

MICROSCOPIC STUDY OF THE RABBIT PANCREAS AFTER VAGOTOMY

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الدراسة المجهرية لبنكرياس الأرنب بعد قطع العصب الحائر

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في هذه الدراسة المجهرية تم الكشف عن التغيرات الشكلية في بنكرياس الأرنب بعد قطع العصب الحائر. فقد تم ملاحظة التغيرات التركيبية في خلايا البنكرياس الكأسية ، وكذلك في جزر لانجرهانز بعد أسبوعين وثلاثة أسابيع من قطع العصب الحائر.

ان قياس مستوى الجلوكوز في الدم لحيوانات التجارب الصائمة وعلى فترات مختلفة من عملية قطع العصب الحائر وكذلك قياس منحنى الجلوكوز التحملي في الدم لدليل يؤكد التغيرات التركيبية في جزر لانجرهانز بعد قطع العصب الحائر.

ان نتائج هذه الدراسة تدل على ان البنكرياس يعتمد في تغذيته العصبية على العصب الحائر وان قطع العصب الحائر قد يؤدي الى العديد من اختلالات الأيض . هذه النتائج ايضا تفسر ان الاختلالات في نسبة الجلوكوز والأنسولين والتي تحدث بعد عملية زرع البنكرياس هي غالبا ناتجة عن تآكل في الخلايا الصماء والتي تعزى الى قطع الأعصاب عن البنكرياس.

على أي حال ان التغيرات التركيبية لأجزاء البنكرياس الصماء وغير الصماء الناتجة عن قطع العصب الحائر قد تفسر ان الضغط النفسي والصدمات العصبية في الإنسان قد تسبب امراض ومضاعفات في البنكرياس.

Key-words : Pancreas, vagotomy microscopic study

ABSTRACT

The microscopic study of the morphological changes in the rabbit pancreas were investigated after vagotomy. Structural changes were observed in the pancreatic acinar cells and in the islets of langerhans two and three weeks after vagotomy. Measurement of the fasting blood glucose level at different intervals of time post operatively and also the glucose tolerance test confirmed the structural changes of the islets of the pancreas after vagotomy.

The results of this study indicate that the pancreas is dependent on the innervation by the vagus nerve and

vagotomy inflicts numerous metabolic abnormalities. These results also explain that post transplantation abnormalities in glucose and insulin levels are mostly due to degeneration of the endocrine cells which are attributed to denervation.

However, structural changes in the exocrine and endocrine parts of pancreas after vagotomy could explain why stress and neurogenic shock in human causes pancreatic complications.

INTRODUCTION

Much work has been done on various aspects of pancreas and in different species [1,2,3]. In rabbit, the pancreas is a very small organ embedded in the mesentery of small intestine like tree branches and the pancreatic duct opens in the second part of duodenum similar to the human pancreas [2]. Recently, several important studies have been concentrated on pancreatic transplantation [4,5] as well as pancreatic denervation and its complications [6,7]. The effect of vagotomy on the cardiac muscle of monkey and stomach of the ferret has been studied [8,9,10] but to our knowledge there is no previous description of the effect of vagotomy on the rabbit pancreas. Therefore, the aim of this study is to investigate the effect of vagotomy on the exocrine and endocrine parts of the pancreas which may add some information to the literature specially in the aspect of pancreatic transplantation.

MATERIALS AND METHODS

Eight adult rabbits of both sexes ranging in body weight from 700 to 1500 gm were used in this study. The animals were anaesthetized by inhalation of chloroform, and divided into three main groups. The first group of two animals was the control group, the second group of three animals were allowed to survive for two weeks after subdiaphragmatic vagotomy operation while the three animals of the third group were allowed to survive for three weeks after the operation. Subdiaphragmatic vagotomy was performed by cutting both the ventral and dorsal trunks of vagus nerve below the diaphragm after opening the abdomen by midline incision and after isolation and ligation of both vagus nerves. All animals were sacrificed by perfusion method through the left ventricle of the heart with normal saline then with 10% formaldehyde fixative. The pancreas was dissected out, cut into small pieces and placed in the fresh fixative for 48 hours. Tissues were then dehydrated in alcohol, cleared in xylene and then embedded in paraffin

wax. The tissue blocks were cut into 10 μ m thick sections, then rehydrated and stained with Hematoxyline and Eosin. The tissues were then examined with the light microscope.

