

covery of this coenzyme of cell activity by Warburg in 1936 and the first measurements on living tissue by B. Chance and coworkers in 1956, measuring techniques and methods in this field have developed enormously. The modern way of measuring the metabolic state on the surface of living tissue is characterized by the use of impulse lasers, fiber optics, very sensitive optical receivers and versatile computing facilities.

Method. In order to evaluate cell damage and the deficiency of energy the time-dependent intensity of NADH-surface fluorescence at 470 nm is measured by a newly developed fluorimetric device. The excitation wavelength was 337 nm. The device was calibrated by testing normal conditions on a probe substance. The fluorescence intensity was registered at the output of the device in V-scale. Liver ischemia was induced by cross-clamping of the hilar pedicle for 30, 45, 60 min in 6 groups of rats (control, ischemia alone, and ischemia with radical scavenger) treated by asc. acid, tocopherol, allopurinol and SOD.

Results. The typical trace curves of fluorescence intensity during ischemia under the application of radical scavengers show a marked protective effect on liver tissue. The laser exited in vivo NADH-fluorescence intensity on the liver surface represents an instant sensitive marker of liver cell ischemia, whereby the reperfusion damage by the effect of allopurinol (150 mg/kg body weight) and tocopherol was totally abolished in contrast to a reperfusion damage without scavengers, shown by a 4-fold amplitude of output signal. The results obtained are of importance in liver preservation and transplantation.

159 Ischemia-Reflow Induced Changes of Hemoglobin Saturation in Rabbit Liver as Measured by Tissue Near-Infrared Spectroscopy

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Purpose. Tissue spectroscopy of hemoglobin saturation using visual and dual wavelength has been developed as a means of monitoring tissue oxygenation. However, the reflectance method cannot accurately measure hemoglobin saturation, since dual wavelength measurement is interfered with by the changes in oxidation-reduction state or concentration of tissue pigments

such as cytochromes, and also since visual light can only penetrate the surface area. However, the novel method of tissue near infrared spectroscopy using multicomponent analysis of continuous wave spectra can resolve these disadvantages. The purpose of this study is to analyze rapid changes in hemoglobin saturation (SO_2 ; $[oxyHB]/[oxyHB] + [deoxyHB]$) and concentration (THB; $[oxyHB] + [deoxyHB]$) during and after clamping of blood supply to the liver.

Material and Methods. Multichannel Photodetector 1000 (Otsuka Electronics, Japan) was used to measure continuous wave spectra at every 2 nm from 700 to 1000 nm from the liver. Time resolution of each scan was 2 sec. A multicomponent curve fitting analysis was performed for quantification of hemoglobin by the following equation: optical density = $c_1[oxyHB] + c_2[deoxyHB] + c_3[oxidized\ cytochrome\ aa3] + c_4[reduced\ cytochrome\ aa3] + (HB-free\ liver)$ (i.e., absorption coefficient). Male rabbits weighing 2.5 to 3.5 kg were divided into 3 groups ($n=5$): group A, clamping of hepatic artery; group B, clamping of portal vein; group C, clamping of both. These clamping procedures were performed for 15 min under intravenous anesthesia with sodium pentobarbital (50 mg/kg).

Results. In group A, the SO_2 gradually decreased from the control value of $61.6 \pm 2.3\%$ (mean \pm SEM) to $53.2 \pm 3.2\%$ at 15 min. After declamping, it immediately recovered to the control value. By contrast, in group B, SO_2 decreased to $21.2 \pm 2.7\%$ within 5 min after clamping. For 20 sec after declamping, SO_2 further decreased to $11.1 \pm 3.6\%$ concomitantly with increase in THB due to inflow of congested blood and then recovered to the control value. In group C, SO_2 decreased to $6.7 \pm 13.0\%$ immediately after clamping. The percentage decrease in THB was 75% in group B, while the value was 40% in group C.

Conclusion. The present method provides a rapid and reliable method of quantifying hepatic oxygenation in liver surgery.



