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Transpl Int (1996) 9: 62-67

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The impact of midline versus transverse incisions on wound complications and outcome in simultaneous pancreas-kidney transplants: a retrospective analysis

Received: 4 April 1995 Received after revision: 12 May 1995 Accepted: 6 June 1995

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Introduction

fulness and safety of a transverse incision has not been previously reported. The purpose of this study was to compare midline and transverse incisions, with respect to wound complications and outcome, in simultaneous pancreas-kidney transplant recipients with intraperitoneal placement of the pancreatic graft. The incidence of deep abscess formation, superficial abscess formation, wound leak, and fascial dehiscence, as well as graft survival, were retrospectively compared in 41 bladder-drained simultaneous pancreas-kidney recipients with a midline incision and in 15 with a transverse incision. The overall incidence of wound complications was similar (34% vs 20%, P = NS) in the two groups. Deep abscess formation occurred more frequently in the midline group (27 % vs 0 %, P = 0.02). Staphylococcus epidermidis and Candida albicans were the most common microbial isolates from

Abstract Intraperitoneal place-

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deep abscesses. Multivariate logistic regression analysis revealed donor age 40 years or older (P = 0.04), the occurrence of a bladder leak (P = 0.05), and a peak serum amylase in the 1st week of 1000 IU/l or greater (P = 0.02) to be independent risk factors for the development of wound complications. The type of incision, however, was not found to be an independent risk factor. Patient (90 % vs 83 %, P = NS), pancreas allograft (78 % vs 82 %, P = NS), and kidney allograft (83 %) vs 70 %, P = NS) survival rates were similar for the midline and transverse groups. We conclude that the transverse incision is a reasonable alternative to the midline incision in simultaneous pancreas-kidney transplantation and it is presently the incision of choice at our institution. It offers excellent exposure and is associated with a similar wound complication rate and outcome when compared to the midline incision.

Key words Pancreas transplantation, incision · Incision, pancreas transplantation

A progressive evolution in surgical technique and immunosuppressive regimens has resulted in improved patient and graft survival rates and wider acceptance of pancreas transplantation as a therapeutic alternative for the treatment of diabetes mellitus. Intraperitoneal placement of the pancreas allograft, usually through a midline incision, has so far achieved the best results in North America [8]. At our institution, simultaneous pancreas-kidney transplants are presently performed using a transverse incision instead of a midline one because of improved exposure. The usefulness and safety of a transverse incision in pancreas transplantation has not been previously reported. This report compares midline and transverse incisions, with respect to wound complications and outcome, in simultaneous bladderdrained pancreas-kidney transplants with intraperitoneal placement of the pancreatic graft.

Patients and methods

Patient population

The records of simultaneous pancreas-kidney transplant recipients who were transplanted between April 1988 and June 1994 at the University of Texas Medical Branch were reviewed (n = 61). A midline incision was used in 41 recipients, a transverse incision in 15, and bilateral flank incisions in 5. Recipients with bilateral flank incisions were not included in the present analysis. The mean follow-up period was 28 ± 21 (median 27.4, range 0.67–74.3) months.

Technical aspects

The external iliac artery and vein were used for inflow and outflow, respectively, for both allografts. The pancreatic allograft consisted of the whole organ and a 10- to 15-cm segment of duodenum. Bladder drainage of pancreatic exocrine secretions through a duodenocystostomy was used in all cases. The transverse incision was curved inferiorly and required transection of both rectus muscles. Both grafts were placed intraperitoneally in all cases. Midline wounds were closed with a single running layer of nonabsorbable monofilament suture, whereas transverse wounds were closed in two layers using the same suture. Staples were used for skin closure. Drains were not used at the completion of the operation in any of the patients. Transplants were performed by three different surgeons during the study period. Given the fact that all three surgeons used a similar technique and management approach, the data was not analyzed separately for each surgeon.

