Diet After Pancreas Transplantation

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OBJECTIVE — To determine whether discontinuation of insulin therapy and glucose monitoring and instructions to increase dietary salt and water intake after pancreas transplantation (PTX) resulted in changes in food choices.

RESEARCH DESIGN AND METHODS — All PTX recipients who had completed a preoperative diet record, had received their PTX >6 months before, had stable pancreas and kidney function, and were on a stable diet were invited to submit a 3-day post-PTX diet record. Of the 14 eligible, 11 agreed to participate and completed the study (2 women and 9 men). Their pre- and post-PTX diet records were analyzed by computer program. Weight, glycohemoglobin, blood pressure, medications, and fasting lipids both before and after PTX were also analyzed.

RESULTS — The recipients were studied 576 ± 60 days post-PTX, on average. Total calories and BMI were unchanged after PTX. Before PTX, 34% of calories were in fats, 49% in carbohydrate, and 17% in protein with no change in distribution of calories after PTX, although there was a trend toward greater saturated fat intake. Total salt intake was increased after PTX ($P < 0.01$) because of sodium bicarbonate administration, although dietary salt intake did not change. The HDL cholesterol concentration increased and cholesterol-to-HDL ratio decreased after PTX ($P < 0.05$), while the remaining lipids were unchanged.

CONCLUSION — Weight, total calories and distribution of calories, and dietary salt were unchanged after PTX, and diet did not explain the changes in HDL cholesterol or cholesterol-to-HDL ratio. These preliminary diet results suggest that greater emphasis on dietary instruction may be needed after PTX.

The effect of pancreas transplantation (PTX) on the development of atherosclerosis in patients with IDDM is yet unknown. Corticosteroids and cyclosporine, used frequently as immunosuppressive agents in PTX patients, have been shown to alter lipid concentrations (1–7). Yet we have previously shown that combined pancreas-kidney transplantation (PKT) results in lower serum triglyceride concentrations and cholesterol–to–HDL cholesterol ratios and higher HDL cholesterol concentrations, despite the initiation of those immunosuppressive medications (8,9).

Most PTX recipients discontinue glucose monitoring immediately after PTX and are instructed to increase intake of salty foods to counteract the loss of sodium in the urine because of bladder diversion of exocrine secretions. It is not known whether these changes result in changes in dietary habits or whether the changes in lipids observed after PTX result from changes in diet. We have prospectively analyzed dietary intake before and after successful PTX to assess whether any changes in diet occur after PTX and whether these changes contribute to changes in lipid concentrations.

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ADA, American Diabetes Association; apo, apolipoprotein; PKT, pancreas-kidney transplantation; PTX, pancreas transplantation.

RESEARCH DESIGN AND METHODS

A 3-day record of all food and fluids ingested, including quantities and salt added, was requested of pancreas transplant candidates since 1992 as a cost-effective method for obtaining food intake data as reliable as those previously published (10). All IDDM patients who received a cadaveric donor PTX or combined PKT at Clarkson or University Hospital between December 1992 and June 1993, had a functioning pancreas graft and a serum creatinine concentration <2.0 mg/dl, and completed the pre-PTX 3-day diet record were invited to participate in the study. A total of 14 PTX recipients had completed the pre-PTX diet records and were eligible because of a currently functioning pancreas graft and normal renal function. All consumed a stable meal pattern for at least 6 months before study. Of these 14 recipients, 2 elected not to participate, and 1 was excluded because of recent-onset renal failure. The remaining 11 (9 men and 2 women) were studied.

All patients had received an intraperitoneal whole-organ vascularized transplant with pancreaticoduodenostomy and iliac venous drainage (11,12). All subjects were treated with triple drug immunosuppression, as previously described (11), although one patient later received FK-506 in place of cyclosporine.

The patients were instructed to write down all foods and liquids ingested, including quantity and brand names when applicable, and any use of additional salt for 3 days for the post-PTX diet record just as they were instructed for the pre-PTX record. When necessary, follow-up information on quantities or food choices was obtained by phone. The dietary histories were analyzed by computer program (Nutripractor; Practor Care, San Diego, CA). Total calories, distribution of calories, distribution of fat calories, and salt and water intake from each day's record were calculated. An average of the results of the 3 days was also calculated. Total salt intake was calculated as dietary plus any prescribed sodium bicarbonate, where a 650-mg sodium bicarbonate tablet = 7.8 mEq sodium = 180 mg sodium.