160 Antioxidant Therapies and Ischemic Liver Regeneration

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Liver ischemia is sometimes necessary during hepatic surgery (liver transplantation, repair of a liver

injury, metastasectomies, etc.). The interruption of blood flow results in cellular injury, which is increased by reperfusion. On the other hand, liver regeneration is fundamental as a compensatory mechanism following injury.

Material and Methods. Five groups of 10 male Sprague-Dawley rats (250 g) have been used. Hepatic ischemia (HI) was induced, under ether anesthesia, by clamping the hepatic pedicle, the superior mesenteric artery and the celiac trunk for 15 min, just prior to 70% hepatectomy. The different drugs were administered diluted in 2 cm² of saline, through the left femoral vein during the last 10 min of liver ischemia. The animals were sacrificed 24 h after surgery, and the hepatocytic DNA content was measured by means of a microcytophotometric technique. The results were expressed in terms of the percentage of regenerating hepatocytes (%RH) and regenerative gradient (RG: DNA content of regenerating hepatocytes/DNA content of static hepatocytes).

Experimental series: (1) 70% hepatectomy, (2) 70% hepatectomy + HI, (3) 70% hepatectomy + HI + SOD (6 mg/kg), (4) 70% hepatectomy + HI + allopurinol (50 mg/kg), (5) 70% hepatectomy + HI + folic acid (2.5 mg/kg).

Results. %RH: (1) 22.29, (2) 8.85, (3) 15.66, (4) 6.42, (5) 29.1. RG: (1) 1.61, (2) 1.74, (3) 2.16, (4) 2.09, (5) 1.95.

Conclusions. (1) Liver ischemia reduces the %RH after 70% hepatectomy ($p < 0.05$), but it does not affect the RG ($p = 0.214$). (2) Allopurinol does not improve the %RH after ischemia ($p = 0.74$). (3) SOD increases the regenerative response but it does not reach statistical significance. (4) Both SOD and allopurinol improve the RG. (5) Folic acid increases the %RH ($p < 0.0005$) and totally reverts the deleterious effect of ischemia ($p = 0.15$).

161 A Computer-Aided Manometric Evaluation of the Lower Oesophageal Sphincter after Nissen Repair: An Explanation for Post-Surgery Overcompetency

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The Nissen antireflux procedure prevents abnormal gastroesophageal reflux (GOR). However, the physiological reflux patterns are also modified and an 'overcompetent' sphincter is created. The aim of this study was to evaluate the manometric characteristics of the lower oesophageal sphincter (LOS) after antireflux surgery. Twelve patients were evaluated 3–60 months after Nissen repair for GOR disease (median 10.5 months). All were asymptomatic; 12 healthy volunteers served as a control group (CG). Oesophageal manometry was performed using an infused 12-channel probe with the distal 8-side holes at the same level. The LOS was evaluated using a motorized step-wise pullback technique withdrawing the probe at 1 mm/sec. A software program allowed the automatic calculations of the LOS pressure at the respiratory inversion point, the area under the pressure curve (AUC), as well as the total and abdominal lengths. A 3-dimensional representation of the LOS was constructed and its volume, termed 'vector volume', was calculated (LOSVV). Both patients and volunteers underwent 24-h pH monitoring of the distal oesophagus. The Mann-Whitney test was used for statistical analysis (data are expressed as means and SEM).

Results. After surgery, the percent of acid exposure in upright position and the number of GOR episodes were statistically lower than the controls ($p < 0.05$). There were no differences observed in LOS pressure (post Nissen: 14.8 ± 1.2 ; CG: 12.2 ± 1.3 mm Hg). However, the LOS (post Nissen: $22,696 \pm 4529$; CG: $11,367 \pm 2208$ mm \times mm Hg), the AUC (post Nissen: 560 ± 54 ; hv 372 ± 46 mm²), the total length of LOS (post Nissen: 46.3 ± 3 ; CG: 36.3 ± 3 mm) and the abdominal length (post Nissen: 35 ± 3 ; CG: 24 ± 2) were significantly higher than the control values ($p < 0.05$).

Conclusion. Nissen antireflux repair not only effectively controls pathological GOR, but also abolishes the physiological reflux. This effect is due to a dif-