

LETTER TO THE EDITORS

## Annular pancreas as graft for pancreas transplantation. Technical considerations and long-term follow-up of two successful cases

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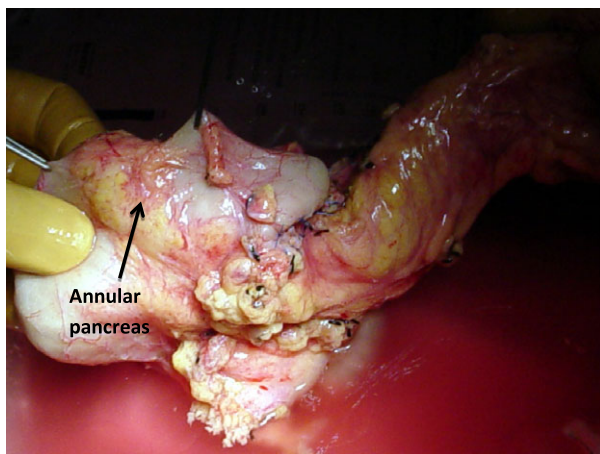
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Dear Sirs,

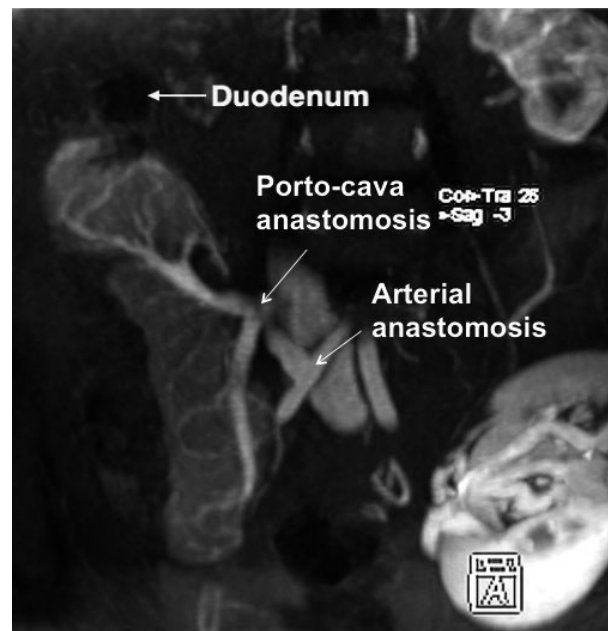
Annular pancreas consists of a band of pancreatic tissue that encircles the descending part of the duodenum with smooth continuation to the pancreatic head. About two-thirds of cases with annular pancreas remain asymptomatic for life [1], but several complications such as acute pancreatitis [2], duodenal stenosis, peptic ulceration, and chronic pancreatitis have been associated with this anomaly [3–5]. To our knowledge, only two pancreas transplants have been reported using grafts that showed annular pancreas, both with a short follow-up time (1 and 6 months, respectively) [6,7]. We analyze our two cases of annular pancreas grafts with long-term follow-up after transplant (Figs 1 and 2).

None of our donors had presented previous gastrointestinal symptoms. A complete annular pancreas was

identified on the second duodenal portion with small but insignificant duodenal stenosis in both cases. On the back table, we prepared the pancreaticoduodenal grafts with 6–8 cm of duodenum, which were subsequently implanted, in a caudal position, on the right iliac fossa. The portal vein was anastomosed end-to-side to the distal caval vein, and the arterial Y-graft of the pancreas was anastomosed end-to-side to the common iliac artery of the recipient. The duodeno-cystostomy was constructed 1.5 cm proximal to the annular pancreas in the first case, and a side-to-side duodeno-ileostomy to a point 100 cm proximal to the ileocecal valve was constructed in the second case. Postoperative course of recipients was uneventful. After a long-term follow-up of 11.5 and 7.5 years, respectively, none of our patients has developed clinical evidence of pancreatitis, obstruction, or rejection, and currently pancreas function tests show values within normal limits (Table 1).