Prophylactic antimicrobial regimens

Intravenous vancomycin (1 g), cefotaxime (1 g every 8 hours). and metronidazole (1 g every 6 hours) were administered on call in the operating room and were continued for 7 days if duodenal/preservation fluid cultures were positive for microbial growth and for 48 h otherwise. the vancomycin dosage was adjusted according to vancomycin levels. The prophylaxis regimen also included acyclovir, 800 mg p. o. q. i. d. for 6 months, fluconazole, 200 mg once a day for 6 months, and sulfisoxazole, 500 mg once a day for 1 year. In addition, intraoperative bladder and wound irrigation with 1 g/l of cephalothin sodium was performed in all recipients. During the backtable pancreatic reconstruction, the duodenal lumen was irrigated with 10 % amphotericin mixed with approximately 100 ml of Betadine solution (povidone-iodine, Purdue-Frederick). The prophylactic antimicrobial regimen was not changed during the study period.

Immunosuppression

Induction with intravenous antithymocyte or antilymphocyte globulin (ATG or ALG, 15 mg/kg), intravenous methylprednisolone (2 mg/kg), intravenous azathioprine (5 mg/kg), and intravenous cyclosporin (2 mg/kg) was used in all cases followed by triple maintenance immunosuppression.

Wound complications

Deep abscess was defined as an infrafascial infected collection and superficial abscess was defined as a suprafascial wound infection. A wound leak was defined as leakage of ascitic fluid through the wound without clinically detectable dehiscence. Dehiscence was defined as clinically detectable disruption of the fascial closure.

Statistical analysis

Overall patient and graft survival

The Kaplan-Meier method was used to determine survival rates. Pancreas graft failure was defined as the need for insulin therapy or death with a functioning graft. Renal graft failure was defined as initiation of dialysis therapy or death with a functioning graft. The Mantel-Cox method was used to determine the statistical significance of survival differences between the midline and transverse groups.

Demographic data and wound complications

The chi-square analysis was used to compare the breakdown of donor and recipient demographics, as well as the relationship between different wound complications in the two groups studied.

Multivariate analysis of risk factors

A logistic regression analysis was used to determine variables that predisposed patients to the occurrence of wound complications.

Results

Demographic data

Donor and recipient demographic data for the midline and transverse incision groups are summarized in Tables 1 and 2. With the exception of time on dialysis prior to transplantation (shorter in the midline group, P = 0.06), time interval from donor admission to procurement (shorter in the midline group, P = 0.0004), and donor cause of death (higher proportion of donor nontraumatic deaths in the midline group, P = 0.06), all other factors were matched between the two study groups (Tables 1, 2). Length of recipient hospitalization was similar for the two groups (midline 23.3 ± 16 days, median 19.5; transverse 21.5 ± 8.9 days, median 21; P =NS). Similarly, mean operative time was not significantly different (midline 5.4 ± 1.4 h; transverse $5.6 \pm$ 1.4 h; P = NS).

| <u></u> | | Type of incision | | |
|------------------------------|------------------------------------|------------------------------------|----------------------------------|--------|
| | | Midline $(n = 41)$ | Transverse $(n = 15)$ | Р |
| Age | < 40 years ≥ 40 years | 35 (85 %) 6 (15 %) | 12 (80 %) 3 (20 %) | NS |
| Gender | Male Female | 32 (78 %) 9 (22 %) | 12 (80 %) 3 (20 %) | NS |
| Duration of hospital stay | < 48 hours \geq 48 hours | 29 (71 %) 12 (29 %) | 4 (27 %) 11 (73 %) | 0.0004 |
| Preservation time | < 15 hours ≥ 15 hours | 19 (46 %) 22 (54 %) | 5 (33 %) 10 (67 %) | NS |
| Cause of death | Traumatic Nontraumatic | 24 (58 %) 17 (42 %) | 12 (80 %) 3 (20 %) | 0.06 |
| Prothrombin time | < 14 seconds ≥ 14 seconds NA | 18 (44 %) 20 (49 %) 3 (7 %) | 8 (53 %) 6 (40 %) 1 (7 %) | NS |
| Use of vasopressors | Yes No | 35 (85 %) 6 (15 %) | 12 (80 %) 3 (20 %) | NS |
| DR mismatch | 0 1 2 | 4 (10 %) 17 (45 %) 17 (45 %) | 2 (14 %) 1 (7 %) 11 (79 %) | 0.04 |

 Table 1 Donor demographic data by type of incision (NA not available)

