Transpl Int (1996) 9 [Suppl 1]: S73–S75

J. Fangmann
K. Oldhafer
G. Offner
R. Pichlmayr

Retroperitoneal placement of living related adult renal grafts in children less than 5 years of age – a feasible technique?

J. Fangmann (✉) · K. Oldhafer · R. Pichlmayr
Klinik für Abdominal- und Transplantationschirurgie, Medizinische Hochschule Hannover, Konstanty-Gutschow-Strasse 8, D-30623 Hannover, Germany

G. Offner
Abteilung II für Kinderheilkunde, Medizinische Hochschule Hannover, D-30623 Hannover, Germany

Abstract The extraperitoneal approach was used for transplantation of adult renal grafts in eight children under 5 years, three of them weighing less than 10 kg. Usually, children of this size are approached transperitoneally. The modified procedure included partial mobilization of the right liver to provide enough space for retroperitoneal graft placement and positioning of the vascular anastomoses, invariably to the aorta and caval vein. With this regimen, no significant space problems were encountered in recipients as small as 9 kg, and particularly, neither arterial nor venous complications occurred. Currently, at a mean follow-up of 2.4 years, all patients are alive with well-functioning grafts. Thus, the extraperitoneal approach represents a feasible and successful procedure in the pediatric living related renal transplantation setting for recipients under 10 kg of weight.

Key words Kidney transplantation · Living donors · Children

Introduction

Living related pediatric renal transplantation is technically characterized by an extreme disparity in size of adult grafts and small recipients. Whereas in recipient children weighing more than 20 kg [10] the transplant procedure essentially is the same as for adults using the extraperitoneal approach, in small children and infants below this weight limit, a priori assumptions of space problems have led to the predominant practice of intraabdominal placement of the grafts [2, 8, 9]. Since the transperitoneal approach is associated with considerable disadvantages and thus is not considered to represent the optimal placement of the graft, we have modified the technique of the adult-type extraperitoneal approach. This paper describes the results by using this modified procedure in pediatric living related renal transplantations for small recipient children less than 5 years of age.

Patients and methods

Patients

The series between April 1991 and September 1995 presented here included seven boys and one girl less than 5 years of age transplanted with adult grafts from living related donors, in two cases from the mother and in six cases from the father. Except for one case, exclusively right donor kidneys were used. The mean age of the recipients was 3.0 ± 1.0 years (range 1.4–4.8 years); five of them were younger than 3 years. The mean weight of the entire series was 11.4 ± 2.0 kg (range 9.3–15.3 kg), three children weighing less than 10 kg. Seven children had been on dialysis prior to transplantation, and one boy, 17 months old, received a preemptive transplantation.

Surgical technique

In all recipients we employed a modified technique of the adult-type procedure. Surgery was carried out via an extraperitoneal approach from the right iliac fossa up to the retrohepatic space.

A standard oblique incision in the right lower quadrant of the abdomen from just above the symphysis pubis has been employed, which was extended cephalad to the costal margin to increase expo-

sure for the disproportionately sized adult renal grafts. The external oblique aponeurosis and the muscle layer were divided in line with the skin incision, including the transversal fascia, without injuring the peritoneum. The peritoneum then was reflected off the psoas muscle medially, thus exposing the distal aorta and vena cava inferior including the iliac vessels in the retroperitoneal space. Depending on the size mismatch between the donor kidney and the recipient, the right retrohepatic area had to be mobilized as well and the peritoneum was retracted off. This maneuver created a large enough space to place an adult donor kidney retroperitoneally even in very small recipients weighing less than 10 kg. In addition, positioning of the graft may be facilitated by native nephrectomy, as indicated in the presence of chronically infected kidneys, uncontrolled nephrotic syndrome or extremely large polycystic diseased kidneys. Renal grafts placed in this manner will occupy the entire space between the bladder and the right retrohepatic area.

All grafts, irrespective of the side (left or right kidney), were invariably placed into the right iliac fossa, thus achieving an easy access to the inferior caval vein for venous anastomosis. This is especially important in the presence of a short renal vein, which would not allow an anastomosis to be performed from the left iliac fossa.

The venous anastomosis is always performed first in an end-to-side fashion, invariably to the distal caval vein. Venotomy is performed by a linear incision of the approximate size of the renal vein diameter; additionally, a small elliptical patch of the anterior venous wall may be excised. It is of great importance to shorten the renal vein as much as possible since the abdominal closure may exert considerable compression on the anastomoses, leading to impairment of the venous drainage as well as kinking, which may occur if the renal vein is too long. For the venous anastomosis, 6/0-monofilament running prolene suture was used. The renal artery, without an aortic patch, was anastomosed end-to-side, invariably to the distal aorta between the bifurcation and the branching of the mesenteric artery, anteriorly passing the caval vein. For the anastomosis, 6/0- or 7/0-running prolene suture was used. In the case of multiple arteries, we preferred separate anastomoses, with the superior artery anastomosed to the aorta and the inferior renal artery to the common iliac artery.

Urinary tract continuity was restored by means of an extravesical ureteroneocystostomy, as originated by Gregoir, using 6/0-polydioxanone suture.

