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Ethical aspects of using “marginal” kidneys for transplant

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Abstract The continuing demand for transplantable organs leads to ongoing debates about organ procurement, even with arguments in favour of xenotransplantation as a valid alternative. This article examines the management of kidneys with major anatomical anomalies, almost one-quarter of those available for transplantation in our experience: the decision-making is considered from a scientific and an ethical standpoint. Surgical techniques include primary revascularization (PR) and/or bench-top reconstructions (BR). The results, examined for 1311 normal grafts (Group I) and 362 grafts presenting major anatomical anomalies (Group II), all transplanted for the first time,

showed almost the same rates of failures due to surgical causes in these two groups. No operative mortality was associated with any of the vascular techniques, BR being easier and safer than PR. Graft survival at 1 year is the same for Group I and Group II (85 % versus 84 %, respectively). An ethical allocation system ought to take into account the experience of the transplant surgeon for maximizing outcome and minimizing cost and risk for transplantation.

Key words Marginal kidneys · Renal anomalies · Surgical complications · Kidney transplantation · Microsurgery in kidney transplantation

Introduction

The success of kidney transplantation (KT) has increased the need for transplantable organs: over 2000 dialysis patients die each year in the United States on the waiting list for a kidney [7]. The discrepancy between request and offer continues to grow, making it imperative to transplant all functioning organs, including kidneys with abnormal anatomy, which constitute in some series up to 28 % of the total available [6]. On the other hand, graft quality is important for transplant outcome and must be taken into account in kidney sharing.

The purpose of the present study is to examine our experience with anomalous kidneys that are generally considered to be at higher risk for surgical complications [1, 5, 6] and delayed graft function [5], evaluating

the question of transplanting so-called marginal kidneys from an ethical standpoint.

Patients and methods

From May 1969 to July 1995, 1760 renal transplants were performed at our Institution, the majority (89.2 %) from cadaver donors (CD). Eighty-five patients received a second transplant and two of them a third transplant (Table 1). From the outset, we have adopted a wide policy of kidney procurement and graft exchange.

Where donor nephrectomy is done by our team and the abnormality is unilateral, the normal kidney is generally sent away and the anomalous one transplanted at our center. A total of 385 anomalous kidneys, with major anatomical abnormalities or repaired renal arteries, has been transplanted, coming from either CD (375) or living donors (LD) (10). In 115 of these grafts, 123 extracorporeal bench reconstructions (95 arterial and 28 venous) had to be performed before transplantation. The earliest microvascular

Table 1 Kidney transplants performed at the Policlinico University Hospital of Milan (May 1969–July 1995). Fourteen simultaneous multivisceral transplants were performed between 1986 and 1995

Transplants at different time periods	Number	Live donors	Retransplants
1969–1973	132	4	2
1974–1978	257	21	10
1979–1983	360	28	15
1984–1988	501	43	46
1989–1995	490	93	14
1969–July 1995	1760	189	87

Table 2 Causes of variations from the standard technique in vascular anastomoses (1760 renal transplantations). (In 115 transplantations with vascular anomalies of the grafts, 123 extracorporeal reconstructions (95 arterial and 28 venous) were performed before transplantation. Two of the en-bloc transplants were of horseshoe kidneys

	Artery	Vein
Vascular anomalies of the graft	371	120
Arterial sclerosis of the recipient	301	–
Vascular anomalies of the recipient	6	5
Discrepancy of vascular size	41	19
En-bloc transplant	14	14
Ligature of thin vessels	55	144

bench reconstructions were successfully made on grafts from LD found to have at nephrectomy supernumerary vessels, which had not been visualized by preoperative arteriography. Later on, our Institution, as the most experienced center of KT in Italy, took on the role of collecting anomalous cadaver kidneys that would otherwise have been discarded from other transplant centers.

The lack of hypoperfused areas and the absence of severe atherosclerotic disease were the criteria requested for repairing the organs whose vessels had been damaged at nephrectomy. In only 55 cases could a simple ligation of thin arterial vessels less than 1 mm in diameter be made, as hilar branches or small capsular arteries of the upper pole, supplying areas smaller than 2 cm in diameter (Table 2). Multiple arteries supplying the lower pole are always revascularized to avoid ureteral necrosis and fistula or stenosis.

A total of 1673 grafts coming from CD or LD and transplanted for the first time are considered for the present study:

1. Group I: 1311 normal kidneys [776 treated with cyclosporine (CsA) and 535 with conventional therapy].
2. Group II: 362 kidneys with major anatomical anomalies (194 under CsA and 168 under conventional therapy). Group II comprises 348 kidneys having an abnormal vascular supply (two arteries in 303 cases, three arteries in 40 cases and four arteries in 5 cases; not included are grafts in which thin supernumerary arteries were ligated); 12 organs presenting a complete ureteral duplication (treated by two separate ureterocistoneostomies with an anti-reflux technique); 2 indivisible horseshoe kidneys [transplanted en-bloc into two recipients using different techniques (Fig. 1)].

