is also endorsed by current concepts of the cardiovascular reflex interplay[5].

Zusammenfassung. Nachweis eines latenten reflektorischen Blutdruckabfalls bein Kaninchen in Pentobarbital-Narkose nach der Denervation des Karotis Sinus und des Aortenbogens. Die Reflexauslösung erfolgt durch Steigerung des venösen Drucks im Sinus coronarius.

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31 October 1972.

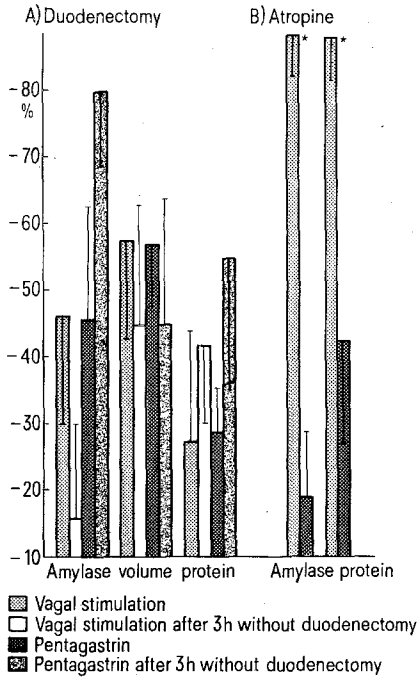
[5] P. I. KORNER, Physiol. Rev. *51*, 312 (1971).

Does Vagal Stimulation Liberate Secretin and/or Cholecystokinin in Pigs?[1]

Vagal stimulation is a potent stimulator of pancreatic secretion in pigs[2]. In dogs vagal section reduces the daily output of pancreatic juice[3]. This may result from depressed sensitivity of the pancreas to the pancreatropic hormones[3] but it may be that vagi release secretin and cholecystokinin from the mucosa[4]. We have attempted to decide between these two explanations.

Material and method. Pigs were anesthetized with i.v. chloralose. The pancreatic duct was cannulated, the pylorus clamped and the lesser omentum divided so that the entire pyloric part of the stomach was deprived of its vagal supply. The stomach was drained continuously via a stomach tube passed through the mouth. I.v. secretin[5] was given throughout the experiment at a rate of 0.25 U min in 2 ml of saline. Juice was collected at 5 or 10 min intervals depending on the secretory rate.

Stimulating electrodes were placed on both vagi and major branches 3–4 cm above the diaphragm. The vagi above the electrodes were crushed and tied tightly and the animals maintained on a respirator. Stimulation was always at 25 Hz and 10 volts.



A) Percent change in amylase and protein in response to vagal stimulation or pentagastrin after duodenectomy and after 3 h without duodenectomy compared with control response before. All values significantly less than the preduodenectomy or 1 h control. B) Effect of atropine on the amylase and protein responses to vagal stimulation or pentagastrin expressed as precent decrease from pre-atropine control. * Values significantly different from pre-atropine control.

In the 5 animals the pancreatic reponses to 10 ml of 1/10 *N* HCl given intraduodenally, 10 µg gastrin pentapeptide (pentagastrin)[6], 10 µg cholecystokinin (CCK)[7] and vagal stimulation were tested as a control.

After the controls, the whole small intestine between the pyloroduodenal junction and the ligament of Treltz was removed and CCK, pentagastrin and vagal stimulation repeated as before. Two or three 10-min-periods were allowed between each procedure or enough time to allow the volume of secretion to return to basal. Animals which did not respond to HCl were discarded.

In 9 control pigs, CCK, pentagastrin and vagal stimulation were repeated at intervals for 5 h to estimate decline in response with the passage of time. In the 5 duodenectomized and 2 of the control pigs, as the last procedure, the effect of 1/10 mg of atropine/kg on vagal stimulation was tested.

In every case the responses after duodenectomy were compared with the responses in the control animals after the same time interval using the non-paired *t*-test. Responses were compared also with the mean of the previous control.

