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Case report

Pancreatic polypeptide rich tissue in the annular pancreas

A distinctive feature of ventral primordium derivatives

F. Sessa[1], R. Fiocca[1], P. Tenti[1], E. Solcia[1], E. Tavani[2], and S. Pliteri[3]

[1] Institute of Pathologic Anatomy, University of Pavia, Via Forlanini 16, I-27100 Pavia and [2] Pathologic Anatomy and [3] Surgical Divisions, S. Carlo Hospital, Milano, Italy

Summary. A case of annular pancreas found in a 45 year man was successfully treated by surgical resection. An histological and immunohistochemical study of the endocrine component within the resected annular tissue showed its identity with that of the postero-inferior head in the normal adult pancreas, both tissues being characterized by very high PP cell content, extremely few A cells and irregularly shaped islets.

This observation supports a common origin of the two tissues from the ventral pancreatic primordium.

Key words: Annular pancreas – Ventral lobe – PP cells – Immunohistochemistry

In the human pancreas, the posterior and inferior part of the head is characterized by abundant, irregularly shaped islets with a very high proportion of pancreatic polypeptide (PP) cells (Paulin and Dubois 1978; Malaisse-Lagae et al. 1979; Rahier et al. 1979; Fiocca et al. 1973). This PP-rich tissue has been suggested to correspond to the portion of the pancreas originating from the ventral primordium, although the exact inter-relationship remains difficult to ascertain in the adult pancreas, due to the relatively intimate fusion of dorsal and ventral primordial derivatives. Annular pancreas, a well known malformation caused by defective migration of the ventral primordium and lack of fusion with the dorsal pancreas (Lecco 1910), offers an unique opportunity to verify whether pancreatic tissue of obviously ventral origin is of PP-rich type. A positive answer to this question has been suggested by the study of a fetal case (Stefan et al. 1982). An adult case of this malformation, allowing us to compare fully developed annular tissue with the posterior head tissue, is investigated in the present paper.

Offprint requests to: E. Solcia at the above address

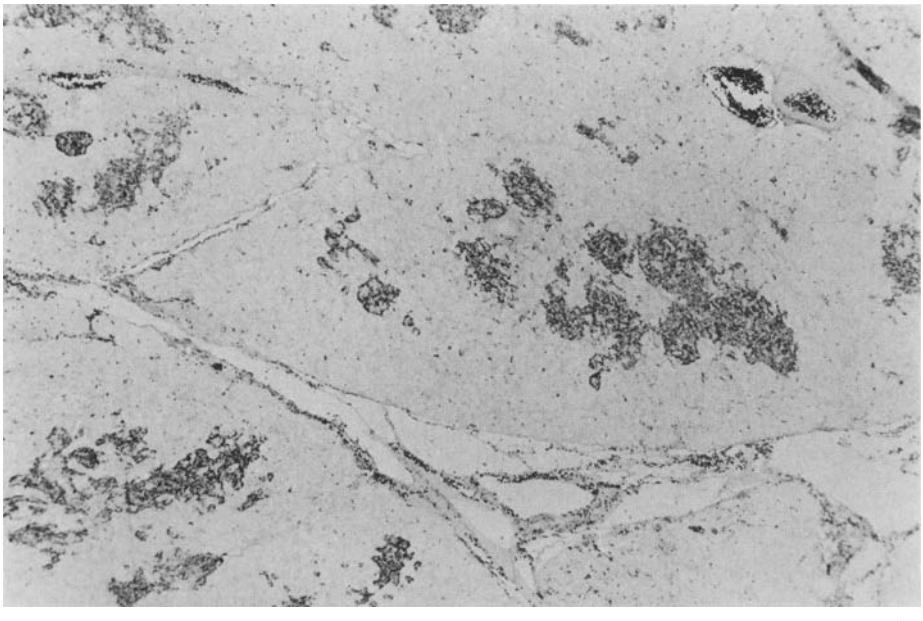

Fig. 1. Section of annular tissue showing abundance of PP immunoreactive endocrine cells grouped in irregular islets or scattered in the exocrine tissue. Immunoperoxidase, × 30

