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Comparison of Ipsilateral and Contralateral Simultaneous Pancreas and Kidney Transplantation: A Single-Center Analysis with 5-Year Outcome

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Background: It is routine to implant the pancreas on the right and the renal graft on the left iliac fossa during a simultaneous kidney and pancreas transplant (cSPK). Ipsilateral placement of both organs on the same side raises concerns that the pancreas graft might compromise the distally placed kidney. However, ipsilateral SPK (iSPK) can be faster than the conventional contralateral graft placement and allows for preservation of the other side for future transplants.

Material/Methods: In a single unit, 67 SPK transplantations (cSPK n=49, iSPK n=18) were performed from 2008 to 2011. The decision for graft placement was made during the procedure. Donor and recipient demographics, surgical complications, reoperations, surgical time, and patient and graft survival with 5-year follow-up were compared between the 2 groups.

Results: Duration of operation was shorter in the iSPK group. Recipient and donor demographics were comparable, apart from more females receiving ipsilateral graft placement. The broader female pelvis was probably the determining factor contributing to this outcome. The iSPK group included marginally younger recipients. The ipsilateral group also demonstrated a trend to improved survival of patient, pancreas, and kidney graft, at 1- and 5-year follow-up. There was no difference in complication rates between the 2 groups.

Conclusions: There were no significant differences in overall outcomes. iSPK is a safe procedure, which proves similar patient and graft survival as with cSPK. Both procedures have comparable surgical complication rates. iSPK is a safe and quicker procedure that allows for preservation of the contralateral side for potential subsequent transplants.

MeSH Keywords: Pancreas Transplantation • Kidney Transplantation • Organ Transplantation

Abbreviations: **cSPK** – contralateral simultaneous pancreas and kidney transplantation; **iSPK** – ipsilateral simultaneous pancreas and kidney transplantation; **SPK** – simultaneous pancreas and kidney transplantation; **DCD** – donation after cardiac death

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Background

Simultaneous pancreas and kidney transplantation (SPK) is the treatment of choice for the management of diabetes mellitus with significant diabetic complications and associated end-stage renal disease. SPK accounts for 83% of pancreas transplant procedures, followed by 12% pancreas after kidney transplantation and 5% pancreas transplant alone [1]. Furthermore, SPK is associated with reduced long-term cardiovascular mortality compared with live donor kidney transplantation [2]. Routinely, during an SPK, the pancreas is placed on the right iliac fossa and the kidney contra laterally on the recipient left iliac vessels through a midline incision or, less frequently, through bilateral incisions. An alternative, less commonly used approach, is the ipsilateral placement of both pancreas and kidney grafts into the right iliac fossa.

Implantation of both grafts on the same side remains controversial, as there is concern that ipsilateral placement of both grafts could jeopardise the usually distally placed kidney graft and potentially increase the risk of surgical complications.

Here, we report our experience with ipsilateral placement of pancreas and kidney grafts in a single high-volume centre. We compare the incidence of patient and graft survival and surgical complications between ipsilateral SPK (iSPK) and contralateral SPK (cSPK) transplantations during the same period, taking into consideration a 5-year follow-up. The overall surgical time was also compared between the 2 groups.

Material and Methods

From October 2008 to October 2011, 67 SPKs were performed in our center. All SPK recipients during this period were included in our study. In 18 of them, both the pancreas and the kidney were placed in the right iliac fossa (ipsilateral graft placement (iSPK) (Figure 1). In 49 cases, the pancreas was placed in the right and the kidney in the left iliac fossa (contralateral graft placement (cSPK) (Figure 2). An abdominal midline incision was used for both groups. Enteric drainage of the exocrine pancreas was used for all pancreata, except for 3 from the cSPK group that were bladder-drained. Duodeno-enteric drainage was constructed with side-to-side duodenal distal ileum anastomosis. All pancreatic grafts were positioned head-down.

Pancreata from both groups were systemically drained with anastomosis of the portal vein to the recipient inferior vena cava, without portal venous extension. Arterial reconstruction of all pancreata was performed with Y graft connecting the pancreas superior mesenteric artery and splenic artery using donor CIA. Arterial supply of all pancreata for both groups was constructed with anastomosis of the Y graft to the recipient

Figure 1. Ipsilateral graft placement.

Figure 2. Contralateral graft placement.

