INFLUENCE OF ACUTE ADMINISTRATION OF ETHANOL ON BILE FLOW AND BILE CALCIUM SECRETION

BY

SOONTHREE SUBRUNGRUANG

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE (PHYSIOLOGY)

IN THE FACULTY OF GRADUATE STUDIES OF MAHIDOL UNIVERSITY

1984

Copyright by Mahidol University
INFLUENCE OF THE ACUTE ADMINISTRATION OF ETHANOL ON BILE FLOW AND BILE CALCIUM SECRETION

by

SOONTHREE SUBRUNGRUANG

Department of Physiology, Faculty of Science, Mahidol University
Rama VI Road, Bangkok 10400, Thailand

ABSTRACT

To evaluate the influence of the acute administration of ethanol on bile flow and bile calcium secretion, the experiments were performed in male Wistar rats weighing between 180-200 g. Ethanol at doses of 1.3 and 5 g/kg BW administered intraperitoneal provoked a dose-related reduction in plasma and bile calcium concentration (mg/dl), total bile calcium secretion (µg/100 g/30 min), and bile flow rate (µl/100 g/30 min). In an attempt to test whether the reduction in bile calcium secretion was a result of a direct effect of ethanol or a consequence of hypocalcemia, calcium clamp technique was performed to maintain a condition of normocalcemia after ethanol (5 g/kg BW) administration. The experimental results showed that despite a reduction in bile flow rate, the bile calcium concentration (9.7±0.4 mg/dl) was higher than in ethanol treated group (5.4±0.3 mg/dl) indicating that the bile calcium concentration may have some relations with the plasma calcium concentration. On the other hand, the plasma calcium concentration did not seem to interfere with the bile flow rate which was 134±20 µl/100 g/30 min as compared to 201±7 µl/100 g/30 min in control (P < .001).
To investigate the relation between plasma and bile calcium concentrations, hypercalcemic and hypocalcemic conditions were induced. Hypercalcemia induced by loading of calcium gluconate solution resulted in an increased bile calcium concentration at 30 min (9.9±0.6 mg/dl) while thyro-parathyroidectomy-induced hypocalcemia led to a significant reduction in bile calcium concentration at 30 min (5.6±0.2 mg/dl). When the bile calcium concentration were plotted against plasma calcium concentrations, every experimental group with or without ethanol exhibited a linear relationship with correlation coefficients of 0.86 and 0.87 for groups with ethanol and groups without ethanol respectively (P < 0.001).

In addition, the bile calcium concentration in every group gradually decreased more or less at the same rate with time which may possibly be linked with the interruption of enterohepatic circulation of bile salts. Concerning the mechanism of ethanol induced reduction in bile flow, the primary investigation demonstrated that ethanol (5 g/kg BW) reduced the activity of plasma membrane (Na⁺-K⁺)-ATPase which is important for both bile salt dependent, and bile salt independent bile flow, from 5.25±0.87 in control to 2.46±0.39 µmole P_i/mg Protein/h (P < 0.001) while having no effect on either the total ATPase or Mg²⁺-ATPase activities.

In conclusion, acute ethanol administration (1, 3 and 5 g/kg BW) led to a dose-dependent reduction in plasma and bile calcium concentrations bile flow rate and total bile calcium secretion. Such a reduction in total bile calcium secretion was a result of firstly, a direct inhibitory effect of ethanol on bile flow rate. Secondly, a reduction in bile calcium concentration was consequence of ethanol-induced hypocalcemia.