**Figure 1** Annular pancreas graft.



**Figure 2** RMI 8 years after transplant of annular pancreas in recipient 1.

**Table 1.** Characteristics of annular pancreas grafts and recipients

|                                  | Case 1   | Case 2  |
|----------------------------------|--|---|
| <b>Donor characteristics</b>     |  |   |
| Age at SPKT* (year)              | 19   | 30  |
| Gender                           | Male   | Male  |
| Cause of death                   | Head trauma  | Head trauma   |
| Cardiac arrest                   | No   | No  |
| Vasopressor use                  | No   | No  |
| Serum glucose (mg/dl)            | 152  | 117   |
| Serum creatinine (mg/dl)         | 0.86   | 0.6   |
| Serum amylase (IU/l)             | 799  | 120   |
| Serum sodium (mEq/l)             | 142  | 120   |
| Hemoglobin (g/ml)                | 14   | 12  |
| ICU stay (h)                     | 24   | 8   |
| Cold ischemia time (h)           | 9  | 13  |
| Warm ischemia time (min)         | 70   | 60  |
| Preservation solution            | Celsior <sup>R</sup>   | Celsior <sup>R</sup>                                    |
| <b>Recipient characteristics</b> |  |   |
| Age at SPKT (years)              | 45   | 37  |
| Gender                           | Male   | Male  |
| Time from diabetes to transplant | 24 years   | 26 years  |
| Pretransplant C-peptide (ng/ml)  | <0.1   | <0.1  |
| Pretransplant dose of insulin    | 30   | 35  |
| Pancreas transplant indication   | ESRD** type 1 diabetes   | ESRD type 1 diabetes                                    |
| Peritoneal dialysis (months)     | 24   | 8   |
| D/R CMV serology                 | D+/R+  | D+/R–   |
| Immunosuppression (post-SKPT)    | Thymoglobulin<br>Tacrolimus<br>Mycophenolate mofetil<br>Steroids | Thymoglobulin<br>Tacrolimus<br>Azathioprine<br>Steroids |
| Acute rejection                  | No   | No  |
| Hospital stay (days)             | 22   | 20  |
| <b>Follow-up</b>                 |  |   |
| Time from SPKT (yrs)             | 11.5   | 7.5   |
| Current graft pancreas function  |  |   |
| Fasting serum glucose (mg/dl)    | 106  | 105   |
| Hemoglobin A1c (%)               | 5.6%   | 5.5%  |
| C-peptide (ng/ml)                | 5.5  | 3.6   |
| Serum insulin (μU/ml)            | 6  | 21.6  |
| Current graft renal function     |  |   |
| Serum creatinine (mg/ml)         |  | 1.2   |
| MDRD-4 (ml/min)                  |  | 62.2  |
| Hemodialysis                     | Yes (loss of renal function for chronic rejection)               | No  |
| Current tumor markers            |  |   |
| CA 19-9 (U/ml)                   | 10.4   | 4   |
| CEA (ng/ml)                      | 3.7  | 4.5   |
| MR of pancreas graft             | Normal   | Normal  |

SPKT\*, simultaneous pancreas–kidney transplant; ESRD\*\*, end-stage renal disease.

The pancreatic tissue ring of the annular pancreas contains a large duct that usually communicates with the main pancreatic duct [4], and any injury of this ring should be avoided to prevent the development of complications such as pancreatitis and leaks [5,7]. Similarly, as in previous reports [6,7], we chose the place between

the distal first portion and proximal second duodenal portion, opposite to the papilla, as the site for duodenal-bladder or duodenal–enteric anastomosis, but taking care to leave about 1.5–2 cm of free duodenal margin proximal to the pancreatic ring to prevent any possible damage.

Zyromski *et al.* [8] reported an increased association of pancreatobiliary malignancies with annular pancreas in 11% of the adult cases in a nontransplant population. In our experience, we have performed periodically determinations of tumor markers (CEA and CA 19-9) and graft MR screening during follow-up, and we did not find any features of graft pancreatobiliary tumors. The advantage of transplant patients over nontransplant population is the absence of stenosis and duodenal obstruction after duodeno–enteric drainage in pancreas recipients.

Although a low probability of pancreatobiliary tumor development has been reported in the nontransplant population with annular pancreas, we did not observe during long-term follow-up any tumor or graft pancre-

atitis in our two recipients of annular pancreas grafts. Thus, we do not have any strong arguments for discarding these grafts, especially given the increasing need for grafts for whole pancreas transplantation.

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### Conflict of interests

The authors of this manuscript have no conflict of interests.

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## REFERENCES

1. Bickford B, Williamson JCFL. Annular pancreas. *Br J Surg* 1952; **39**: 49.
2. Drey NW. Symptomatic annular pancreas in the adult. *Ann Inter Med* 1957; **46**: 750.
3. Kiernan PD, ReMine SG, Kiernan PC, ReMine WH. Annular pancreas: Mayo experience from 1957 to 1976 with a review of the literature. *Arch Surg* 1980; **115**: 46.
4. Gilinsky NH, Lewis JW, Flueck JA, Fried AM. Annular pancreas associated with diffuse chronic pancreatitis. *Am J Gastroenterol* 1987; **82**: 681.
5. Jarry J, Wagner T, Rault A, Sa Cunha A, Collet D. Annular pancreas: a rare cause of acute pancreatitis. *JOP* 2011; **12**: 155.
6. Barone GW, Henry ML, Elkhammas EA, Tesi RJ, Ferguson RM. Whole-organ transplant of an annular pancreas. *Transplantation* 1992; **53**: 492.
7. Romagnoli J, Papalois VE, Hakim NS. Transplantation of an annular pancreas with enteric drainage. *Int Surg* 1998; **83**: 36.
8. Zyromski NJ, Sandoval JA, Pitt HA, *et al.* Annular pancreas: dramatic differences between children and adults. *J Am Coll Surg* 2008; **206**: 1019.