this way. However the synapses and neuronal elements may also have only a uni-lamellar, or partial glial covering. These variations are most obvious in the n. suprachiasmaticus.

Similar glio-neuronal relationships are observed in the n. arcuatus and the n. supraopticus, though multilamellar formations are rare on synapses in these nuclei. Preliminary observations show that after saltloading the perineuronal accumulation of astroglial lamellae seems to increase in the n. supraopticus.

The present results demonstrate increased perineuronal wrapping produced by astroglial processes in various nuclei of the hypothalamus. The fraction of the covered surface of the neuron, and the number of astroglial lamellae varies significantly. In contrast to the cerebellar cortex, nucleus of Deiters and the spinal cord[4], the astroglial covering does not seem to be restricted to a distinct type of neuron or synapse. The large differences of glial covering found on neuronal elements in the hypothalamus might be caused by periodic, long-lasting changes of the activity level[6]. Further studies are necessary to reveal whether the degree of neuronal wrapping by astrocytic processes is dependent on the activity level of the neuron concerned.

Zusammenfassung. In verschiedenen Kerngebieten des Hypothalamus wird eine wechselnde Zahl neuronaler Elemente, wie Somata, Dendriten und verschiedene Synapsentypen, von multilamellären Formationen der Astroglia umhüllt. Diese verstärkte Umhüllung ist hier nicht spezifisch für bestimmte Neuronen- und Synapsentypen, wie in anderen Teilen des ZNS. Vorläufige Ergebnisse am n. supraopticus nach Salzbelastung lassen es als möglich erscheinen, dass die wechselnd starke Bedeckung der neuronalen Elemente durch Astrocytenlamellen vom Aktivitätsniveau der Neurone abhängt.

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Impaired Jejunal Transport of Monosaccharides in Experimental Cholestasis

Monosaccharide absorption is assumed to be unimpaired in children with extrahepatic biliary atresia[1]. However, in these patients, D-xylose values may be affected by alterations in plasma volume, shunting or inability of the cirrhotic liver to metabolize the absorbed substrate[2]. The purpose of this study was to examine, in rats, the effect of acute experimental cholestasis on the transport of 3-*o*-methyl glucose (3-*o*-MG). Absorption was measured in extracorporeally perfused jejunal segments and in everted intestinal rings.

Material and methods. Bile duct ligation was carried out in male Sprague-Dawley rats weighing 150 to 220 g. Controls were sham operated. The 2 groups of animals were placed in restraining cages and offered ad libitum a 5% sucrose solution containing 40 meq/l of NaCl and 20 meq/l of KCl for a period of 48 h following the surgical procedures.

Absorption through jejunal segments: The animals were weighed and bilirubin levels determined. Under pentobarbital anesthesia, 20 cm segments of jejunum distal to the ligament of Treitz were completely removed from the animals and perfused extracorporeally as described previously[3]. Circulation of the blood perfusate was maintained at a rate of 2.5 ml/min. The proximal end of the jejunal segment was perfused for 36 min at a rate of 1 ml/min with a 5 m*M* solution of 3-*o*-MG and 2 μCi of ^{14}C-labeled 3-*o*-MG (New England Nuclear Corporation: 5.3 mCi/mmole) in a physiological electrolyte solution. At the 24 min mark in 16 of the 24 animals, the luminal perfusate contained in addition a 35 m*M* solution of Na taurocholate (Maybridge Research Chemicals, U.K.) which was repurified[3]. The % absorption of 3-*o*-MG per min was calculated by dividing the amount of substrate in the portal effluent collected at 1 min intervals by the mean luminal substrate concentration. Results were then corrected per g dry weight of mesentery free jejunal segment.

Transport in intestinal rings: The rats were decapitated and a segment of proximal jejunum was removed, everted and cut into intestinal rings weighing 7–10 mg each[4]. The rings were kept until incubation in chilled Krebs-Ringer bicarbonate (pH 7.4) which had been gassed for 30 min with 95% O_2 and 5% CO_2. Each ring was then transferred to a 10 ml Erlenmeyer flask containing 2 ml of freshly gassed Krebs-Ringer bicarbonate buffer and either Inulin-Carboxyl-^{14}C (New England Nuclear Corporation: 1–3 mCi/g) or a 0.5 m*M* solution of 3-*o*-MG with .3 μCi of

3-*o*-MG absorption in the vascular compartment of perfused jejunal segments

	Bile duct ligated (12)	Sham operated (12)	*P*
Weight loss (%)	8.2 ± 2.3	6.8 ± 2.1	N.S.
Bilirubin at 48 h	7.2 ± 3.0	0.8 ± 0.2	< 0.001
Absorption per min (%)	23.1 ± 7.7	36.6 ± 13.2	< 0.01

Figures in parentheses correspond to the number of animals studied. Results shown represent mean ± SD. *P* was calculated using the student *t*-test.