Amylase was estimated using the dinitrosalicylic acid method in the Autoanalyzer[8]. It was expressed as mg of maltose/min. Total proteolytic activity was expressed as mg of tyrosine liberated from hemoglobin substrate in 10 min[9]. Protein was measured by optical density at 280 nm and expressed as mg of bovine albumin.

Results. Duodenectomy (Figure). With the passage of time the responses of the pancreas to all of the stimuli used fell slightly. A significant reduction in the amylase, protein and protease responses to vagal stimulation followed duodenectomy. The volume response was not significantly diminished. There were similar significant and equal depressions in the responses to pentagastrin and CCK.

There was no difference between the reduction in any vagal response following duodenectomy and that seen in control animals after 3 h of experimentation whether

[1] Supported by funds from National Science Foundation, Industria Distillers, and Veterans Administration Hospital, Omaha, Nebraska, USA.

[2] J. C. D. HICKSON, J. Physiol. *206*, 275 (1970).

[3] T. HAYAMA, D. F. MAGEE and T. T. WHITE, Ann. Surg. *158*, 290 (1963).

[4] H. J. MORELAND and L. R. JOHNSON, Gastroenterology (abstract) *58*, 1047 (1970).

[5] GIH Research Unit, Chemistry Department, Karolinska Institute, Stockholm, Batch 17042.

[6] Peptavalon®, Ayerst Research Laboratories, New York.

[7] GIH Research Unit, Chemistry Dept., Karolinska Institute, Stockholm, Batch 27021.

[8] P. BERNFIELD, *Methods in Enzymology* (Ed. S. P. COLOWICK and W. O. KAPLAN; Academic Press, Inc., New York 1955), p. 149.

[9] W. RICK, *Methods of Enzymatic Analysis* (Ed. H. U. BERGMEYER; Academic Press, Inc., New York 1963), p. 807.

calculated as percent difference or actual difference. In the case of pentagastrin the fall off in responses for protease and protein was significantly less following duodenectomy than after an equal time lapse without operation.

Atropine (Figure). Atropine, 3 mg/animal, significantly depressed the response of amylase, protein and portease to vagal stimulation by approximately 80%. It did not alter the responses to CCK or pentagastrin.

Discussion. HICKSON[2] has shown that vagal stimulation is effective in enterectomized, anesthetized pigs but has not shown whether or not it is less so than in intact animals. He has shown, as we have, that atropine does not reduce juice volume but does reduce enzyme secretion.

In these studies we have controlled the decline in gland responsiveness with the passage of time, and also, by using i.v. CCK and pentagastrin before and after duodenectomy, the effect of the surgery. It is evident that surgery has at least as profound an effect on the responses to CCK and pentagastrin as on vagal stimulation. The reduced response to vagal stimulation after duodenectomy is more than offset by the spontaneous loss in gland sensitivity with the passage of time and by the decline in sensitivity to CCK and pentagastrin following duodenectomy. We have been unable, therefore, to produce evidence in the chloralose-anesthetized pig that vagal stimulation releases either secretin or CCK.

Zusammenfassung. Beim Schwein wird mittels Parameter des Pankreas nachgewiesen, dass Sekretin- oder auch Cholecystokinin-Sekretion vom Vagus reguliert wird.

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A Quantitative Investigation of the Response to Injury of the Central Nervous System of Rats Treated with ACTH and Triiodothyronine

Although interruption of a tract in the mammalian central nervous system (CNS) is not usually followed by any functional regeneration, histological signs of axonal growth and/or indications of some return of function have been claimed following the administration of the thyroid hormones triiodothyronine (T3) and tetraiodothyronine (T4),[1,2] and adrenal corticoids[3,4] or substances which cause their release, such as ACTH[1,5] or the bacterial polysaccharide 'Pyromen'[3,6–9].

Most workers consider that circulating corticoids stimulate the phagocytic activity of macrophages, depress the cellular and fluid phases of inflammation and decrease the formation of connective tissue at the site of a wound in the CNS and thereby facilitate regeneration by providing an environment through which axons grow more easily. On the other hand thyroid hormones may promote regeneration by increasing protein synthesis in central neurons[1].

