A simple technique for gastric parietal cell vagotomy in the rat

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Summary. A rapid and simple technique of parietal cell vagotomy in the rat caused a marked inhibition of basal and stimulated gastric secretion with minimal effect on gastric emptying and gastric volume.

Preservation of the vagal innervation to the gastric antrum and pylorus during operations for the clinical treatment of duodenal ulcer disease has been reported[1-3]. In man[1-3], dogs[4,5] and rabbits[6] due to the anatomy of the vagus nerve, with its numerous branches to the parietal cell mass, the operation of parietal cell vagotomy is often tedious and time-consuming. This study reports the technique of parietal cell vagotomy (PCV) in the rat and assesses the response to duodeno-ulcerogenic doses of gastric secretagogues.

Material and methods. Male Wistar rats, weighing between 150 and 200 g were deprived of food for 12 h and then anaesthetized with ether B. P. Through a 2 cm upper midline incision and using a Mediscope Mark II operating microscope, the anatomy of the left anterior and right posterior vagal trunks was examined from the cardio-oesophageal junction in the caudad direction. At the cardio-oesophageal junction the left vagus divides into 2 nerves. A branch continues along the lesser curve to the antrum and pylorus (nerve of Latarjet) and the vagal trunk then supplies the anterior wall of the body of the stomach after dividing into 2 branches (figure 1). Posteriorly the antral nerve arises from the right vagal trunk just proximal to the gastro-oesophageal junction and the vagus nerve supplying the body and rumen is more readily found.

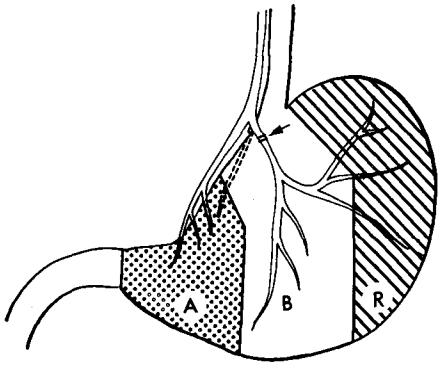

Fig. 1. Diagramatic illustration of the left anterior vagus nerve dividing into the nerve to antrum and pylorus (A), nerve to the rumen (R) and body of the stomach (B). The arrow represents the site of division of the anterior branch of the vagus nerve to the body and rumen of the stomach.

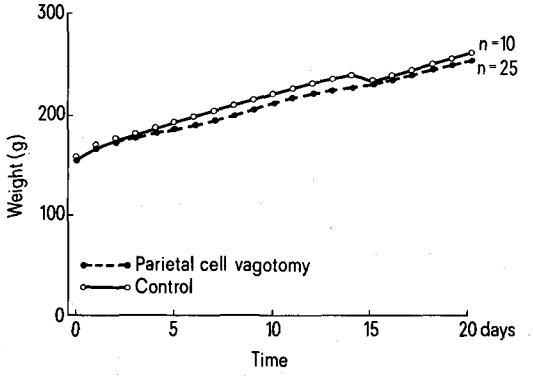

Fig. 2. Weight of rats after a parietal cell vagotomy (n = 25) and control (n = 10).

Anteriorly and posteriorly, 2 00000 silk sutures were gently passed around the continuation of the vagal trunks distal to the origin of the nerve to the antrum. The neurovascular bundles were ligated and divided between the sutures. The mean time to carry out this operative procedure was 8 ± 2.4 min. Control animals underwent similar anaesthesia and the laparotomy consisted of mobilisation of the stomach, identification of the vagal trunks and their branches but without division of the vagal nerves. Water and food (Diet 41 B, Christopher Hill, Dorset) were immediately available postoperatively and the rats were individually weighed at 09.00 h for 5 days preoperatively and daily postoperatively.

Immediately after completion of the parietal cell vagotomy (PCV), the pylorus was ligated, a PVC gastrostomy tube inserted and gastric juice was collected in 20 rats for 60 min under basal and 120 min stimulation with a continuous s.c. infusion of 2 gastric secretagogues, pentastrin (4 $\mu g\ kg^{-1}\ min^{-1}$) and carbachol (0.8 $\mu g\ kg^{-1}\ min^{-1}$)[7,8]. After 3 weeks, following an overnight fast, the gastric volume was determined in normal rats, sham-operated and rats who had undergone a parietal cell vagotomy[9]. The upper gastrointestinal tract was then carefully opened along the greater curvature of the stomach and the anti-mesenteric surface of the duodenum and the mucosa examined for petechiae and ulceration.

Results. The PCV rats had a similar pattern of weight gain to the controls (figure 2). Gastric secretory tests revealed a significant reduction in the basal and stimulated acid output. The basal secretion in the control rats was 0.54 ml/60 min at a concentration of 60.2 mEq/l. PCV decreased the volume of gastric juice to 0.27 ml and it was achlorhydric (pH 7). Stimulation with the gastric secretagogues increased the volume in the control rats to 2.1 ml/60 min at an acid concentration of 105 mEq/l. However, in the PCV rats this volume was significantly less, 0.2 ml at a concentration of 47 mEq/l ($p < 0.01$).

