OUTCOME OF LIVE-DONOR RENAL ALLOGRAFT TRANSPLANTATION FROM SINGLE VS MULTIPLE ARTERIES' GRAFTS

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Abstract - This study compares the results and outcome of live-donor transplantation between single-artery vs multiple-artery transplant kidneys. Cadaver kidneys with multiple vessels are retrieved with a patch of the donor artery. This is not possible in the live donation setting. Therefore live donation of renal allografts with multiple arteries is not a straightforward surgery. We studied 22 multiple-artery live donor renal allografts among 223 renal transplantations in a sequential, prospective manner for 3 years. One-year graft survival was 96.5% in single-artery group and 95.5% in the muliple - artery group. In the single-artery group the complications were: delayed graft function in 3.5%, reanastomosis of the vessels in 2.9%, transient post-transplant dialysis in 1.5%, graft nephrectomy in 2.5%, ATN in 1%, Urine leak in 2.5%, renal artery stenosis in 0.5%, and lymphocele in 1%. None of these occurred in the multiple-artery group. This difference is statistically significant ($X^2 = 8.10$). Cold ischemia time was significantly longer in the multiple - artery group ($p<0.0005$). Duration of in vivo arterial anastomosis was not significantly different among the 2 groups ($t = 1.255$). The total length of the operation was longer in the multiple-artery group ($p<0.0005$). In conclusion it is apparent that the intra-operative complications, post-operative complications and one-year graft survival are comparable in single - artery vs. multiple - artery renal transplantation. In other words, live - donor transplantation with multiple - artery renal units is safe and has a good outcome.

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INTRODUCTION

The kidney pool for transplantation is not enough to compensate for the growing need even in countries which have cadaver- kidney readily available (1). Except for a small number of recently performed cadaver renal transplants, the bulk of kidney for transplantation in Iran comes from live-donation, mostly from unrelated donors. Live-donor renal transplantation of kidneys with more than one renal artery is technically more demanding and is not easily accepted by every renal transplant facility. In certain situations we had to deal with renal transplantations from live donors with multiple renal arteries on both sides.

We thought this would be a good opportunity to launch the current study to compare the outcome of these grafts with the regular single-artery transplants. We hoped that this may encourge our fellow transplant surgeons in Iran to adopt multiple-artery live donation into their programs more easily.

MATERIALS AND METHODS

The study was designed as an open clinical trial and it took 3 years. A total number of 223 renal allograft recipients were included in succession. The age ranged from 5 to 60 years. Patients were grouped into Single-artery (n = 203), and multiple-artery groups (n = 22). The 2 groups were matched for the age and sex distributions. There was no difference in inclusion criterria or preoperative evaluation among the 2 groups. Donor nephrectomy was performed, usually through a flank incision, with resection of 11 or 12th rib (2).

Reconstruction of the vessels was performed extracorporeally using a 3.5× surgical loupe magnification. Technical details are discussed else-where (3).

Study variables included: time spent to prepare the transplant vessels; warm and cold ischemia time; type of arterial anastomosis; time spent for arterial anastomosis; time spent for vascular anastomosis; time spent to perform the whole operation; intra-operative complications (Donors

and Recipients); post-operative complications (Recipients); occurrence of rejection or infection; hospital stay.

RESULTS

Epi Info 6 software was used to analyze the variables. Age and sex were matched in both groups. Out of 223 renal angiograms, 38.1% showed only one artery on either side. In 9.5% of angiograms multiple renal arteries were present on both sides. Left - only multiple branches were encountered on 28.6%, and right-only multiple branches on 23.8% of times. Two-branch arteries occurred on 83.3% and the rest were 3 branches. Nephrectomy side: single-artery group-left = 64.3%, and right=35.7%. Multiple-artery group-left=75%, and right = 25%. In Tabel 1, intra-operative variables in 2 groups are presented.

Table 1. Intra-operative variables

	Single-A(x,sd)	Multiple-A(x,sd)
Time to prepare the vessels(min)	20 - 75 (42,10)	40 - 120(80,17)
Warm ischemia time (sec)*	10 - 65(36,13)	20 - 55(38,8)
Cold ischemia time (min)	20 - 65(41,9)	40 - 140(80,16)
Anastomosis to Ext. iliac artery	13.4%	27.3%
Time spent for Arterial anastomosis(min)**	10 - 40(20,6.5)	10 - 35(18,7.2)
Time spent for Vascular anastomosis(min)***	20 - 55(35,7.3)	20 - 55(34,4,7,6)
Total time (min)****	130 - 255(177,22)	123 - 225(198,27)

*t = 0.796 **t = 1.225 ***t = 0.366 ****P<0.250

The comparison between intra-operative complications in donors of single vs. multiple transplant arteries is shown in Table 2. Intra-operative complications in the 2 groups are shown in Table 3. Post-operative complications are listed in Table 4.