Table 1. Donor and recipient characteristics (mean $\pm$ SD).

	iSPK	cSPK	p Value
Donor age (year)	30.3 $\pm$ 13.6	33.3 $\pm$ 13	p=0.41
Donor male (%)	50	47	p=0.83
Donor BMI (kg/m ²)	22.6 $\pm$ 2.7	23.3 $\pm$ 3.13	p=0.4
DCD Donor (n, %)	(2) 11.1%	(3) 6.1%	p=0.49
Recipient age (year)	38.6 $\pm$ 9.7	43.6 $\pm$ 8.51	p=0.04
Recipient Male	5 (28%)	44 (90%)	p<0.0001
Recipient BMI (kg/m ²)	25.2 $\pm$ 4.6	24.9 $\pm$ 3.5	p=0.77

iSPK – ipsilateral graft placement SPK; cSPK – contralateral graft placement SPK.

common iliac artery, or less often to the distal aorta. For the iSPK group, the renal artery and vein were anastomosed on the right external iliac artery and vein, respectively. A uniform perioperative anticoagulation protocol was followed for all SPK recipients in the study. Anticoagulation included heparin-saline flush in all arterial and venous anastomosis sites, 150 mg aspirin suppository, subcutaneous heparin prophylaxis before the procedure, and IV heparin after the procedure with or without a bolus starting dose.

All ureteric anastomoses were performed using Gregoire Lich uretero neocystostomy over a ureteric JJ stent. In the cSPK group, the kidney was placed intraperitoneally or extraperitoneally on the left iliac fossa. Anastomosis of the renal artery and vein in the latter group was with the external iliac artery and vein, respectively, and, less frequently, with the common iliac artery. Ureteric anastomosis was constructed using the same technique – the Gregoire Lich over a JJ stent.

Donor and recipient characteristics are shown in Table 1. There were 2 donors after cardiac death (DCD) in the iSPK group and 3 DCD in the cSPK group. For the iSPK group, 72% of the recipients were female, while 90% of the recipients were male in the cSPK group ($p<0.05$). The graft placement was selected for each recipient on the day of the operation, according to the surgeon's decision. The broader female pelvis was probably the determining factor contributing to this decision. Implantation of both pancreas and kidney grafts in a narrow pelvis can potentially be more technically challenging. There was a trend for younger recipient age in the iSPK group. There was no significant difference in donor and recipient BMI between the 2 groups.

Patient, pancreas, and kidney graft survival and surgical complications were compared between the iSPK and cSPK groups. A 5-year follow-up was performed. Continuous variables were compared using the *t* test, and categorical variables were compared using the chi-square test. P values less than 0.05 were considered significant.

Results

The average surgical time was 293 min for the iSPK group, significantly lower than the 359 min in the cSPK group ($P<0.05$). Surgical time was defined as the total operation time from skin incision to closure of the surgical wound. For our cohort, the difference in overall surgical time did not affect the cold ischemia time for the kidney graft (935 $\pm$ 157 min vs. 940 $\pm$ 275 min, respectively, $p=0.942$). One kidney graft (5.5%) from the iSPK group developed DGF in the immediate post-operative period, but finally achieved a baseline creatinine level of 89 μ mol/L. In the cSPK group, 1 kidney (and pancreas) presented primary non-function and 1 kidney developed DGF due to acute tubular necrosis, with a final baseline creatinine of 391 μ mol/L. The latter 2 grafts were from a DCD donor.

The frequency for reoperation due to surgical complication was 22% for the iSPK group versus 35% for the cSPK group ($P=0.31$) (Figure 3). The complications that mandated reoperation in the iSPK group were collection (5.5%), bleeding (5.5%), and transplant pancreatectomy (11.1%). One of the pancreatectomies was performed on a recipient who had previously been reoperated on for duodenal enteric reanastomosis. The second graft pancreatectomy was due to thrombosis 24 h after transplant. The organs of the bleeding case came from a DCD donor.

The complications presented in the cSPK group were bleeding (12.2%), thrombosis (2%), enteric reanastomosis (2%), collection (2%), pancreatitis (14.2%), and small bowel obstruction (2%). In the iSPK group, 2 recipients (11.1%) underwent transplant pancreatectomy during the first month after transplant, versus 6 recipients (12.2%) that underwent graft pancreatectomy from the cSPK group ($P=0.9$). Overall, organs from DCD donors were not related to higher complication rate in either technique.

Comparing the survival benefit, there was a trend towards improved patient and graft survival for the iSPK group in the first year, which was maintained during the 5-year follow-up.

Figure 3. Patient reoperation.

Figure 5. Kidney graft survival.

Figure 4. Pancreas graft survival.