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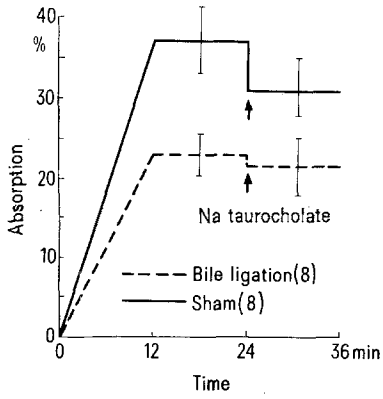

Fig. 1. Effect of Na taurocholate on 3-*o*-MG absorption in jejunal segments perfused in vitro. % absorption per min is shown on the ordinate. Arrows indicate the point at which the 3-*o*-MG perfusate containing taurocholate was started.

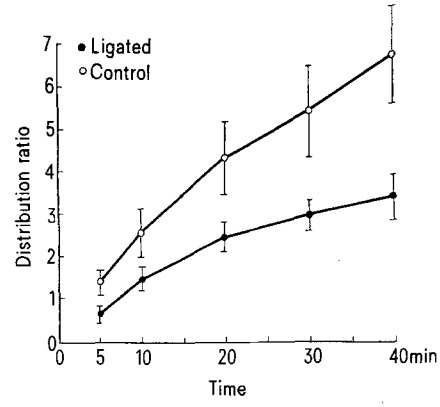

Fig. 2. Uptake of 3-*o*-MG in everted gut rings. Distribution ratios are expressed as mean ± SE for 2 groups of 7 animals. 2 rings from each animal were incubated with 3-*o*-MG for each period shown. The P value was < 0.025 for the 5, 10, 20 and 30 min incubation periods, it was < 0.01 at the 40 min mark.

^{14}C labeled 3-*o*-MG. 2 rings from each animal were used for each incubation at 37 °C with 3-*o*-MG. After 5, 10, 20, 30 and 40 min of incubation, the rings were removed from the flasks, dipped twice in saline, blotted, weighed and dissolved in N.C.S. (Nuclear-Chicago Corporation). Calculation of dpm/ml of intracellular fluid was made from measurements of total tissue water and extracellular space as described previously[4,5]. The uptake of 3-*o*-MG was expressed as distribution ratios between the intracellular compartment and the incubation medium.

Results. As shown in the Table, the weight loss suffered by the animals during the 48 h following bile duct ligation did not differ from that of the sham rats. Bilirubin levels indicate that a significant degree of cholestasis had been achieved. The % min absorption of 3-*o*-MG in the vascular compartment of extracorporeally perfused jejunal segments was significantly decreased in the experimental animals. The addition of a 35 m*M* solution of Na taurocholate to the 3-*o*-MG intestinal perfusate had no effect on the difference in % min absorption (Figure 1). Data from the study in everted rings is shown in Figure 2. Distribution ratios achieved by the rings from the bile duct ligated animals are lower than those from the controls. Total tissue water and the size of the extracellular space did not differ between the 2 groups of animals.

Discussion. The results of this study show that the transport of 3-*o*-MG through the jejunum of rats, in whom cholestasis has been induced 48 h previously by bile duct ligation, is impaired. Since semistarvation and fasting are respectively associated with an increased[6] and a decreased[7] absorption of 3-*o*-MG, a significantly different % weight loss could have explained absorptive changes but this was not the case. It is unlikely that the findings could be secondary to the absence of bile or of bile salts from the intestinal lumen of the cholestatic animals. The addition of Na taurocholate to the intestinal perfusate of 3-*o*-MG from both control and bile duct ligated animals failed to bring about any change, and neither bile[8] nor conjugated bile salts[9] modify monosaccharide absorption except in bile fistula rats where bile salt depletion was countered by a 48 h intestinal perfusion of Na taurocholate[3]. In the light of our present findings, the possibility that circulating bile acids could have an effect on the monosaccharide transport system should be examined. Biliary tract obstruction is associated with the highest levels of serum bile acids[10] and they are nearly all conjugated[11]. High concentrations of bile acids in the systemic circulation have a number of clinical effects such as pruritus[12], red cell morphological changes[13] and alterations of kidney function[14]. Furthermore, functional and structural hepatic changes have been detected in rat liver as early as one day after bile duct ligation[15]. The impairment of 3-*o*-MG absorption found in acute experimental cholestasis could be secondary to large amounts of circulating bile acids bringing about alterations in membrane composition or structure, modifications in energy supply and in carrier mediated transport mechanisms. This possibility is currently under investigation[16].

Résumé. L'absorption du 3-*o*-methyl glucose par des segments jéjunaux perfusés in vitro et par des anneaux inversés est diminuée chez le rat étudié 48 h après ligature du canal biliaire et non modifiée par l'addition de Na taurocholate au perfusat intestinal.

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