Table 2. Intra - operative complications (Donor)

	Single-A(x,sd)	Multiple-A(x,sd)
Hemorrhage (ml)**	100 - 450(323,80)	100 - 300(259,58)
Transfusion	0.5%	–
Pleural perforation	13.4%	8.2%
Peritoneal perforation**	7%	18.2%

*P<0.0005 **X^2= 2.7

Table 3. Intra - operative complications (Recipients)

	Single-A(x,sd)	Multiple-A(x,sd)
Hemorrhage* (ml)	100 - 500(283,106)	100 - 450(273,96)
Transfusion	12.9%	–
Peritoneal perforation	15.4%	72.7%
Complications of anesthesia**	8.9%	18.2%

*t=0.439 **X^2= 23.5

Table 4. Post-operative complications (Recipients)

	Single-A(x,sd)	Multiple-A(x,sd)
Delayed function	3.5%	–
Vascular reanastomosis	2.9%	–
Temporary posttransplant dialysis	1.5%	–
Transplant nephrectomy	2.5%	–
ATN	1%	–
Urine leak	2.5%	–
Arterial stenosis	0.5%	–
Lymphocell	1%	–

The incidence of rejection and wound or urinary tract infection was not statistically different among the 2 groups. However, compared to our previous report, the incidence of infection was lower (4). Donors of single-artery transplant kidneys stayed at the hospital between 2 and 6 days (Mean 2.3 days). This figure for the multiple-artery donors was 2 to 5 days (Mean 2.1). Hospitalized from 10 to 30 days (Mean 14 days), while the recipients of multiple-artery kidneys stayed between 12 to 28 days (18 days). One-year graft survival in single-artery transplants was 96.5%. The one-year graft survival in multiple- artery group was 95.6%.

DISCUSSION

In our live donor population, 62% had a multiple-branch renal artery on one side, equally distributed to each side. Therefore a right renal unit with a less favorable renal vein, was harvested in half of them. In a multiple-artery live donor transplantation, the vascular dissection is more elaborate and the reconstruction is

time-consuming, hence the preparation time is longer. The mean time spent in single-artery group was 42.3 ± 10.1, compared to 80.5 ± 16.8 in multiple-artery group ($p<0.0005$). Other variables, such as the surgeon's experience, recipients' height and weight, previous surgeries and the number of cases, could have a role. These were matched for the 2 groups except for the relatively small number of cases in the multiple-artery group. The difference in cold ischemia time, is due to the time used for arterial reconstruction. The mean value for the single-artery group was 41.4 ± 9.2 and the mean value for the multiple-artery group was 79.7 ± 16.5 min ($p<0.0005$). This was not functionally detrimental to the allograft, because the kidney was kept in an ice-slash container or bag until the release of the vascular clamps.

A period of 3 to 4 hours is tolerated safely by the ice cooled graft (5, 6). All of our multiple-artery grafts functioned promptly after the release of the vascular clamp. We prefer to anastomose the renal artery to the internal iliac artery if deemed feasible. In our multiple-artery group we have used 2 times more often the anastomosis to the external iliac artery on the recipient. Factors that influence the choice of the recipients' artery and vein for the anastomosis are stump length, potential impotence, vascular kinking, pressure on the vein, and the presence of atheroma plaques. The outcome was not affected by the type of anastomosis.

The time spent to complete the arterial and venous anastomosis, in the recipient did not differ significantly among the 2 groups ($t = 0.366$). There was not a considerable difference in the total operation time among the groups ($p<0.250$). With proper timing, the donors and recipients will spend nearly the usual length of time being under anesthesia, and in the gap period, it would only be the grafts in ice-slash under reconstruction. Hemorrhage was significantly less in the multiple-artery group ($p<0.0005$). A more delicate dissection and attention to details had lessened this complication. Transfusion has been more frequent in the donors and recipients of the mulitple-artery group. A bias due to the relatively small number of the group or a more extensive dissection, are possible explanations. Also, relevant are an increase in the pleural and peritoneal perforations, incidence in the donors of the multiple-artery group ($X^2 = 2.7$). Peritoneal perforations and complications of anesthesia were more frequent in the recipients of the multiple-artery kidney transplants ($X^2 = 23.5$). Again, more dissection for better preparation of the transplant bed, has probably caused this difference. However, this has not affected the outcome. Post-operative complications were not present in the multiple-artery group ($X^2 = 8.1$). A more attentive approach to this group may account for this finding.

Although the number in the group is small, one may conclude that at least the number of post-operative complications is not more than the single-artery group. Hospital stay did not differ significantly among the donors and recipients of each group ($t = 0.304$, $t = 1.162$). The one-year graft survival was 96.5% in the single-artery group and 95.6% in the multiple-artery group. We conclude that considering the study variables, the intra-and post-operative complications and the one-year graft survival, the outcome of live donor multiple-artery renal graft is comparable to the more usual single-artery renal allograft.

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