Specifically, for the first year, pancreas graft survival was 89% for the iSPK group versus 78% for the cSPK group ($P=0.31$). At 5-year follow-up, pancreas graft survival was 84% for the iSPK versus 74% for the cSPK group ($P=0.39$) (Figure 4). Accordingly, kidney graft survival at 1- and 5-year follow-up was 94% and 89%, respectively for the iSPK group, versus 93% and 82%, respectively, for the cSPK group ($P=0.89$ for 1-year; $P=0.49$ for 5-year follow-up) (Figure 5). The same pattern was observed for patient survival, where 1- and 5-year survival was 100% and 94%, respectively, for the iSPK group, compared to 96% and 84%, respectively, for the cSPK group ($P=0.4$ for 1-year; $P=0.29$ for 5-year follow-up). Table 2 summarizes the differences between iSPK and cSPK in 5-year patient survival,

pancreas and kidney graft survival, surgical time, and reoperation frequency between the 2 groups.

Discussion

Simultaneous pancreas kidney transplant continues to be a surgically challenging, long procedure compared to kidney only transplant. It is worth considering any modification of the surgical technique that will result in a significant reduction in time required to complete the operation without compromising the safety of either organ. Furthermore, the pancreas surgeon frequently experiences significant anxiety due to the high morbidity and technical complication rates associated with this procedure compared to kidney alone. Therefore, the decision to implant both organs on the same side is not taken lightly. The surgeon often implants the pancreas first (even though some surgeons prefer to implant the kidney first because the recipient would be making urine and therefore would be less prone to fluid overload) and then assess the space left to decide if it is technically feasible to implant the kidney safely into the right iliac fossa without compromising the safety of both organs.

During the planning stage, the surgeon considers the physical characteristics of the donor pancreas and kidney available and the anatomic features of the recipient, including dimensions of pelvis and vessels characteristics. The surgeon also considers

Table 2. Differences between ipsilateral graft placement SPK (iSPK) and contralateral graft placement SPK (cSPK); Surgical time: the total operation time from skin incision to closure of the surgical wound.

	iSPK	cSPK	p Value
5 year patient survival	94%	84%	p=0.29
5 year pancreas graft survival	84%	74%	p=0.39
5 year kidney graft survival	89%	82%	p=0.49
Patient required reoperation	22%	35%	p=0.31
Surgical time (min)	293	359	p=0.04

the physical characteristics of the pancreas graft, such as size and length and type of exocrine drainage technique, intended for use. The surgeon will now consider the size and number of renal arteries and veins of the donor kidney, and then must consider the recipient characteristics such as height, body habitus, length of the trunk, the width and depth of the pelvic cavity, and the state of the iliac vessels, including the extent of vascular wall calcification and location of hard plaques, if present. Younger recipients are expected to have better-quality iliac vessels. Females tend to have a wider pelvis, providing larger working space, while males often have a narrow, deeper pelvis with less working space. Therefore, a large, long pancreas graft coming with a large kidney graft with multiple renal arteries to implant may not fit into the same side of a short male recipient with a narrow, shallow pelvis. However, a small, short donor pancreas and kidney is more likely to fit into 1 side of the pelvis (iSPK). A recent study comparing ipsilateral versus contralateral placement of the pancreas allograft in pancreas after kidney (PAK) transplant recipients [3] found no difference in recipient sex distribution between the ipsilateral and contralateral placement group. This difference in our study is probably due to the more flexible surgical planning that SPK allows compared to PAK transplantation.

Most surgeons prefer to implant organs into the right iliac fossa because both iliac vessels are more easily accessible compared to the left side, where the iliac vein is deeper and takes a steeper dip into the lesser pelvis to be joined by the short internal iliac vein. Therefore, the implantation of the kidney into the left iliac fossa is often technically difficult after the pancreas has been implanted. It is often generally easier to implant a kidney into the right iliac fossa, as the artery and vein are generally more conveniently anatomically placed for the surgeon. Therefore, it makes sense to consider implanting the pancreas and kidney on the right side if the surgeon considers it safe to do so.

iSPK is a safe procedure that could be preferably used for young recipients or recipients with high BMI or recipients with calcifications and marginal-quality left iliac vessels. In our center, these factors were considered before deciding on the positioning of the grafts. Thus, in the case of younger recipients, iSPK allowed for preservation of the contralateral side for future transplants. For recipients with higher BMI, iSPK prevents a laborious, time-consuming dissection of a deeper left iliac fossa for the implantation of the kidney graft, and this was probably the most important reason why the iSPK group exhibited significantly lower surgical time in our cohort.

Another benefit of the iSPK is that it prevents from pressure on the pancreas graft from the abdominal retractors. During the kidney implantation in the left iliac fossa, the intestine usually is retracted towards the right iliac fossa, giving extra

mechanical pressure on the freshly implanted pancreas. This pressure is sustained for the whole time of left iliac fossa dissection and kidney graft implantation, increasing the risk for injuries and thrombosis in the pancreas graft.