Case report

A 45 year man suffering from post-prandial epigastric pain was found at X-ray examination to have stenosis of the second part of the duodenum. At surgery, an annular pancreas was found. At its left end, the anterior part of the periduodenal ring was isolated smoothly and easily from the head of the pnacreas initially and then from the anterior wall of the duodenum. The two distal centimeters of the pancreatic tissue thus isolated were resected, while the right and posterior part of the annulus – fused at its left end with the pancreatic head – was left in situ. Via the lumen of its main duct, pancreatography of the remaining annular pancreas was performed. It showed continuity of this duct along the right and posterior part of the annulus and its fusion with the duct of Wirsung two centimeters before the ampulla. The surgical procedure proved curative for duodenal stenosis and related digestive symptoms. The patient remains symptom free 4 years after surgery (Pliteri et al. 1983).

Material and methods

The piece of pancreatic tissue (20 × 15 × 10 mm) removed was sliced perpendicularly to its length, fixed in 4% buffered formaldehyde for 24 h, dehydrated in alcohol and embedded in paraffin. Some sections were stained with haematoxylin-eosin, Grimelius' silver (Grimelius 1968) and lead-haematoxylin (Solcia et al. 1969). The indirect immunofluorescence and immunoperoxidase (PAP) technique (Sternberger 1979) was applied overnight to other sections using the following antihormone sera:

1) rabbit anti-human pancreatic polypeptide (hPP) serum n.248/4 (from Dr. R. Chance, Lilly Research Lab., Indianapolis), diluted 1:2,000;

2) rabbit serum n.221 against the C-terminal exapeptide of PP (Fiocca et al. 1982), diluted 1:2,000;

3) rabbit anti-glucagon serum n.K5563, C-terminal specific (from Dr. L. Heding, Novo Research Institute, Denmark) diluted 1:2,000;