RESULTS

Microscopic examination of the pancreas of control animals showed that the exocrine component consists of closely packed secretory acini. Each acinus is made up of irregular cluster of secretory cells which drain into a minute central duct (Fig. 1). The endocrine tissue of the pancreas forms islets of langerhans of various sizes scattered throughout the exocrine tissue (Fig. 1). The islets contain a variety of different types of cells.

Measurement of the blood glucose level and glucose tolerance test of control animals were normal between 3.9 - 4.5 mmol/L (Table 1,2). Microscopic examinations of the exocrine portion of the pancreas, two weeks after vagotomy, showed large vacuoles between the secretory acini cells due to degeneration. The acini were not bounded by a clear membrane. Three weeks after vagotomy, more structural changes were noticed and more vacuoles were observed with distinct cell membrane (Fig. 2).

Microscopic examination of the endocrine portion of the pancreas two weeks after vagotomy showed degenerated islets cells with invisible nuclei. Three weeks after vagotomy, the islets cells disappeared and became replaced by a bloody structure (Fig. 3).

Measurement of fasting blood glucose level at different intervals of time after vagotomy in comparison to control animals were significantly increased (Table. 1). In addition, the glucose tolerance test two hours after injection of glucose in the animals who survived three weeks after vagotomy were significantly increased (Table. 2). One animal was dead two days after injection of glucose from a diabetic coma.

Table (1)
Fasting blood sugar

Period of time after vagotomy	Control animals	Experimental animals
1 week	3.9 - 4.2 mmol/L	4.5 - 7.5 mmol/L
2 weeks	3.9 - 4.2 mmol/L	6.8 - 8.5 mmol/L
3 weeks	3.9 - 4.2 mmol/L	6.9 - 8.6 mmol/L

Table (2)

Glucose tolerance test 2 hours after injection of glucose

Period of time after vagotomy	Control animals	Experimental animals
3 weeks	4.0 - 4.5 mmol/L	7.5 - 9.5 mmol/L

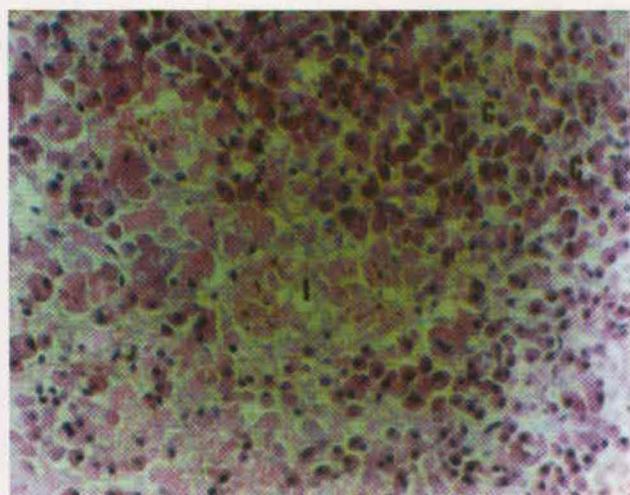


Fig. (1) :

Light micrograph of a section in control rabbit pancreas showing the exocrine and endocrine components of the pancreas.

C: Secretory pancreatic acini.

I : Islets of langerhans scattered between the acini throughout the exocrine tissue (H & E x 400).

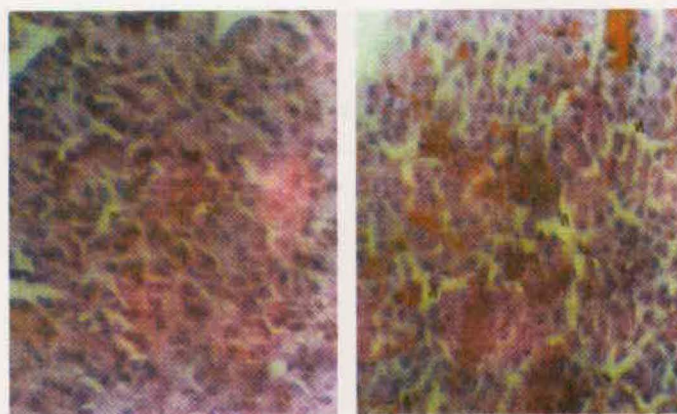


Fig. (2) : (A) (B)

Light micrograph of a section in control rabbit pancreas showing the morphological changes in the pancreatic acinar cells two weeks (A) and three weeks (B) after vagotomy.