Table 1—*Patient characteristics*

n	11
Sex (M/W)	9/2
Duration of diabetes (years)	26.9 ± 3.1
Type of transplant	
Pancreas only	4
Combined pancreas-kidney	7
Prior dialysis	5/11
Age at transplant (years)	39.2 ± 2.9
Age at study (years)	40.8 ± 2.9
Time from transplant until study (days)	576 ± 60

Data are means ± SE.

Preoperative and current weight, blood pressure, fasting lipid profile (cholesterol, triglyceride, and HDL concentrations), apolipoprotein (apo) A1 and apoB, glycohemoglobin, serum creatinine, and medications were recorded from retrospective chart review. Cholesterol and triglyceride (13,14) and HDL (15) concentrations were determined using established methods while the LDL cholesterol concentration was calculated (16). ApoA1 and apoB determinations were performed by a nephelometric method (Behring, Westwood, MA). Glycohemoglobin was assayed by spectrophotometry after affinity column chromatography (17); normal is 4.5–8%. Average blood pressure was determined from three measurements before PTX compared with the two most recent measurements. Activity was judged subjectively by the nursing coordinator on a five-point scale based on variables such as employment, level of exercise, and ability to pursue all desired activities of normal daily living, with 1 being employed and fully physically active and 5 being sedentary, unemployed, and unable to perform all the activities of daily living. Changes between pre- and postoperative diet and other laboratory parameters were compared by paired Student's *t* test. $P < 0.05$ was considered significant.

RESULTS — Of the 11 patients studied, 4 had received a solitary pancreas while 7 had received pancreas and kidney grafts. Average age and time since PTX are shown in Table 1. There was no change in weight for the group, although two recipients had a >10% change in weight after PTX. One regained weight lost in the months just preceding PTX, but his weight was unchanged when compared with his weight 1 year before PTX, while 1 developed obesity after PTX. Other cardiovascular risk factors are shown in Table 2. Glycohemoglobin improved ($P < 0.05$), systolic blood pressure decreased ($P < 0.05$) without any increase in the number of antihypertensive medications used, and serum creatinine decreased as 7 of 11 patients received a combined pancreas-kidney transplant. There were no smokers before or after PTX. In this small group, the improvement in a subjective activity score was not significant (Table 2).

There was no significant change in total calories ingested after PTX (Table 3). The distribution of calories before PTX was close to the American Diabetes Association (ADA) dietary guidelines published when these individuals were counseled on dietary therapy: <30% fat, 55–60% carbohydrates, and the remainder in protein (18). After PTX, there was no change in the distribution of calories. Saturated fat intake increased from 14.4 to 17.3% of total calories, but this change was not significant.

Dietary salt was unchanged after PTX, but total salt intake after PTX increased because of use of prescribed sodium bicarbonate (6.01 ± 0.3 g/day; $P = 0.0035$). Total water intake (direct fluid ingestion and that calculated in foods) increased, but the change was not statistically significant. Fludrocortisone was prescribed for one patient to enhance water retention. Despite the increase in total salt intake, systolic blood pressure decreased ($P = 0.0108$) (Table 2) without the use of more antihypertensive medications.

Lipids pre- and post-transplant are shown in Table 4. The HDL cholesterol concentration increased ($P = 0.0339$), but total cholesterol concentration did not change so that cholesterol-to-HDL ratio decreased ($P = 0.0311$) after PTX. Doses of prednisone and cyclosporine used at the time of the study are given in Table 2. Triglyceride concentrations decreased, but the change was not statistically significant in this small study. There was no change in calculated LDL cholesterol, apoA1, apoB, or apoA1-to-apoB ratio.

CONCLUSIONS — Diet has been the cornerstone of treatment for diabetes, even before any other therapies were available. In recent years, dietary therapy has been guided by a series of statements by the Committee on Food and Nutrition of the ADA. Dietary instructions are now tailored to each individual to improve overall compliance. It is well known how difficult it can be for patients to change dietary habits. The recipients in this study were instructed on the diet published in 1991 by the Committee on Food and Nutrition for the ADA that recommended a diet with <30% total calories in fat, <10% in saturated fat, >50% in carbohydrates, and <20% in protein (18). Not every individual with IDDM achieves these targets, but the preoperative diet of this small group who became PTX recip-