 Table 2 Recipient demographic data by type of incision (NA not available)

| <u></u> | | Type of incision | | |
|-------------------------------|-------------------------------------|-------------------------------------|----------------------------------|------|
| | | Midline $(n = 41)$ | Transverse $(n = 15)$ | Р |
| Age | < 40 years ≥ 40 years | 30 (73 %) 11 (27 %) | 13 (80 %) 2 (13 %) | NS |
| Sex | Male Female | 25 (61 %) 16 (39 %) | 8 (53 %) 7 (47 %) | NS |
| Time on dialysis | < 1 year ≥ 1 years NA | 15 (37 %) 18 (44 %) 8 (19 %) | 1 (7 %) 8 (53 %) 6 (40 %) | 0.06 |
| Duration of diabetes | < 20 years ≥ 20 years NA | 13 (32 %) 18 (44 %) 10 (24 %) | 2 (13 %) 6 (40 %) 7 (47 %) | NS |
| Peak serum amylase first week | < 1000 IU/l ≥ 1000 IU/l | 29 (70 %) 12 (30 %) | 12 (80 %) 3 (20 %) | NS |
| Bladder leak | Yes No | 9 (22 %) 32 (78 %) | 2 (13 %) 13 (87 %) | NS |
| Duration of hospital stay | < 20 days $\ge 20 \text{ days}$ | 21 (51 %) 20 (49 %) | 7 (47 %) 8 (53 %) | NS |
| Acute rejection ^a | Absent Present | 24 (59 %) 17 (41 %) | 9 (60 %) 6 (40 %) | NS |

^a Acute rejection episodes were biopsy-documented

Wound complications

The overall incidence of wound complications was similar (34 % vs 20 %, P = NS) in the midline and transverse groups (Table 3). Deep abscess formation, however, occurred more frequently in the midline group (27% vs 0%, P = 0.02). Since all of the transplants with a transverse incision were performed between 1992 and 1994 compared to only 8 of 41 (20%) of the transplants with a midline incision, the higher incidence of deep abscesses in the midline group may be explained by the fact that the majority were performed in the early stages of the learning curve. The time interval between transplantation and the occurrence of wound complications was extremely variable: deep abscess formation 51 ± 48 days (median 39); superficial abscess formation days 19, 21, 91; wound leak days 6, 23 (midline), day 57 (transverse); wound dehiscence days 2, 6, 149 (midline), days 59, 99 (transverse). Staphylococcus epidermidis and Candida albicans were the most common microbial isolates from deep abscesses (73 % monomicrobial, 27 % polymicrobial) whereas Serratia marcescens (n = 1) and Staphylococcus epidermidis (n = 2) were cultured from the superficial infections (Table 4). Micro-organisms were isolated from the allograft duodenum in five instances (Candida albicans in four and Escherichia coli in one) and from the preservation fluid in two (both Staphylococcus epidermidis) for a total of 7 of 40 (17%) isolates. Cultures of the graft duodenum and/or preservation fluid were not performed in 16 cases. Of the 11

 Table 3 Incidence of wound complications by type of incision

| | Type of incision | | |
|---------------------|--------------------|-----------------------|------|
| | Midline $(n = 41)$ | Transverse $(n = 15)$ | Р |
| Deep abscess | 11 (27 %) | 0 | 0.02 |
| Superficial abscess | 3 (7%) | 0 | NS |
| Leak | 2 (5%) | 1 (7%) | NS |
| Dehiscence | 3 (7%) | 2 (13%) | NS |
| All complications | 14 (34 %) | 3 (20 %) | NS |

 Table 4
 Microbial isolates from deep and superficial wound infections^a

| | Deep $(n = 15)$ | Superficial $(n = 3)$ |
|----------------------------|-----------------|-----------------------|
| Staphylococcus epidermidis | 5 | 2 |
| Candida albicans | 3 | |
| Citrobacter freundii | 2 | _ |
| Staphylococcus aureus | 1 | _ |
| Enterococcus faecalis | 1 | _ |
| Serratia marcescens | 1 | 1 |
| Pseudomonas aeruginosa | 1 | _ |
| Torulopsis glabrata | 1 | _ |