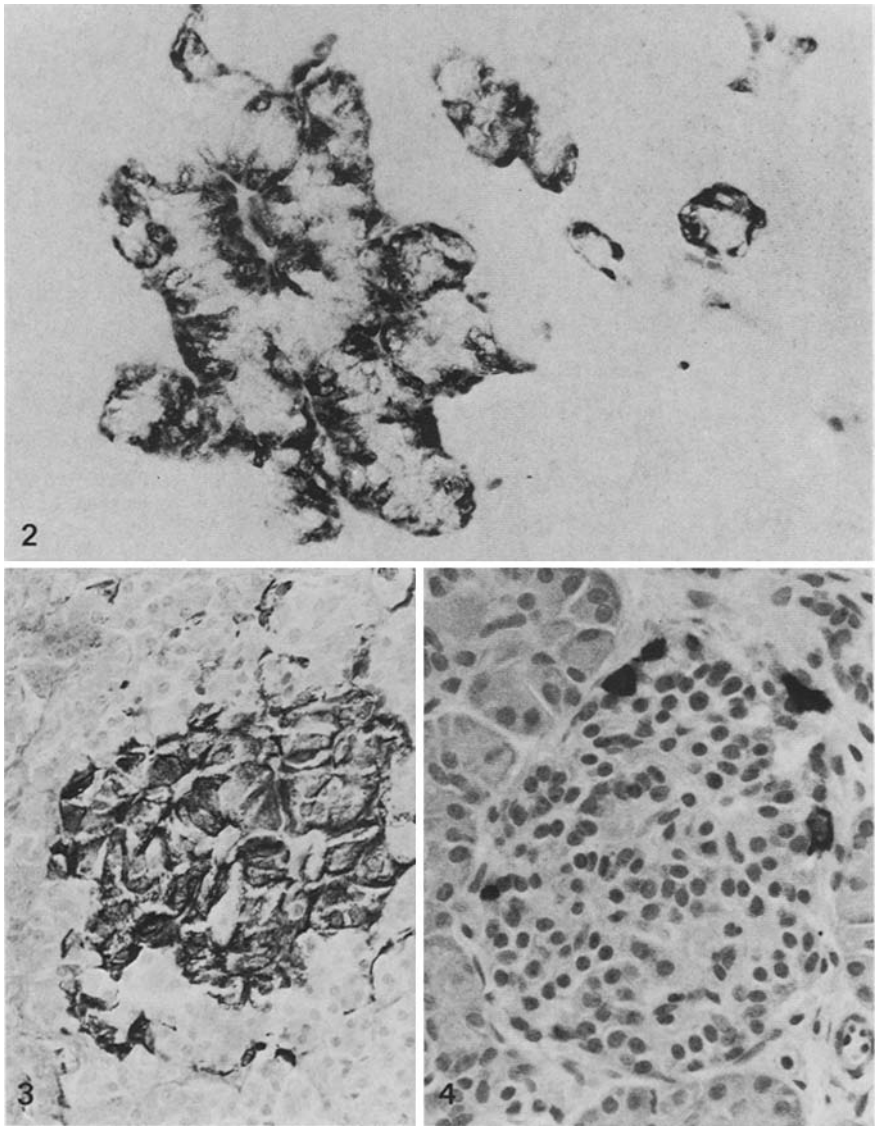

Fig. 2. Annular pancreas with PP-immunoreactive cells forming an irregular islet of trabecular structure and several extrainsular clusters. Immunoperoxidase, × 350

Fig. 3. Islet of the annular pancreas showing PP cells stained with Grimelius' silver. × 250

Fig. 4. Tail of normal human pancreas showing a few PP-immunoreactive cells at the periphery of a regular islet. Immunoperoxidase – Haematoxylin, × 350

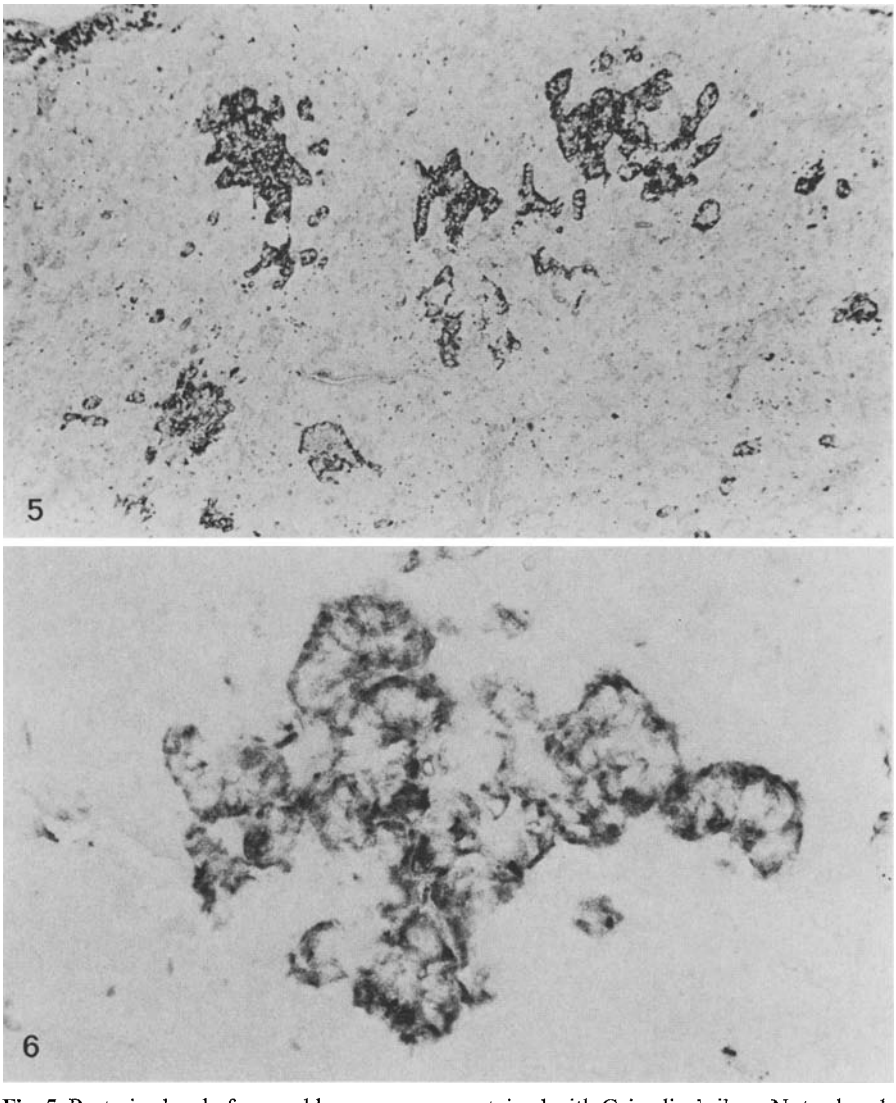

Fig. 5. Posterior head of normal human pancreas stained with Grimelius' silver. Note abundant argyrophil (mostly PP) cells forming irregular islets, ribbons and small clusters or scattered in the exocrine tissue. × 80