This paper reports the findings of a quantitative study on the effects of ACTH and T3 on the glial response within the corpus callosum following surgical incision.

Materials and methods. Adult male Wistar rats aged 40 days post partum were used. 30 animals were allocated to each of the following 4 treatment groups: 1. normal saline; 2. ACTH (Synthecin Depot CIBA); 3. T3 (Glaxo Freeze Dried preparation); 4. ACTH and T3 together. Within each group 5 animals were allocated for study at 1, 2, 5, 10, 50 and 100 days after cutting the corpus callosum. Injections were given 6 h before making the lesion and at 24 h intervals thereafter. The total number of injections received by each animal surviving for a period of 1, 2, 5, 10, 50 or 100 days were 2, 3, 6, 7,7 or 7 respectively. The doses given (per 100 g body weight) were as follows: 0.75 ml normal saline; 10 μg ACTH; 3 μg T3; 10 μg ACTH + 3 μg T3 (see FERTIG et al[1] for rationale of dosages). The entire corpus callosum was cut stereotaxically along a saggittal plane 2 mm from the midline.

The glial reaction occurring in the corpus callosum 1, 2, 5 and 10 days after making the lesion was measured counting the number of cells in 5 sections from each animal, occupying a grid 75 μm × 75 μm placed 50, 150, 250, 500 and 1000 μm from the boundary of the wound in sections stained with cresyl violet. As well as estimating total density, the cell population was differentiated into seven sub-populations, namely: light oligodendroglia, medium oligodendroglia, dark oligodendroglia, astrocytes, microglia and endothelial cells according to their nuclear characteristics[10–14] and 'cytoplasmic cells' according to both the configuration of chromatin and the presence of a stainable cytoplasm (a group of cells probably analogous to 'brain macrophages').

The functional tests for regeneration of axons consisted of eliciting an interhemispheric response (IHR) in 2 groups of 5 animals surviving for 50 and 100 days after making the lesion. The IHR is mostly eliminated by cutting this tract except for a characteristic low amplitude residual response[15]. Qualitative histological examination of silver stained sections from the brains of these animals were also carried out.

The activity of the ACTH and T3 were tested by measuring the release of corticosterone using a fluori-

[1] A. FERTIG, J. A. KIERNAN and S. S. A. S. SEYAN, Expl. Neurol. *33*, 372 (1971).
[2] J. E. HARVEY and H. H. SREBNICK, J. Neuropath. exp. Neurol. *26*, 661 (1967).
[3] C. D. CLEMENTE, in *Regeneration in the Central Nervous System* (Ed. W. F. WINDLE; Thomas, Springfield, Illinois 1955), p. 147.
[4] L. W. FREEMAN, in *Regeneration in the Central Nervous System* (Ed. W. F. WINDLE; Thomas, Springfield, Illinois 1955), p. 195.
[5] R. E. MCMASTERS, J. comp. Neurol. *119*, 113 (1962).
[6] W. F. WINDLE and W. W. CHAMBERS, J. comp. Neurol. *93*, 241 (1950).
[7] J. L. ARTETA, J. comp. Neurol. *105*, 171 (1956).
[8] D. SCOTT, in *Regeneration in the Central Nervous System* (Ed. W. F. WINDLE; Thomas, Springfield, Illinois 1955), p. 181.
[9] J. L. LITTRELL, in *Regeneration in the Central Nervous System* (Ed. W. F. WINDLE; Thomas, Springfield, Illinois 1955), p. 219.
[10] I. SMART and C. P. LEBLOND, J. comp. Neurol. *116*, 349 (1961).
[11] E. K. ADRIAN and B. E. WALKER, J. Neuropath. exp. Neurol. *21*, 597 (1962).
[12] S. MORI and C. P. LEBLOND, J. comp. Neurol. *135*, 57 (1969a).
[13] S. MORI and C. P. LEBLOND, J. comp. Neurol. *137*, 197 (1969b).
[14] S. MORI and C. P. LEBLOND, J. comp. Neurol. *139*, 1 (1970).
[15] G. FLINT and M. BERRY, in preparation.