V : Vacuoles between the secretory acini cells due to degeneration (H & E x 150)

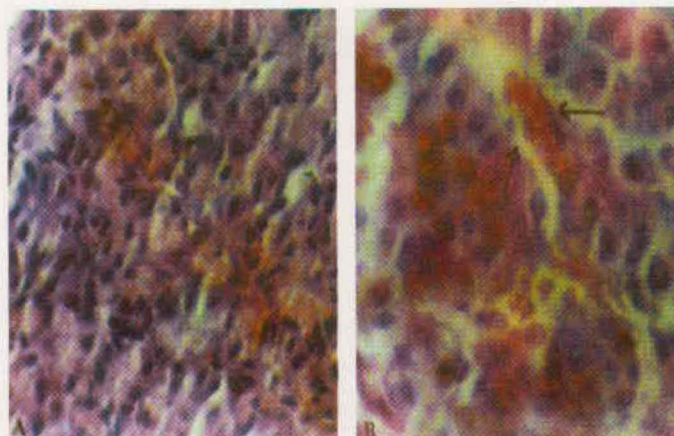


Fig. (3) : (A) (B)

Light micrograph of a section in rabbit pancreas showing the morphological changes in the islets of langerhans.

(A) Degenerated cells of islets of langerhans (arrow) two weeks after vagotomy (H &E x 150).

(B) Islets of langerhans cells are replaced by a bloody structure (arrows) three weeks after vagotomy (H & E X 400).

DISCUSSION

The morphological appearance of the exocrine and endocrine parts of control pancreas were similar to that described in previous studies [1,2,11]. The pancreas is richly innervated by the autonomic nervous system but the significance of this on pancreatic secretion is not well understood [11,12]. However pancreatic denervation has been reported with metabolic abnormalities specially in pancreatic transplantation [4,5,6,13]. It is unclear in pancreatic transplantation whether denervation or splanchnic venous drainage is responsible for the metabolic abnormalities [6]. In this study, the morphological changes in the acinar cells of rabbit pancreas two and three weeks after vagotomy were demonstrated and these findings suggest that the previously described post transplantation metabolic abnormalities are attributed to denervation which causes morphological changes in pancreatic acinar cells. Vagotomy is still considered one of the surgical treatment of peptic ulceration in which the parietal cells of the stomach are denervated. However surgical complications are still recorded [14,15]. The effect of vagotomy on the ferret stomach was studied [9,10] and the morphological changes in the myenteric ganglia after unilateral vagotomy was demonstrated. This study also demonstrated morphological changes in the exocrine and endocrine parts of pancreas two and three weeks after vagotomy. It is known that acute pancreatitis is one of the complications of vagotomy which is caused by the escape of pancreatic juice from pancreatic duct into the pancreatic tissues [11]. Higher level of blood glucose level and glucose tolerance test were noticed at different intervals of time post operatively in comparison to the control. These findings confirmed the morphological changes in the islets of pancreas. This result is in agreement with the abnormalities in the glucose and insulin post transplantation which are mostly attributed to denervation [16]. Stress also injures the pancreas by excess of secretion of catecholamines and this causing microcirculatory disturbances and changes in the blood glucose level [17]. However nerve stimulation induced mesenteric vasoconstriction and catecholamines also impaired the blood flow [18].

In conclusion, this study indicates that vagotomy causes morphological changes in the pancreatic acinar cells and in the islets of langerhans and these results could explain the

numerous metabolic abnormalities post transplantation of pancreas. Furthermore these findings may explain why the stress and neurogenic shock in man causes pancreatic complications and diseases similar to vagotomy operation in peptic ulcer patients.

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