A variety of surgical techniques has been employed to solve the problem of multiple arterial supply, using primary revascularization (PR) in 265 cases and/or 95 arterial bench-top reconstructions (BR). End-to-side anastomosis of an aortic patch bearing the multiple vessels, separate end-to-side anastomoses of multiple renal ar-

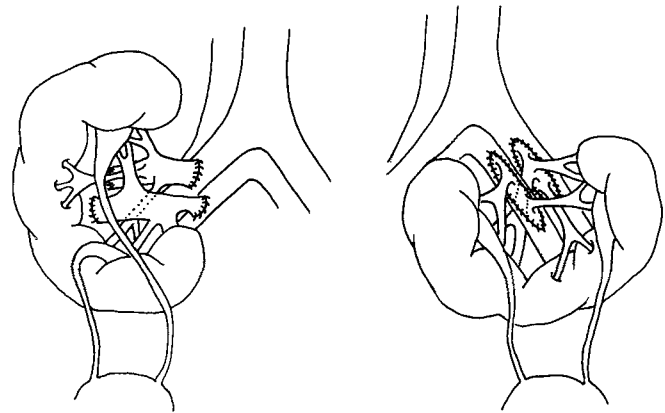


Fig. 1 Two different techniques for en-bloc transplantation of indivisible horseshoe kidneys

teries, removed without a patch, end-to-end anastomoses of multiple renal arteries to the bifurcation of the hypogastric artery, and end-to-end anastomosis of a lower polar artery to the recipient epigastric artery are some of the techniques employed for primary revascularization.

BR techniques have been adopted for transplanting 95 grafts (Fig. 2) with repair of a damaged accessory artery at the aortic patch junction (6 cases), anastomosis of multiple arteries end-to-side to the main renal artery (67 cases), end-to-end anastomosis of the supernumerary artery after having cut off the damaged segment (3 cases), where necessary by interposing an inverted homologous vein graft to extend the length of the artery (6 cases), a vena cava patch (6 cases) or an aortic patch (2 cases), both derived from the actual CD, were employed for an end-to-side anastomosis of accessory artery or arteries. Where a donor patch was unavailable, a homologous saphenous vein patch acquired from a stripping was adopted to anastomose one or more accessory arteries (5 cases).

Our vascular shield [2], used as an intraluminal stent, prevents the inferior wall being entrapped. This simple device allowed the microsurgical repairing of damaged vessels, even in infant necro-kidneys: in the World Transplant Records 1994 reported by P. Terasaki we are the first center successfully to transplant the youngest (and smallest) CD renal allografts reconstructed at the bench [9].

Group I and Group II, similar in demographic variables and clinical profiles such as sex, age, original disease, source of organs, HLA matching, prior transfusions, sensitization, mean warm/cold ischemia time and preservation, are separately evaluated on the basis of the immunosuppressive treatments by actuarial graft survival according to Kaplan-Meier curves and compared by means of the log-rank test. No patients were excluded from the analysis.

Results

There was no operative mortality associated with any of these vascular techniques. In Group I, overall failures related to a surgical cause were 45 (3.4%), while in Group II, 15 kidneys were lost through surgical complications (5.6%); the difference is not significant. Moreover, the majority (80%) of these complications belong to the initial stages of our study. Infact, in the 95 BR

Fig. 2 Some bench-top techniques employed for transplanting kidneys with multiple or damaged arteries

