairment was seen even in older (6 months old) PHR; however, post-load insulinaemia was markedly higher than in the controls, a finding suggesting insulin resistance (IR). 2. Further findings showed that IR is not mediated by receptor mechanisms – specific binding of insulin to the erythrocyte membrane, and the number of receptors were surprisingly higher in PHR than in the controls. These results unequivocally indicate a post-receptor defect in insulin action progressing with age in PHR.

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THE EFFECT OF DIETARY SUPPLEMENTATION WITH FISH OIL ON LIPID PEROXIDATION AND ON ENDOGENOUS ANTIOXIDANT LEVELS. L. Kazdová, A. Vrána, M. Vidláková, V. Nováková, M. Matějčková, Institute of Clinical and Experimental Medicine, Prague.

Because of their hypolipidaemic effect, fish oil (FO) preparations with high n-3 fatty acid (FA) contents are used in the prevention of cardiovascular disease (1). However, a high n-3 FA intake can also have an adverse effect due to increased peroxidation and oxidative damage to tissues. Our study was designed to determine whether the administration of an FO preparation (Activepa, Martens) in normocholesterolaemic and hypercholesterolaemic rabbits affects the formation of lipoperoxidation products (conjugated dienes and malondialdehyde) and levels of endogenous antioxidants (α -tocopherol, retinol and vitamin C). We found that while FO (0.5 ml/kg b.w.) in hypercholesterolaemia, had a marked hypertriglyceridaemic effect, it also raised the serum levels of lipoperoxidation products, enhanced lipoperoxidation in the liver, and decreased the serum concentrations of α -tocopherol and vitamin C. These adverse effects were dose-related. The above findings could possibly explain the atherogenic action of FO observed in some studies (2).

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MORPHOLOGY OF THE INTIMAL PART OF THORACIC AORTA IN HEREDITARY HYPERTRIGLYCERIDAEMIC RATS (HTG). F. Kristek, S. Edelsteinová¹, A. Vrána², I. Klimeš³, Institute of Normal and Pathological Physiology, ³Institute of Experimental Endocrinology, Slovak Academy of Sciences, ⁴Pharmaceutical Faculty, Comenius University, Bratislava, Slovak Republic and ²Institute of Clinical and Experimental Medicine, Prague.

Structural changes of aortal endothelial cells (EC), the subendothelial space (SS) and inner layer of smooth muscle cells (SMC) of the thoracic aorta in HTG rats were studied using the standard transmission electron microscopy method. EC formed a continual layer in some places interrupted by small gaps between cells. The most prominent alterations were found in EC, and namely large vacuoles in the cytoplasm, an enlarged number of vesicles of the Golgi complex and vacuolized mitochondria. Protrusions of EC penetrate into enlarged SS which contained membranous debris and amorphous deposits mixed with intercellular matrix. The inner layer of SMC in tunica media was also slightly affected (vacuolization of mitochondria, lipid droplets in the cytoplasm). Endothelium-dependent relaxation to acetylcholine of aortic rings precontracted by noradrenaline was present.

METABOLIC DISORDERS OF THE MYOCARDIUM IN EXPERIMENTAL DIABETES. V. Chorváthová, R. Ondreička, P. Bobek, K. Volkovová, J. Kľvanová, M. Jurčovičová, L. Koszeghyová, Research Institute of Nutrition, Bratislava, Slovak Republic.

We observed changes in the lipid spectrum and enzymatic and non-enzymatic antioxidants in the myocardium of rats with chronic diabetes (8 weeks) induced by streptozotocin. The results showed that the higher content of cholesterol as well as of triacylglycerols in the myocardium of diabetic animals, the changes in the spectrum of aliphatic acids in triacylglycerols: Decrease C:16 (palmitic acid and palmitoleic acid), increase C:18 (stearic acid and linoleic acid). The percentage abundance of arachidonic acid was raised. At the same time, the values of malondialdehyde rose as well as the activities of superoxide dismutase and of catalase. Oxidized glutathione decreased to 25 %. The levels of tocopherol were lower by 50 %, the levels of vitamin C were lower by 21 %. Our findings show that diabetes potentiates lipid accumulation in the myocardium as well as the formation of free radicals. This leads to changes in the spectrum of aliphatic acids and to lipoperoxidation.