A barium meal at 1 week and 3 weeks showed complete and adequate gastric emptying in both the PCV and control rats 10 min after introduction of the barium. The gastric volume 3 weeks after a PCV was 3.5 ml (SEM 0.4) and in the control rats 2.2 ml (SEM 0.2) ($p < 0.05$) This

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indicated that there was minimal associated gastric retention. The gsatric and duodenal mucosa in rats having undergone a parietal cell vagotomy was normal.

Discussion. We have described a simple technique of parietal cell vagotomy in the rat which aimed at denervation of only the acid-secreting part of the stomach. This selective denervation of the body and the rumen in the rat produced an effective denervation of the 'parietal cell mass' and retained the antral and pyloric innervation. Secretomotor function of the stomach, studied after PCV showed a definite reduction in acid secretion, of both basal and secretagogue-stimulation, and the maintenance of gastric 'emptying'. These effects eliminate the complication found after a truncal vagotomy without drainage which results in gross stasis in the stomach[9]. The surgical anatomy of the vagus nerve in the rat allows the operation of PCV to be carried out rapidly with minimal operative trauma, rapid recovery of the rats and without impaired nutrition due to gastric retention.

The technique of parietal cell vagotomy in the rat now provides a method of studying its effect on experimental duodenal ulcers and response to the addition of gastric anti-secretory agents as the H_2-receptor antagonists. Furthermore, the aetiology and pathophysiology of recurrent duodenal ulceration following parietal cell vagotomy can now be studied in the rat.

Application of chemicals in early chick embryos in ovo: A precaution

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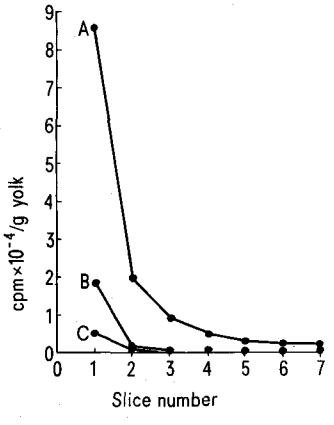
Summary. A passive diffusion method is described and is compared with other methods for the application of chemicals in early chick embryos in ovo.

Work on the effect of chemicals on chick morphogenesis and growth in ovo has mainly used the window method[2], that is, opening a window in the egg and injecting the substance directly under the blastoderm. However, injecting a substance, especially in large volumes, makes the blastoderm lose its intimate and delicate contact with the underlying yolk mass, and results in abnormal development. In the worst cases, it imposes a strong mechanical stress on the blastoderm and makes it blow-up and burst in a baloon-like manner.

To avoid malformations of the developing embryo, the chemical substance must be injected in the yolk sac at a place distant to the embryo. However, the main question is whether the injected material can distribute itself throughout the yolk and reach the embryo in a uniform manner. During the course of a series of experiments, we injected a D-chloramphenicol-^{14}C (CAP) solution into eggs to determine the mode of its diffusion throughout the yolk. In an alternate method, we applied a CAP solution onto the embryo.

Materials and methods. Freshly laid chicken eggs were supplied by a local hatchery. After locating the embryos by candling, a hole was opened at the air space of the eggs. This permitted the embryonic membranes to fall free from the shell membranes. A CAP solution (3×10^{-4} M) which included ^{14}C-CAP (0.04 μCi/ml, 7.94 mCi/mmoles) was either injected into the yolk sac or applied on top of the embryo. For this, either a volume of the solution was applied on the embryo after removal of egg white with a syringe, or the CAP solution was introduced in the pit provided by the exposed air space and was allowed to diffuse through the extraembryonic membranes. The eggs were incubated at 38 °C for 48 h. At the end of the incubation period, they were placed in the freezer until use. The egg white was removed from the frozen egg, and the yolk sac was cut lengthwise into 2 halves. Beginning at the blunt end (slice 1), transparent slices were cut every 5 mm from the right and left yolk halves. The slices were spread on fibre glass filters (Whatman GF/C, 2.5 cm) and radioactivity was determined by liquid scintillation with 10 ml of toluene:flour-Triton-X-100 scintillant. Corresponding slices from the right and left yolk sac halves gave the same counts within 6%.

Results. The figure (A) shows the distance the CAP solution travelled after its injection into the yolk sac. CAP moves very slowly from the place of its injection and is not distributed uniformly throughout the yolk. The figure (B) shows the distance travelled through the yolk sac, after the CAP solution was allowed to diffuse through the air sac membrane. 1 ml of CAP solution diffuses through the air space membrane in 90 min. CAP solution enters but does not move beyond the first 8 mm into the yolk sac.



Distance travelled by 0.6 ml CAP solution (3×10^{-4} M) with 0.04 μCi/ml ^{14}C-CAP (7.94 mCi/mmole) through the yolk sac. *A* The CAP solution was injected into the yolk sac next to the sinus terminalis. *B* The CAP solution was allowed to diffuse through the air sac membrane. *C* The CAP solution was applied onto the embryo after the removal of 1 ml of egg white. Conditions as described in 'materials and methods'.

1 Acknowledgments. We thank Mrs Irene Panagopoulou for expert technical assistance.

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