For the iSPK, the cecum is positioned anteriorly to the kidney graft to prevent adhesions of the kidney with the intestinal loops. This alignment may allow only for a narrow anatomical window for future kidney biopsies. Same biopsy difficulties will be encountered for the intraperitoneally-placed kidney of the cSPK group, where the kidney graft is surrounded by intestinal loops.

Potential pitfall of the iSPK graft placement may occur when the duodenal graft anastomosis is constructed before the kidney implantation. This could increase the risk of contamination of the right iliac fossa by the duodenal fluid, which might affect the kidney vessels anastomosis. On the other hand, waiting too long for the duodenal graft anastomosis to be constructed after kidney implantation may increase the pressures in the duodenal stump, which will increase the pressures on the pancreatic parenchyma, thus predisposing to graft pancreatitis and thrombosis.

There are concerns that iSPK potentially increases the risk of infections affecting both grafts (e.g., abscesses and mycotic pseudo aneurysm) or vascular and surgical complications that could affect the otherwise healthy ipsilaterally-placed kidney graft. Any intervention for the management of such complications could jeopardise the outcome for both grafts. In our cohort, we did not experience any of the aforementioned complications and no kidney graft was lost due to local complications from the ipsilaterally-placed pancreas graft. None of the recipients from the iSPK group experienced right lower limb ischemia or symptoms of steal syndrome.

Our results are in accordance with the outcomes of a series of 216 iSPK placements [4,5], where the portal vein was not elongated but rather anastomosed to the common iliac vein. The donor Y graft was anastomosed to the recipient common iliac artery and the graft duodenum was anastomosed end-to-end to the recipient proximal jejunum using a circular stapler. In a series of 6 iSPKs [6], the portal vein was elongated using donor iliac vein to a total of 5 cm. The portal vein was then anastomosed to the superior mesenteric vein of the recipient, while the Y graft was anastomosed to right common iliac artery. The duodenum was anastomosed side-to-side to an adjoining loop of jejunum using a hand-sewn 2-layer anastomosis. Both of these series suggest outcomes similar to our cohort, proving the safety and feasibility of iSPK graft placement.

There have been few reports describing iSPK with composite [7,8] or en block [9] graft transplantation. The composite graft reports describe 2 and 1 cases, respectively, where the

SPK composite graft was constructed with end-to-side anastomosis of the renal graft artery to the common limb of the arterial Y graft and the portal vein anastomosed end-to-side to the graft renal vein. Finally, the renal vein of the SPK composite graft was anastomosed to the recipient IVC and the common iliac artery of the Y graft was anastomosed to the recipient distal aorta [7]. The option of a composite graft was used for recipients with calcified aorta, severe obesity, or scarred vessels due to previous transplant. The ipsilateral en block graft transplantation included 2 recipients in whom the pancreas and kidney were retrieved and transplanted en block in the right iliac fossa [9]. The disadvantage of composite graft or en block SPK transplantation is prominent when complications like vascular thrombosis or abscess occur in a single graft, in which, case the viability of the other graft is jeopardised. Given that the incidence of pancreas graft thrombosis is reported to be as high as 10% to 20% [10,11], use of these methods should be reserved for selected patients.

Interestingly, there were 2 pancreas re-transplantations, 7 and 8 years after cSPK. Both pancreata were implanted in the right iliac fossa. From the iSPK group, there was 1 kidney retransplantation, 2 years after iSPK. The kidney allograft was placed in the virgin left iliac fossa.

The overall 1- and 5-year patient, pancreas, and kidney graft survival rates were comparable between the iSPK and cSPK groups. These findings agree with a recent study comparing patient and pancreas graft survival for PAK recipients with ipsilateral or contralateral placement of the pancreas allograft [3]. The rate of reoperation in many reports ranges from 18% [12] to 24% [13] to 44.3% [14,15]. In our series, the iSPK reoperation rate was 22%, lower than the 35% reoperation rate in the cSPK group. Furthermore, the comparable patient, pancreas,

and kidney graft survival rates make iSPK a feasible and safe procedure.

Conclusions

This was a single-centre study in which a uniform perioperative management protocol was applied to all cases. However, there are limitations in this study, as it was retrospective and not randomized, resulting in subtle selection bias regarding the implantation site. The sample size was small, which prevented us from achieving statistical significance in several comparisons.

Nonetheless, in our experience, iSPK is a safe procedure and results in patient and graft survival comparable to contralateral placement of the grafts. iSPK allows for less dissection over the left iliac fossa, significantly improving the operation time and thus providing a potential for reduced cold ischemic time. The reoperation rate and incidence of surgical complications are comparable between the 2 groups, showing that ipsilateral graft placement is a safe and feasible option that can preserve the contralateral side for potential future transplants.

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Conflict of interest

None.

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