Title : CARBOHYDRATE AND LIPID METABOLISM DURING CONTROLLED HYPOTENSION

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INTRODUCTION

Sodium nitroprusside (NP) and trimethaphan (T) are the most commonly used agents for deliberate hypotension. Their effects on metabolism have not been adequately investigated. This report presents some of the changes in carbohydrate and lipid metabolism that attend the use of these drugs.

METHODS

Ten patients, free of endocrine or metabolic disease, were studied after an overnight fast. They were scheduled for bilateral hip replacement, with a two-week interval between each operation. Hypotension was induced with T for one operation and with NP for the other. Premedication consisted of morphine and scopolamine. N_2O, O_2 and halothane were used for induction and maintenance of anesthesia. Muscular relaxation was provided with d-tubocurarine. Arterial P_{CO_2} was between 36 and 41 mm Hg and mean arterial pressure maintained at 52±6 mm Hg. Arterial blood samples were obtained before anesthetic induction; 45 minutes after induction but before initiation of hypotension and start of operation; 30, 60 and 90 minutes during hypotension; 15 minutes before termination of operation (blood pressure had returned to control); and 60 minutes postoperatively. Samples were analyzed for immunoreactive insulin (IRI), glucose, free fatty acids (FFA), glycerol, gas tensions and electrolytes.

RESULTS

General anesthesia for 45 minutes produced significant elevations ($P<0.05$) in FFA and glycerol levels. During NP hypotension, FFA and glycerol continued to rise significantly ($P<0.005$), glucose increased significantly ($P<0.001$), while IRI and serum K^+ showed small, insignificant increases. Similar changes were observed postoperatively. With T, FFA, glycerol ($P<0.01$) and serum K^+ ($P<0.05$) concentrations were reduced significantly, glucose was moderately but significantly elevated ($P<0.025$), and IRI was significantly increased ($P<0.01$).

DISCUSSION

These results clearly illustrate the role of autonomic activity in response to anesthesia and operation. The observed hyperglycemia, primarily the result of sympathoadrenal activation, may also be caused by increased secretion of insulin antagonists and decreased renal excretion. The modifying effect of T can result from (1) attenuated sympathetic activity; (2) increased insulin secretion; and (3) decreased supply of glycerol and FFA (may deprive hepatic gluconeogenetic pathway of sufficient substrate). Decreased FFA and glycerol concentrations with T and the increase of both substances with NP suggest that autonomic activity influences the dynamic "steady" state of lipid metabolism. Although a high FFA level may have favorable effects, such as protection against possible liver changes with halothane and inhibition of the negative inotropic effect of halothane, it has also an arrhythmogenic effect (at least on infarcted heart) and increases myocardial oxygen consumption ($M\dot{V}O_2$). The decreased FFA level associated with T may partly explain the reduced $M\dot{V}O_2$ observed with this drug.

Available evidence suggests that α-receptors tonically inhibit, while β-receptors stimulate insulin release. Because ganglionic blockade inhibits both α- and β-adrenergic activity, the increase in insulin levels suggests that the net effect of sympathetic activity is to inhibit insulin release.

Decreased serum K^+ associated with T administration may be explained by reduced glycogenolysis and increased insulin secretion. Insulin enhances transcellular movement of K^+ by an unknown mechanism. It may be related to membrane hyperpolarization by insulin, or to the general cyclic AMP lowering property of insulin; cAMP causes a rapid and large liberation of K^+ from perfused liver.