 $a \ge 1$ isolate/abscess

deep abscesses, 7 (67%) were associated with bladder leaks (4 from the duodenal end staple-line, 2 from the duodenocystostomy anastomosis, and 1 from the cystotomy closure suture-line). All deep abscesses associated with bladder leaks (n = 7) required operative drainage

Table 5 Multivariate analysis of donor and pretransplant recipient risk factors for wound complications. Donor age ≥ 40 years was associated with a greater risk for the development of wound complications

| Factor | Category | Р |
|----------------------|--|-------|
| Donor age | $< 40 \text{ vs} \ge 40 \text{ years}$ | 0.036 |
| Donor hospital stay | $< 48 \text{ vs} \ge 48 \text{ hours}$ | NS |
| Preservation time | $< 15 \text{ vs} \ge 15 \text{ hours}$ | NS |
| Donor cause of death | Traumatic vs nontraumatic | NS |
| Recipient age | $< 40 \text{ vs} \ge 40 \text{ years}$ | NS |
| Recipient sex | Male vs female | NS |
| Duration of diabetes | $< 20 \text{ vs} \ge 20 \text{ years}$ | NS |
| Type of incision | Midline vs transverse | NS |
| Transplant date | $< 1992 \text{ vs} \ge 1992$ | NS |

Logistic regression analysis; all complications combined

Table 6 Multivariate analysis of posttransplant recipient risk factors for wound complications. The presence of a bladder leak and a peak serum amylase ≥ 1000 IU/l were associated with a greater risk for the development of wound complications

| - | | |
|-----------------------------|---|-------|
| Factor | Category | Р |
| Bladder leak | Yes vs no | 0.05 |
| Serum creatinine on day 7 | $< 2 \text{ vs} \ge 2 \text{ mg/dl}$ | NS |
| Peak serum amylase 1st week | $< 1000 \text{ vs} \ge 1000 \text{ IU/l}$ | 0.019 |
| Type of incision | Midline vs transverse | NS |
| Year of transplant | $< 1992 \text{ vs} \ge 1992$ | NS |

Logistic regression analysis; all complications combined

and repair of the leak site. Of the deep abscesses not associated with bladder leaks, one was successfully managed with percutaneous drainage; the other three required operative drainage. Except for cases where operative management of deep abscesses was required, wound leaks were managed conservatively. Dehiscences were repaired immediately in four patients and at a later date in one. Superficial wound abscesses were treated by bedside incision and drainage. The type of incision did not influence management of wound complications.

Multivariate analysis by logistic regression analysis of factors affecting wound complications

Because of the small numbers of patients in the study, wound complications were combined in a single group in the logistic regression model. Donor age 40 years or older (P = 0.04), the occurrence of a bladder leak

(P = 0.05) and a peak serum amylase in the 1st week of 1000 IU/l or greater (P = 0.02) were independent risk factors for the development of wound complications (Tables 5, 6). The type of incision, however, was not found to be an independent risk factor, despite the higher incidence of deep abscesses in the midline group. In order to explain the effect of donor age on recipient wound complications, crosstabulation between donor age and recipient peak serum amylase was performed to test the hypothesis that older donor age may be associated with more severe graft pancreatitis which, in turn, could lead to pancreatic ascites and increased risk of infection. Although an early serum amylase peak of 1000 IU/l or greater was more commonly observed in the subset of recipients whose allografts came from donors 40 years of age or older, the difference was not statistically significant (50 % vs 33 %; P = NS).

Patient and allograft survival

Patient (90 % vs 83 %, P = NS), pancreas allograft (78 % vs 82 %, P = NS) and kidney allograft (83 % vs 70 %, P = NS) survival rates were similar for the midline and transverse groups (Table 7).