ANTIOXIDATIVE STATE OF THE MYOCARDIUM AND KIDNEYS IN RATS WITH ACUTE DIABETES. K. Volkovová, V. Chorváthová, M. Jurčovičová, L. Koszeghyová, P. Bobek, Research Institute of Nutrition, Bratislava, Slovak Republic.

We investigated the changes in the antioxidative state of the myocardium and kidneys in acute diabetes (IDDM, streptozotocin 45 mg/kg b.w., insuline Interdep 6 U/kg s.c., 8 days). Diabetes was associated with increased levels of malondialdehyde as well as with the activities of superoxide dismutase and of catalase (CAT) in the heart. The levels of reduced glutathione (GSH) and the activities of glutathione S-transferase (GST) were lowered. The activities of glutathione peroxidase in the diabetic kidneys and of GST were increased by 60 % and 105 % respectively. The results indicate that increased oxidative stress is already present even in acute diabetes and that the antioxidative state of this tissue changes. The endogenic formation of H_2O_2 probably increases and this is mainly degraded through the CAT pathway. Eight-day diabetes also alters the activities of antioxidative enzymes in the kidneys, and the redundancy of free oxygenous radicals is likely to be removed by GSII-dependent system.

INFLUENCE OF VITAMIN C AND E ON THE ACTIVITY OF OXYGEN RADICALS IN THE BLOOD. V. Soška, A. Zechmeister, A. Lojek, J. Siegelová, Department of Clinical Biochemistry, University Hospital, Department of Anatomy, Faculty of Medicine, Masaryk University, Institute of Biophysics and Department of Physiology, Faculty of Medicine, Masaryk University, Brno.

Oxygen radicals (OR) play an important role in the development of many diseases, including atherosclerosis. Low density lipoproteins can undergo oxidation producing lipoperoxides with high atherogenicity. Defence system of the organism against OR effects also includes α -tocopherol and L-ascorbic acid. The aim of the study was to assess the influence of α -tocopherol (200 mg/day) and L-ascorbic acid (1000 mg/day) on the activity of oxygen radicals in the blood. A group of 20 patients with symptoms of atherosclerosis (mean age 58 years) was examined. The method of luminol dependent chemiluminescence (luminometer LKB 1251) was used. A significant decrease of OR activity ($p < 0.01$) was found after one month of α -tocopherol treatment, while a significant increase (< 0.01) was obtained after L-ascorbic acid treatment.

MECHANISM OF HYPOLIPAEMIC EFFECTS OF THE OYSTER MUSHROOM (*Pleurotus oestratus*) IN THE RAT AND HAMSTER. P. Bobek, I. Ozdín, L. Kuniak, Research Institute of Nutrition, Bratislava, Slovak Republic.

Rats, fed from weaning on a diet containing 0.3 % of cholesterol (C) showed, after being given 4 % of the dried mushroom with the diet for 12 weeks, reduced C accumulation in the serum by 45 % and in the liver by 15 %, respectively. The dried mushroom decreased the endogenous production of VLDL by 19 %. By analyzing the die-away curves after applying VLDL-¹⁴C-TG the mushroom reduced $t_{1/2}$ value from 32 to 20 min⁻¹ and accelerated the fractional catabolic rate (FCR) of VLDL by almost 50 %. Accumulation of C and of triacylglycerols was reduced by 20 % in the serum, and by 10-15 % in the liver of hamsters held on a high fat-cholesterol diet after 8 weeks of applying 30 % alcoholic extracts of dried or fresh oyster mushrooms in amounts equivalent to 2 % of the whole mushroom. VLDL production was reduced by 45 %. Analyses of the die-away curves with ¹⁴C-cholesterol have shown that the mushroom shortened the $t_{1/2}$ from 5.7 to 2.9 day⁻¹ and reciprocally increased the FCR of plasma C.