Fig. 6. Irregular, trabecular islet of the posterior head stained with anti-PP serum. Immunoperoxidase, × 250

4) rabbit antisomatostatin serum (from Dr. O. Crivelli, Ospedale Maggiore, Torino, Italy), diluted 1:1,000; and

5) guinea-pig anti-insulin serum (from Sorin, Saluggia, Italy), diluted 1:5,000.

Appropriate specificity controls, including the absorption of antisera with homologous and heterologous peptides and the use of non immune sera, were performed as in previous studies (Buffa et al. 1979). Parallel investigations were also done on biopsies taken from normal pancreata, including the postero-inferior part of the head where PP-rich islets had already been detected (Fiocca et al. 1983).

Results

In haematoxylin-eosin preparations the *annular* pancreatic tissue was characterized by the striking abundance of clear endocrine-like cells forming irregularly shaped, poorly vascular islets, small solid aggregates of polygonal cells and ribbon-like cords of monolayered columnar cells, or even scattered as single elements in the exocrine tissue, both in the acini and ducts. With the exception of a few, small, peripheral lobules – separated from the remaining tissue by relatively thick bands of fibroadipose tissue – which were remarkably deficient in endocrine cells, the endocrine component was distributed throghout the annular pancreas, with some preference for the inner lobules and the juxtaductal tissue.

With PP-antisera most of these endocrine-like cells proved heavily immunoreactive (Figs. 1 and 2). PP cells accounted for about 60–70% of the endocrine cells composing the irregular islets, – where B cells and a few somatostatin D cells also occurred – and for most endocrine cells scattered in the exocrine tissue or forming solid aggregates and ribbons. Glucagon-immunoreactive cells were exceedingly rare (around 0.1% of the whole endocrine cell population). PP cells showed consistent reactivity with Grimelius' silver (Fig. 3) and stained moderately with lead-haematoxylin.

The endocrine tissue of the PP-rich area in the postero-inferior head of *normal* adult pancreas (Figs 5 and 6) showed morphological and histochemical patterns essentially identical with those found in the annular pancreatic tissue, although regular, PP-poor islets were sometimes found adjacent to, and occasionally admixed with, the PP-rich tissue. Only PP-poor islets were found in the remaining pancreas (Fig. 4).

Discussion

The peculiarity and close similarity of their endocrine component clearly show the structural homology of annular and posterior head tissues and strongly suggest their origin from equipotent pancreatic primordia. The origin of the annular pancreas from the ventral primordium, first shown by Lecco (1910), is now generally accepted (Langman 1981; Pliteri et al. 1983). Thus, the ventral origin of the postero-inferior head, already suggested on embryological and cytological grounds (Paulin and Dubois 1978; Malaisse-Lagae et al. 1979; Rahier et al. 1979) and supported by the study of a fetal case of annular pancreas (Stefan et al. 1982), is confirmed by our findings in an adult case of the same disease which allow us to establish the morphological and cytochemical homology of fully developed annular and posterior head tissues.

The peculiar endocrine component of the "ventral lobe" pancreas, also stressed by the distinctive dltrastructure of its overwhelming PP (F) cell population (Fiocca et al. 1983), may have some functional counterpart, given the modulatory action of PP on pancreatic exocrine secretion (Lin 1980), the close association of the PP-rich area with the main pancreatic and biliary ducts and the abundance of PP cells in the epithelium lining medium and small size ducts of such area. It seems interesting that well differentiated pancreatic PP cell (Larsson et al. 1976; Bordi et al. 1977) or F cell (Capella

et al. 1977) tumors showed a remarkably trabecular structure mimicking the PP cell ribbons of human "ventral lobe" pancreas, and that primary PP-cell tumors may arise in the liver (Warner et al. 1980; Sessa et al. 1983) or papilla of Vater (Ljungberg et al. 1981), both of which are embryologically related to the ventral pancreatic primordium.

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