Discussion

With increasing experience in pancreas transplantation, it is clear that intraperitoneal placement of the pancreas graft, usually through a midline incision, is superior to extraperitoneal placement and is associated with a lesser incidence of wound complications [1, 2, 7, 9]. In 1992, we started using a transverse incision for simultaneous pancreas-kidney transplants because we found that it offered a better exposure of the external iliac vessels as well as of the bladder compared to the midline incision, which we had been using previously. Our experience as well as the experiences of others have shown that wound complications may be associated with significant morbidity and prolonged hospitalization [6]. Thus, we embarked on a retrospective comparison of wound complications between midline and transverse incisions in simultaneous pancreas-kidney transplant recipients. Although most of the midline incisions were used before 1992 compared to all of the transverse incisions, which were used after 1992, technical aspects of the

| Table 7 One-year patient and allograft survival by type of in- cision | | Midline incision $(n = 41)$ | | Transverse incision $(n = 15)$ | | |
|---|--------------------------------|-----------------------------|------------------------|--------------------------------|--------------|----------|
| | | Actual ^a | Actuarial ^b | Actual | Actuarial | Р |
| ^a Number of failures and % survival ^b Kaplan-Meier analysis | Patient | 8 (81 %) | 90 % | 2 (87 %) | 83 % | NS |
| | Pancreas graft Kidney graft | 13 (70 %) 13 (70 %) | 78 % 83 % | 3 (80 %) 4 (73 %) | 82 % 70 % | NS NS |

transplant as well as perioperative management were otherwise similar during the two periods. Due to the retrospective nature of this analysis, the midline and transverse incision groups were not completely matched. A longer time on dialysis, longer donor length of hospitalization, and lower frequency of nontraumatic donor deaths in the transverse group compared to the midline group were observed. The first two factors are probably unfavorable for overall outcome whereas the last factor is probably favorable. It is, however, unlikely that these differences in donor factors between the two groups significantly influenced the development of wound complications.

Despite the fact that all of the deep abscesses occurred in the midline group, the overall incidence of wound complications was similar in the two groups. The higher incidence of deep abscesses in the midline group could be explained by the fact that the majority of midline incisions were performed prior to 1992, during the earlier stages of pancreas transplantation at our institution. The frequent correlation between bladder leaks and deep abscess formation strengthens this "learning curve" argument. This explanation is further reinforced by the fact that the type of incision, when controlled for transplant date by multivariate logistic regression analysis, was not found to be an independent risk factor for the development of wound complications. The monomicrobial nature of deep abscesses and the preponderance of Staphylococcus epidermidis and Candida albicans isolated from deep abscesses in our patient population are in agreement with Everett et al., who recently reported their experience with wound complications in 207 pancreas transplants using a midline incision [3]. The association between pancreatic leaks and deep abscess formation is not surprising. The majority of leaks occurred from the duodenal end staple-line, usually at the tip furthest away from the pancreas, which is the least well perfused segment. One could speculate that a longer duodenal segment may increase the risks of ischemic perforation, and for this reason we now shorten the duodenal segment as much as possible.

In addition to wound complications, mean operative time was another parameter that was used to compare midline and transverse incisions. Although the transverse incision and its closure take longer to perform, the overall mean operative times for the midline and transverse groups were not different. Unfortunately, due to the retrospective nature of this study, severity of wound discomfort could not be assessed. Postoperative analgesic requirement and pulmonary function in midline versus transverse incisions have, however, been previously studied in a prospective randomized fashion in elective abdominal aneurysm repairs and found not to be different [4]. Overall postoperative recovery, as estimated by the length of hospitalization, did not differ for the two groups.

Donor age 40 years or older, the occurrence of a bladder leak, and a peak serum amylase in the 1st week of 1000 IU/l or greater were independent risk factors for the development of wound complications. A possible explanation for the association between donor age and recipient wound complications is that older donor age may be associated with more severe graft pancreatitis which, in turn, could lead to pancreatic ascites and an increased risk of infection. Although an early serum amylase peak of 1000 IU/l or greater was more commonly observed in the subset of recipients whose allografts came from donors 40 years of age or older, the difference was not statistically significant and does not support the hypothesis.

Early graft pancreatitis, which was assessed by the peak serum amylase, may lead to pancreatic ascites as a result of oozing from the surface of the pancreas which, in turn, may lead to infection. Ascites is a well known risk factor for postoperative wound leaks and subsequent peritonitis and has been particularly well studied in cirrhotics with portal hypertension. Interestingly, a lower leak rate in transverse incisions compared to midline ones has been reported in cirrhotic patients undergoing various abdominal operations [5].

In conclusion, the transverse incision is a reasonable alternative to the midline one in simultaneous pancreaskidney transplantation. It offers excellent exposure and is associated with a similar wound complication rate and outcome when compared to the midline incision.

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