THE RATIO OF SULPHUR AMINO ACIDS IN FOOD SOURCES AND THEIR RELATION TO METABOLISM IN RATS. S. Dudášová, E. Grančičová, Research Institute of Human Nutrition, Bratislava, Slovak Republic.

A very important role in protein metabolism is ascribed not only to the efficiency of individual tissues and organs in connection with age, but it also depends on the intake of basic nutrients and their mutual proportions. It was found by isotope assays that ingested energy is not deposited in the form of lipids but as saccharides, if the cysteine to methionine ratio in the diet is higher than 3:7 (3). It is evident that it is necessary to state the sulphur amino acid ratio in the protein sources and not only their total content, because a high methionine content in the diet has an antinutritional effect (2). In soya roasted defatted flour this ratio is 4:6. Our results have not only shown changes in lipid metabolism but have also demonstrated a protective role of cysteine on methionine metabolism (1).

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THE EFFECT OF TIME OF DAY AND OF LIGHT REGIMEN ON CAROTENOIDS IN THE LIVER AND SERUM IN RATS. I. Ahlers, J. Zubrický, E. Ahlersová, Institute of Animal Physiology, Faculty of Science, Šafárik University, Košice, Slovak Republic.

Young male Wistar rats fed pellets (VELAZ, Prague) *ad libitum* were adapted to the regimen light:dark - 12:12 h (LD), to constant darkness (DD) or to constant light (LL). Then the concentration/content of A vitamin and beta-carotene in the liver and the concentration of A vitamin in the serum were determined at 3-h intervals during 24 h. The oscillations of liver A vitamin in the LD regimen were flat. The average liver A vitamin values were higher in the constant regimens, in DD two peaks occurred in the middle of subjective light and dark part of the day. The serum A vitamin level oscillated in the LD regimen with the peak in the light/dark transition; in the constant regimens, the peaks were phase-shifted. The liver beta-carotene content in the LD regimen was lower during the light, higher in the dark, peaking in the second half of the period. In the constant regimens, the mean beta-carotene values were higher, in DD the patterns resembled those of the liver A vitamin content.

LIPIDS AND LIPOPROTEINS IN DOMESTIC ANIMALS. V. Eliáš, J. Kolář, V. Rozdobud'ková, A. Sedláková, D. Pavlová, J. Váradý, Department of Normal Physiology, University of Veterinary Medicine and Institute of Clinical and Experimental Medicine, Faculty of Medicine, Košice, Slovak Republic.

The highest levels of triacylglycerol (mmol/l) were found in the blood serum of dogs and pigs (0.59 ± 0.13 and 0.45 ± 0.26 respectively), while the lowest values were present in cows (0.15 ± 0.02). The total cholesterol level (mmol/l) is also the highest in dogs (4.87 ± 1.2) and the lowest in pigs (1.9 ± 0.5) and sheep (1.96 ± 0.37). The highest levels of NEFA (mmol/l) were present in sheep (0.97 ± 0.03) whereas in dogs and pigs they were significantly lower (0.51 ± 0.2 and 0.33 ± 0.17 respectively). The phospholipid levels (mmol/l) were significantly higher in dogs (5.57 ± 1.16) than in cows (1.75 ± 0.52) and the lowest values were found in pigs (1.25 ± 0.28). The percentage occurrence of beta-lipoproteins was the highest in horses (57.8 ± 5.4), while in other animals it was almost the same as in cows (41.6 ± 11.5). Very low percentage incidence alpha-lipoproteins was present in pigs (12.8 ± 4.63) while it was the highest in dogs (59.3 ± 7.2). A significantly low percentage occurrence of beta-lipoproteins was found in sheep (6.8 ± 2.89) while it was significantly high (38.4 ± 0.26) in pigs.

METABOLIC CHANGES AFTER NOCICEPTIVE STIMULATION IN ADULT RATS. R. Rokyta, H. Štátná, Department of Physiology and Clinical Physiology, Third Faculty of Medicine, Prague.

