The Effects of Splanchnic Nerve Stimulation on the Plasma Levels of Serotonin and Substance P in the Portal Vein of the Cat


Department of Surgery III and Institute of Neurobiology, University of Gothenburg, Sweden, and Department of Pharmacognosy and Pharmacology, College of Pharmacy, University of Illinois, Chicago, U.S.A.

With 1 Figure

Received June 19, 1979

Summary

The blood levels of serotonin (5-HT) and substance P (SP) in the portal vein were studied after splanchnic nerve stimulation in the cat. The portal levels of both substances were studied before, during and after splanchnic nerve stimulation. There was a twofold increase in 5-HT during stimulation whilst the SP concentration remained unchanged. These results suggest that the nervous control of the amine release into the portal stream and the mechanism that regulates the release of the polypeptide is not the same.

Key words: Cat, electrical stimulation, serotonin, splanchnic nerves, substance P.

Introduction

Enterochromaffin cells (EC) are distributed all along the gastrointestinal tract, but are most frequent in the duodenum (Pentillä, 1966). EC are typical APUD-cells containing both a monoamine and polypeptides (Pearse, 1969). The monoamine, serotonin (5-HT), is easily demonstrated by fluorescence histochemistry according to the Hillarp-Falck technique, while the nature of the polypeptide has been more controversial. Results obtained with immunohistochemical techniques suggest that motilin and substance P may be present within

0300-9564/79/0046/0105/§ 01.60
different populations of EC (Pearse et al., 1974; Polak et al., 1976). Also, based on variations in the size and shape of 5-HT granules, the presence of various populations of rodent EC has been proposed (Gorgas et al., 1976).

From cytofluorimetric studies it is known that efferent electrical stimulation of the cervical vagi of the cat causes a decrease in the intracellular 5-HT levels of individual duodenal EC (Ahlman et al., 1976 a). Such procedures also cause a prompt rise in the portal 5-HT level of the animal, suggesting a release of 5-HT from EC into the portal circulation (Strauss et al., 1972; Ahlman et al., 1978 a). Ultrastructural studies indicate a vagally induced exocytosis of osmiophilic material from EC (Kobayashi and Sasagawa, 1976; Ahlman et al., 1978 a). Further studies have indicated that a release of 5-HT may be mediated via vagal adrenergic nerve fibers from cervical sympathetic ganglia descending to the gut (Ahlman et al., 1976 b; Lundberg et al., 1978 b).

The purpose of the present study was to investigate if stimulation of the splanchnic nerves to the gut may cause a similar increase in portal 5-HT as stimulation of the vagal nerves does. Furthermore, if the releases of the amine and the polypeptide in EC are under similar neural control mechanisms, an increased portal level of the polypeptide would be expected. Therefore, the effect of efferent electrical stimulation of the splanchnic nerves on the portal concentration of substance P was studied as well.

Materials and Methods

Animal and Blood Sampling

Eight adult cats of both sexes weighing 2.5—3.0 kg were used. Prior to the experiments the animals were fasted for 24 hours but had free access to water. Anesthesia was induced by ether and maintained with chloralose (50 mg/kg b.w. i.v.). Blood samples (2.5 + 2.5 = 5 ml each) were drawn before, during (1, 5, 10, 15 min) and after (5, 10, 15 min) nerve stimulation through a heparinized catheter inserted into the portal vein with the tip in the liver hilus. The total volume of blood samples from each animal was 40 ml. For volume substitution all animals were given 20 ml of saline through the femoral vein before the onset of electrical stimulation and an additional 20 ml were given during stimulation. Two animals served as controls and had identical operations but no nerve stimulation was performed. Blood samples were drawn according to the same time schedule. The samples were placed on ice and centrifuged within 30 min for 20 min at +4 °C, 3000 rpm. The plasma was deepfrozen until the assay was performed.