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OUTCOME OF RENAL GRAFTS WITH MULTIPLE OR DAMAGED VESSELS

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Summary

We have examined a total of 708 donor kidneys for vascular abnormalities. Twenty-two point seven per cent of these had arterial damage or anomalies and in 11 per cent venous abnormalities were found. Five hundred and fifty-one of these kidneys were transplanted in our centre. Excluding 38 recipients of living related donor grafts there was a slightly higher incidence of re-operation and urological complications amongst the recipients of kidneys which had either required bench-top arterial microvascular surgery for vessels damaged at donor nephrectomy or which had multiple vessels. However, the function and actuarial graft survival of such kidneys differed little from those of kidneys transplanted with a conventional single arterial anastomosis.

Introduction

Most surgeons until the early 1970s preferred to exclude from transplantation kidneys that had more than one artery, that is about 30 per cent. In addition up to 17–20 per cent of available grafts commonly have to be discarded because of damage suffered at the time of donor nephrectomy [1]. This paper describes our efforts to increase the number of cadaver grafts available by transplanting kidneys whose vascular supply was anomalous or damaged and subsequently reconstructed by microvascular techniques. The overall results of transplanting kidneys with normal and anomalous vascular supply are compared.

Patients and methods

A total of 551 transplants were carried out in the Policlinico Hospital of Milan, between May 1969 and February 1982 in 535 patients aged four to 56 years, 38 from living donors, 513 from cadavers; 16 patients had a second graft after

failure of the first transplant.

The longest functioning cadaveric donor graft was transplanted more than 12 years ago. All kidneys were preserved by simple perfusion and storage, utilising intracellular solutions. Warm ischaemia time was always less than five minutes, while cold ischaemia time varied from 50 minutes to 34 hours. Seven hundred and eight kidneys became available over 14 years, 576 of them removed by the same surgical team, 132 sent from other centres.

The reported incidence of vascular anomalies (33.7 %) includes arterial and venous abnormalities and arteries that were inadvertently cut at the time of the removal, needing some repair 'on the bench' by microvascular techniques.

When the vascular abnormality was unilateral, the abnormal kidney was preferentially transplantated in our centre.

Twenty-nine cadaveric kidneys out of 708 removed were discarded for various reasons, but only 10 (1.4%) because of irreparable vascular damage. The usual end-to-end arterial anastomosis was modified 134 times, either because of vascular anomalies of the donor kidney, or because of iatrogenic damage incurred during removal, or because of the condition of the donor arteries (atherosclerosis, anatomical abnormalities and marked donor-recipient arterial discrepancy) (Table I).

TABLE I. Vascular anomalies in 708 donor kidneys (551 transplanted)

Vascular anomalies	Total number of donor kidneys (n = 708)	Technical variations in 551 renal transplants	
		Vascular anastomosis	Ligation
Arterial	161 (22.7%)	134 (24.3%)	27 (4.9%)
Venous	78 (11%)	24 (4.3%)	54 (9.8%)

In transplanting kidneys with anomalous vascular supply, we employed similar techniques to those adopted by others [2–4].

The most common types of 'bench' reconstruction employed by us in cases of vascular damage are:

1. Damage at the aortic junction of a polar vessel, roughly removed with a patch, can be repaired by direct suture with interrupted stitches or resecting the damaged segment and reconstructing the polar artery end-to-end using the 'vascular shield' [5].
2. Damage to the main branches of the renal artery is preferentially repaired by end-to-side anastomosis to the adjacent renal artery; sometimes it was necessary to interpose a segment of autologous vein.

Small aberrant veins or capsular arteries were ligated.

In this analysis we have considered only the results obtained in 468 cadaver donor recipients followed for at least one year after operation, we excluded the 38 living donor recipients.

Immediate recovery of function means freedom from dialysis after the first post-operative day; delayed function is considered where renal function improved after a period of tubular necrosis from two to 45 days post transplant. The non-functioning group consists of kidneys that had to be removed without ever having produced urine.

Immunological and surgical complications, needing reoperation within the first year are considered separately according to the different types of vascular anastomosis.

The proportion of normal or abnormal kidneys functioning with various values of serum creatinine (<1.5; 1.5–3.5; >3.5mg/100ml) at one, three, six and twelve months are reported as percentages.

Results

The outcome of transplantation of kidneys with vascular abnormalities and those requiring 'bench' repair is similar to that of kidneys with a normal vascular supply (Table II). More reoperations were performed in patients who received kidneys with multiple or repaired vessels (14/54) in comparison with the ones requiring a single anastomosis (27/304): the difference for surgical complications is statistically significant ($p<0.001$) and we noted a preponderance of urological complications (20/27 in normal kidneys and 12/14 in kidneys with multiple or repaired vessels).