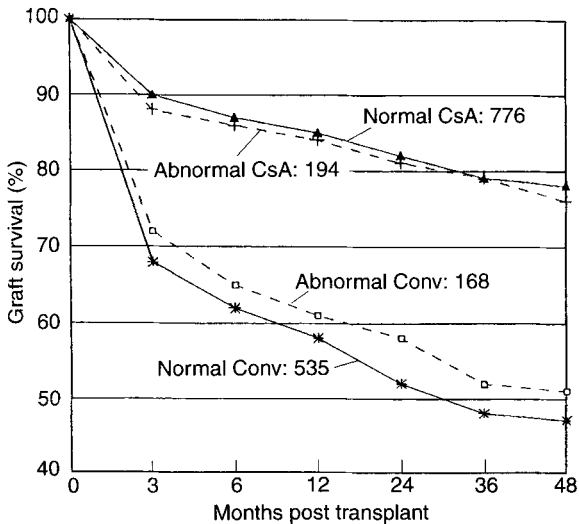
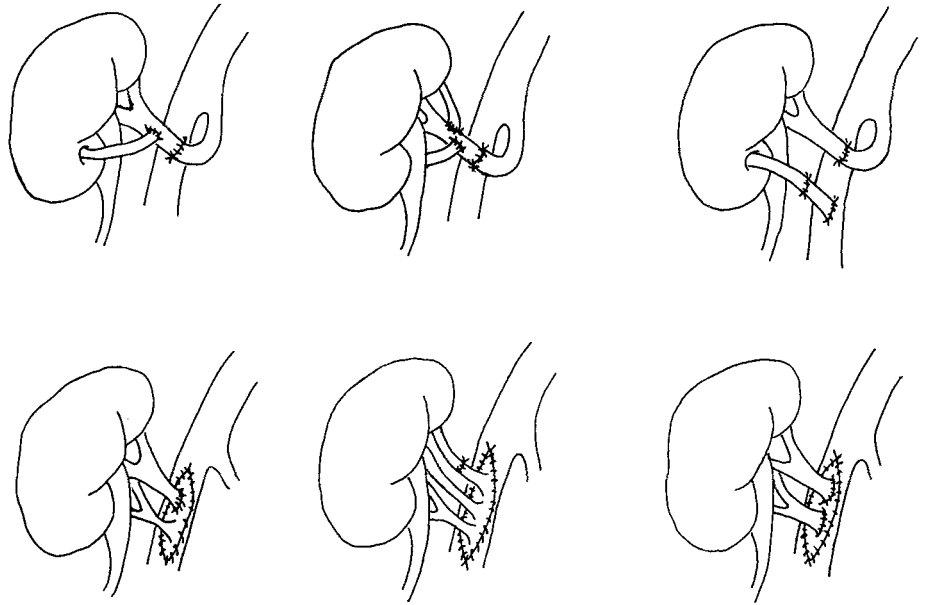


Fig. 3 Actuarial first graft survival of normal and abnormal kidneys on the basis of the immunosuppressive treatment. (CsA Cyclosporine)

grafts belonging to Group II, only one kidney had to be removed due to a surgical complication, which was a result of spontaneous parenchymal rupture. Of the 12 patients receiving organs with a double ureter, two have been treated by conventional therapy and ten were submitted to CsA therapy; none had any surgical problem; two patients lost their graft at 1 and 53 months respectively due to irreversible rejection; one patient died 37 months after transplantation in a road accident; the other nine patients have a well-functioning kidney from 3 to 152 months after transplant (57.3 ± 52.9 months).

The two indivisible horseshoe kidneys had a postoperative course free of complications and immediate diuresis in both cases. The function remained good for 25 and 61 months, when the grafts were lost due to non-compliance and rejection, respectively [9].

The presence of renal anomalies did not influence the primary function of 194 patients under CsA, transplanted with an anomalous graft, in comparison with those receiving a normal one (88.9%, versus 90.1%).

The results of graft survival are significantly better under CsA therapy [3] in comparison with historical series of transplants under conventional immunosuppression (Fig. 3); moreover, actuarial graft survival of 776 normal grafts, transplanted for the first time and treated with CsA, evidenced the same success rate as the 194 "marginal" kidneys under CsA, at all time intervals (85% versus 84% at 1 year, and 78% versus 76.8% at 4 years).

Lastly, vascular supply does not appear to influence function, as measured by creatinine clearance at the first postoperative year, as we have previously noted [8].

Discussion

Our results indicate that anomalous kidneys must not be considered as high-risk grafts, contrary to the experience of others, who report an increase of 22.9% in vascular complications after transplantation of kidneys with multiple arteries [1]. Some of the contradictory results of studies analyzing surgical complications of anomalous kidneys may be explained by different management and different experience in microsurgical techniques. The current allocation system ought to take into

account the anatomical anomalies of the kidney, and the experience of the transplant surgeon who is responsible for the decision to transplant a kidney. In order to reduce organ shortage and maximize outcome of transplantation, anomalous kidneys ought to be collected in those centers with the most experience, where a critical evaluation is mandatory. The anomalous kidney becomes a "marginal" graft only for those operators having poor experience.

Routine use of extracorporeal reconstruction allows a liberalization of the eligibility criteria for transplantation and optimal utilization of a limited organ supply. If

the basic ethical issue remains that of "saving the largest number of lives, and utilizing organs that have the greatest chance for a long-term function" [4], the present paper demonstrates, in our opinion, that there is the potential for increasing the donor pool by up to 25 % with the use of anomalous kidneys, without losing the quality of post-implant function.

Last, but not least, the allocation system now being assessed, maximizing outcome and minimizing costs and risk for transplantation, has a valuable financial benefit to society and to the patient.

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