Table 2—*Longitudinal variables*

	Pretransplant	Current
Weight (kg)	72.2 ± 3.9	79.7 ± 6.3
BMI (kg/m²)	24.5 ± 1.3	26.7 ± 1.6
Systolic blood pressure (mmHg)	165 ± 10	138 ± 6*
Diastolic blood pressure (mmHg)	96 ± 5	87 ± 4
Antihypertensive medications (no./patient)	1.3 ± 0.3	1.4 ± 0.2
Smoking status	0/11	0/11
Activity level	2.2 ± 0.5	1.4 ± 0.2
Glycosylated hemoglobin (%)	7.7 ± 0.6	4.7 ± 0.3*
Serum creatinine (mg/dl)	5.9 ± 1.3	1.6 ± 0.2*
Prednisone dose (mg/day)		10.4 ± 1.8
Cyclosporine		
Dose (mg/day)		377 ± 50
Concentration (ng/ml)		670 ± 82

Data are means ± SE. Cyclosporine data exclude one recipient who received FK-506 instead of cyclosporine (11 mg/day with a concentration of 29 ng/ml). *$P < 0.05$ compared with pretransplant.

Table 3—*Diet results: all recipients*

	Pretransplant	Post-transplant
Calories	2,255 ± 154	2,356 ± 253
% fat	35.0 ± 2.8	38.4 ± 1.7
Saturated (g)	25.1 ± 2.9	32.4 ± 4.2
Saturated (% fat calories)	40.4 ± 1.8	44.8 ± 1.9
Saturated (% total calories)	13.8 ± 1.0	17.2 ± 1.0
Monosaturated (g)	24.7 ± 3.2	28.9 ± 3.5
Monosaturated (% fat calories)	39.2 ± 1.1	39.6 ± 1.9
Unsaturated (g)	15.1 ± 4.9	11.4 ± 1.6
Unsaturated (% fat calories)	20.4 ± 2.2	15.5 ± 0.9
% carbohydrate	49.2 ± 2.9	45.3 ± 1.9
% protein	16.8 ± 0.9	16.1 ± 1.0
Water (g)	2,356 ± 312	3,118 ± 436
Dietary sodium (g)	4.03 ± 0.43	4.45 ± 0.40
Total sodium (g)	4.03 ± 0.43	6.01 ± 0.31*

Data are means ± SE. Total sodium includes dietary plus oral pharmacological sodium. *$P < 0.01$ compared with pretransplant.

ients was surprisingly close to the published recommendations.

After successful PTX, glucose concentration returns immediately to normal without insulin administration (11,19, 20), and most PTX recipients immediately cease glucose monitoring. Other factors may also influence dietary choices. Urinary sodium losses can result in dehydration after diversion of pancreatic duct secretions unless total salt and fluid intakes are increased. Recipients are almost routinely given sodium bicarbonate supplementation to counteract both the salt and bicarbonate losses but are also asked to liberalize salt and water intake. Many foods high in salt are also high in fat so that changes in dietary salt intake could have an impact on more than salt content alone. Yet, overall, diet changed very little after PTX. Total calorie consumption and weight were unchanged after PTX even though corticosteroids can stimulate appetite and cause abdominal obesity in other transplant populations (3,4,7,21, 22). There was also no significant change in distribution of calories, although a trend toward greater use of saturated fats in place of monosaturated fats was observed. Total salt intake was increased because of pharmacological therapy with sodium bicarbonate rather than changes in dietary salt.

The HDL cholesterol concentration increased while the cholesterol-to-HDL ratio decreased, as observed previously (9). As saturated fat intake was unchanged or increased, changes in diet do not explain the changes in HDL cholesterol and cholesterol-to-HDL ratio observed after PTX.

In summary, diet did not change in this subset of PTX recipients, as assessed by total calories, weight, and distribution of calories. Changes in diet alone did not explain changes in HDL and cholesterol-to-HDL ratio. These results should be confirmed in a larger, longer study.

Table 4—*Lipid concentrations*

	Pretransplant	Current
Cholesterol (mg/dl)	214 ± 25	223 ± 13
HDL (mg/dl)	47 ± 5	61 ± 3*
Triglycerides (mg/dl)	146 ± 27	129 ± 20
LDL (mg/dl)	138 ± 22	137 ± 12
Cholesterol/HDL	5.0 ± 0.7	3.8 ± 0.3*
ApoA1 (mg/dl)	145 ± 13	163 ± 6
ApoB (mg/dl)	141 ± 24	126 ± 11
ApoA1/apoB	1.4 ± 0.4	1.5 ± 0.2

Data are means ± SE. *$P < 0.05$ compared with pretransplant value.

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