Results

Of the eight renal grafts, seven functioned immediately after reperfusion was reinstituted. One graft showed a delayed onset of function for approximately 24 h, but the patient did not require hemodialysis. The pocket which was created in the iliac fossa cephalad up to the retrohepatic area after reflection of the peritoneum was large enough for all the adult grafts in the recipients as small as 9.3 kg. In all but one case, abdominal closure could be done directly without significant tension or any impairment of the arterial supply or venous drainage. In that single case, a boy of 2.8 years and 11 kg, an interposition of a vicryl mesh was needed for closure. Within 2 weeks, however, a secondary approximation of the skin could be accomplished.

No vascular complications were encountered, specifically no arterial or venous thrombosis occurred either in the early postoperative course or during the entire follow-up period. The patients have been followed for 1–4.5 years with a mean follow-up of 2.4 years. One-year graft survival was 100 %. Currently, all patients are alive with well-functioning grafts.

The only surgical complication we encountered in this series was one urinary leakage noted on day 5 postoperatively due to distal ureteral necrosis. The patient had to undergo ureteral reimplantation.

Discussion

Kidney transplantation in small children less than 5 years of age has been reported to be associated with a considerable number of surgical complications, often leading to technical failure and subsequent overall poor results [1, 2, 4–6]. In this context, the two main technical considerations are placement of the graft and positioning of the vascular anastomoses. Primarily depending on the size discrepancy between adult grafts and recipients, two surgical approaches are proposed, namely the intraperitoneal and the adult-type extraperitoneal procedures. Because of anticipated space problems using adult renal grafts, recipients weighing less than 20 kg have been recommended to be best approached transperitoneally with the kidney placed intraabdominally behind the right colon, as first described by Starzl et al. [10]. Recently, there have been reports [2, 7] showing transplantation of adult grafts via the extraperitoneal approach into children under 15 kg.

The results of the series of patients presented here demonstrate that the extraperitoneal approach represents a technically feasible, safe, and successful procedure for transplanting adult grafts into small children less than 5 years of age. It is of particular importance that this also holds true for children as small as 9 kg. However, the actual recipient weight limit for retroperitoneal graft placement remains to be determined.

Besides the extraperitoneal approach, the most critical factor that contributed to the success in our series is the positioning of the vascular anastomoses exclusively to the distal aorta and inferior caval vein. These vessels in small children are of approximately the same size as those of adult type renal vessels, and they therefore ensure adequate perfusion of the graft as well as sufficient venous drainage. Thus, a thrombosis of the graft, which has been reported to be a significant risk factor in pediatric renal transplantation [3], is prevented. Consequently, we have not encountered any immediate or late vascular complications in our entire series. In addition, an aggressive fluid replacement intraoperatively immediately before the release of the vascular clamps is important in order to avoid underperfusion of the graft, leading to non-technical thrombosis. Adult renal grafts sequester a significant percentage of the pediatric circulation blood volume.

Furthermore, the extraperitoneal graft placement offers major advantages compared to the transperitoneal approach, namely no intraabdominal adhesions, no small bowel obstructions or ileus, and thus a quicker mobilization of the patients. Possible bleedings and urinary leakage are restricted extraperitoneally, graft biopsy for monitoring is easy, and continuation of peritoneal dialysis is possible in cases of delayed graft function.

In conclusion, we therefore recommend the extraperitoneal approach with vascular anastomoses to aorta and caval vein in the pediatric living related transplantation setting as the standard technique. With this regimen we have realized 100 % 1-year graft and patient survival. However, small children assigned for transplantation remain a fragile group of patients who require great commitment and close cooperation of physicians and surgeons.

Acknowledgements We are indebted to Dr. S. Tager, currently at the Surgical Department of the Medizinische Hochschule Hannover, for critical reading of the manuscript.

References

1. Arbus GS, Hardy BE, Balfe JW, Churchill BM, Steele BT, Baumal R, Curtis RN (1983) Cadaveric renal transplants in children under 6 years of age. Kidney Int Suppl 15, 24: S111
2. Fine RN, Ettenger R (1994) Renal transplantation in children. In: Morris PJ (ed) Kidney transplantation: principles and practice, 4th edn. W. B. Saunders, Philadelphia, pp 412–459
3. Harmon WE, Stablein D, Alexander SR, Tejani A (1991) Graft thrombosis in pediatric renal transplant recipients. Transplantation 51: 406
4. Hodson EM, Najarian JS, Kjellstrand CM, Simmons RL, Mauer SM (1978) Renal transplantation in children aged 1 to 5 years. Pediatrics 61: 458
5. McEnery PT, Stablein DM, Arbus G, Tejani A (1992) Renal transplantation in children. N Engl J Med 326: 1727
6. Moel DI, Butt KM (1981) Renal transplantation in children less than 2 years of age. J Pediatr 99: 535
7. Rosenthal JT, Ettenger RB, Ehrlich RM, Fine RN (1990) Technical factors contributing to successful kidney transplantation in small children. J Urol 144: 116
8. Sheldon CA, Najarian JS, Mauer SM (1985) Pediatric renal transplantation. Surg Clin North Am 65: 1589
9. Simmons RL, Najarian JS (1984) Kidney transplantation. In: Egdahl RH (ed) Comprehensive manuals of surgical specialties. Springer, Berlin Heidelberg New York
10. Starzl TE, Marchioro TL, Morgan WW, Waddell WR (1964) A technique for use of adult renal homograft in children. Surg Gynecol Obstet 119: 106