TABLE II. Clinical results according to the type of vascular anastomosis

Vascular anastomosis	Recovery of function			Reoperations	Nephrectomy for surgical reason	Nephrectomy for rejection
	Immediate	Delayed	Never			
Normal vascular supply: end-to-end anastomosis n = 304	207 (68.1%)	75 (24.6%)	22 (7.3%)	27* (8.8%)	12† (3.9%)	85 (27.9%)
Normal vascular supply: end-to-side anastomosis n = 40	33 (82.5%)	4 (10%)	3 (7.5%)	5 (12.5%)	3 (7.5%)	12 (30%)
Multiple arteries with patch: end-to-side anastomosis n = 46	30 (65.2%)	12 (26.0%)	4 (8.8%)	3 (6.5%)	2 (4.3%)	15 (32.6%)
Multiple or repaired vessels: multiple anastomoses n = 54	32 (59.2%)	18 (33.3%)	4 (7.5%)	14* (25.9%)	5† (9.2%)	16 (29.6%)
All abnormals n = 164	109 (66.4%)	41 (25.0%)	14 (8.6%)	24 (14.6%)	12 (7.3%)	44 (26.8%)

* $p<0.001$; † $p<0.005$

Only five nephrectomies on 54 kidneys with multiple vessels were required for surgical reasons (two urinary fistulae, one arterial haemorrhage, two polar infarctions). However, 12 nephrectomies were undertaken for surgical reasons in the

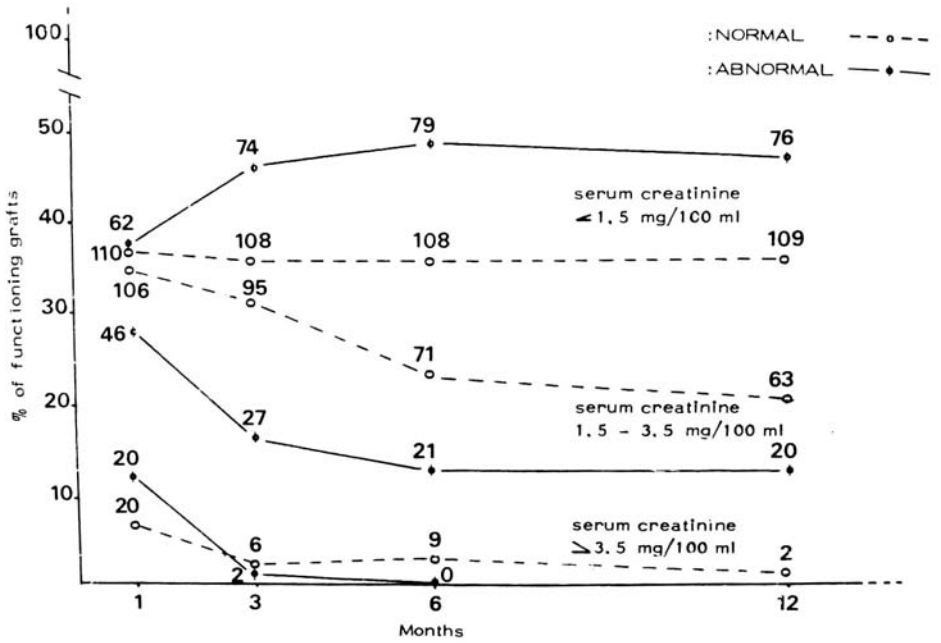

Figure 1. Renal function according to the type of vascular anastomosis

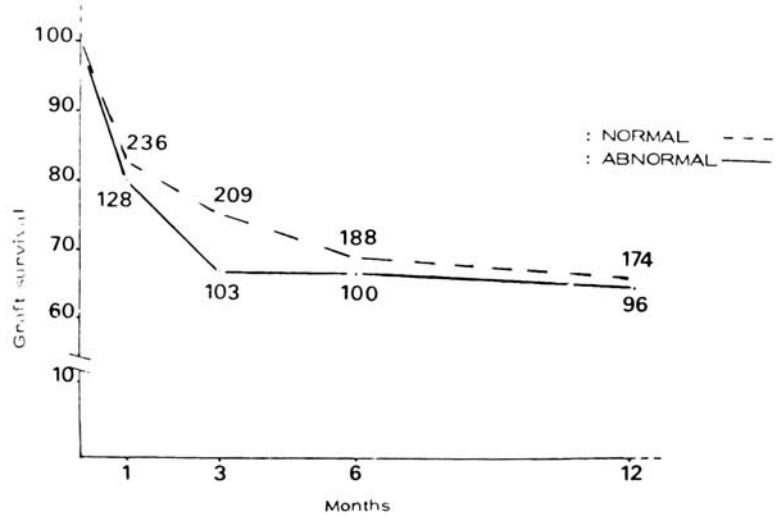

Figure 2. Actuarial curves of cadaveric graft survival with normal or abnormal blood supply

three hundred and four transplanted kidneys with a normal vascular supply.

No problems arose following ligation of multiple aberrant veins or small capsular arteries.

Almost the same percentage of grafts with a normal or abnormal vascular supply were removed for irreversible rejection within the first post-operative year.

The vascular supply does not appear to influence renal function in the first post-operative year (Figure 1). The actuarial curves of cadaveric graft survival according to the vascular supply, confirm the good results with the anomalous kidneys (Figure 2).

Discussion

The presence of abnormal vasculature is often considered a hazard in kidney transplantation [2–4]. Although the incidence of surgical complications is higher in kidneys with multiple vessels, our results show that it is worth transplanting kidneys with an abnormal vascular supply, both in regard to graft survival and function.

The pre-operative inspection of the kidneys received from other centres is important, considering the possibility of bench top repair of the damaged arteries.

We believe that injury to a polar vessel at the aortic junction is responsible for the increase in bleeding and vascular complications reported by some authors.

The extracorporeal microvascular technique of reimplantation of a polar vessel is made easier by the use of the 'vascular shield', introduced into the sectional artery through the aortic orifice or through the adjacent artery.

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