In our previous work, we demonstrated that both early and late stimulation leads to metabolic changes in the spectrum of proteins, glycid and lipids (1). Likewise we tried to disclose metabolic consequences of epinephrectomy in these phenomena. In this paper we demonstrated the effect of cortisol in painfully stimulated adult rats. In the majority of the observed parameters cortisol increased the level of nonesterified fatty acids, triacylglycerols and HDL cholesterol. On the contrary, it decreased the level of total cholesterol and caused no change in the levels of glucose. Nociceptive stimulation and epinephrectomy (except for its influence on glucose levels) did not alter the general trend of these changes.

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CHANGES IN TRANSMUCOSAL POTENTIAL DIFFERENCES IN THE RAT STOMACH EXPOSED TO ETHANOL.

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Ion transport and electrical resistance of the gastric mucosa are responsible for the generation of the transmucosal potential difference (PD) which is considered as an index of mucosal integrity. The aim of the present work was to study the effect of some antisecretory and gastroprotective agents on PD in stomachs damaged by ethanol. PD was measured in anaesthetised rats. Control PD values were -39.6 ± 2.4 mV (mucosa negative). The intragastric instillations of 20 % ethanol induced an abrupt fall in PD to -11.7 ± 1.3 mV. PD recovered within 90 min to 90 % of the basal value. Inhibition of gastric acid secretion by the administration of ranitidine and cimetidine, as well as pretreatment with the gastroprotective agents PGE₂ and pentacaine, reduced the maximal drop of PD caused by ethanol and accelerated the recovery rate. The results indicate that the gastric barrier can be protected by various drugs acting by different mechanisms.

THIAMIN, RIBOFLAVIN AND VITAMINS B₆ AND C IN VEGETARIANS. O. Černá, L. Ramacsay, M. Kudláčková, M. Jurčovičová, Research Institute of Nutrition, Bratislava, Slovak Republic.

Vegetarianism as an nutrition tendency, include spacions palette of nutrition usages, omitting different species of animal diet. Uncorrect planned diet can origine a lot of health problems, which are connected with nutrient adequancy intake. On account of that we studied in accidental selected group of vegetarians the values of some in water soluble vitamins: vitamin C in leucocytes, vitamins B₁, B₂ and B₆ in hemolysate erythrocyte with method of the coenzyme stimulation of the erythrocyte enzymes transketolase, glutathion reductase and glutamat oxaloacetate aminotransferase. The value for stimulation is obtained as the differences between the reaction rates of parallel assays of enzyme activity in a hemolysate. One assay is made with untreated hemolysate, the other with the same hemolysate after *in vitro* incubation with excess coenzyme. The result of the test is expressed as activation coefficient.

EFFECT OF VARIOUS SOURCES OF PROTEIN NUTRITION ON CHANGES OF THE ANTIOXIDANT SYSTEM IN RATS.

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We investigated the effect of different sources of protein nutrition on antioxidant enzymes changes - superoxiddismutase (SOD), glutathione peroxidase (G-Px) and the concentration of reduced (GSH) and oxidized glutathione (GSSG) in the liver of growing male rats. Sources of protein diets were as follows: animal protein casein, defatted soya bean flour and concentrate of wheat protein gluten. The nutrient content in all these diets was the same, only the amino acids were different due to the various quality of the protein sources. The E/N ratio is 0.79 for casein, 0.73 for soya and 0.30 for gluten. The highest, statistically significant activity was that of G-Px which was found in rats fed the casein diet (15.01 ± 1.10 U.kg⁻¹) when compared to the vegetable diets (gluten 10.57 ± 0.38 ; soya 5.78 ± 0.71). Similar statistical changes were found in the concentration of GSH (casein 4.12 ± 0.30 ; soya 3.52 ± 0.28 ; gluten 2.00 ± 0.17 μ mol.g⁻¹). The activity of SOD and concentration of GSSG tended to be higher in animals fed the animal protein compared to vegetable sources. Our results show that inadequate amino acids composition in the nutrition of growing rats diminishes the detoxicating capacity of the organism.