

SURGICAL COMPLICATIONS AFTER RENAL TRANSPLANTATION IN GRAFTS WITH MULTIPLE ARTERIES

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ABSTRACT

Introduction: Renal transplantation with multiple arteries appears, in literature, associated to a major index of surgical complications. This study compared the surgical complications and short-term outcome renal transplants with multiple arteries and single artery grafts.

Materials and Methods: The data of 64 renal transplants with multiple arteries performed between January 1995 and December 1999 were compared to the ones of 292 transplants with single renal artery. The aspects analyzed were number of arteries of the graft, donor type, vascular reconstruction technique, the occurrence of surgical complications, the incidence of delayed graft function, graft function 1 month after transplantation, graft loss and the patients' deaths.

Results: The incidence of surgical complications in grafts with multiple arteries and single renal artery was respectively: vascular – 3.1% and 3.1%; urological – 6.3% and 2.7% and other surgical complications – 15.6% and 10.6%, respectively. The incidence of lymphoceles was 3.1% in grafts with a single artery and 12.5% in grafts with more than 1 artery ($p = 0.0015$). The incidence of delayed graft function in grafts with multiple arteries and with a single renal artery was respectively 35.1 and 29.1% ($p = 0.295$). Mean serum creatinine at the 30th postoperative day was 2.46 and 1.81 in grafts with multiple and with 1 artery, respectively ($p=0.271$).

Conclusions: Kidney transplantation using grafts with single and multiple arteries present similar indexes of surgical complications and short-term outcome; lymphoceles were more frequent among grafts with multiple arteries.

Key words: kidney transplantation; renal arteries; abnormalities; intraoperative complications
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INTRODUCTION

Despite being a consolidated procedure, renal transplantation is liable to complications due to technical problems and peculiarities inherent to patients with chronic renal failure.

Some difficulties arise from anatomical anomalies like multiple arteries and ureters, pediatric donors and horseshoe kidneys, among others (1). Multiple renal arteries are unilaterally found in 25% of the population and bilaterally in 10%, and may represent

a challenge to the surgeon (1,2). As an auxiliary procedure for renal transplantation with multiple arteries, the out-of-body vascular reconstruction (bench technique) aims at generating a unique arterial ostium to facilitate the vascular anastomosis and to decrease the incidence of complications (3,4). On the other hand, in situ reconstruction of multiple artery grafts can be used, like the inferior epigastric artery applying to small caliber polar arteries revascularization (5,6).

Vascular complications in renal grafts with a single artery, including thrombosis and arterial steno-

sis, range from 1 to 16% (7,8). Urologic complications occur in 2% to 10% of transplanted patients (9-11). Renal transplantations with multiple arteries are reported as having a major index of vascular and urologic complications (12).

The aim of this study was to compare the incidence of surgical complications in grafts with multiple arteries and those with a single artery.

MATERIALS AND METHODS

The charts of 356 renal transplantations performed in 351 patients between January 1995 and December 1999 were reviewed. The patients were divided into 2 groups. Group 1 - grafts with a single artery (292 grafts – 288 patients) and group 2 - grafts with multiple arteries (64 grafts – 64 patients). Five patients

were submitted to 2 transplants during the study period. One of them had the first graft with 2 renal arteries and the second one with 1 renal artery. The other 4 patients had both transplants with one artery.

Demographic data are in Table-1.

Open live donor nephrectomy was performed through an extraperitoneal flank incision in all cases. Vascular anastomoses were performed to the external iliac vein and external iliac artery. Urinary tract reconstruction was accomplished by the Gregoir technique. Ureteral stents were exceptionally used either when ureteral re-implant to the bladder was not adequate, or when the ureter was ischemic or when the bladder wall was thickened due to neurological disorders. The techniques applied for arterial reconstructions in graft with multiple arteries are presented in Tables-2 and 3.

Table 1 – Demographic data and patients’ characteristics of group 1 (single renal artery) and group 2 (multiple renal arteries).

	Group 1 (N = 288)	Group 2 (N = 64)
Gender: men/women	157/131	34/30
Mean/median age (range)	41/41 (18-70)	39/37 (18-70)
No. white/African American/ others	168/43/77	44/4/16
No. cadaveric/live donors	187/105	40/24
No. transplants/re-transplants	246/ 47	58/6
No. arteries per graft	1	55 cases - 2 arteries 7 cases - 2 arteries 1 case - 4 arteries 1 case - 5 arteries

Table 2 – Bench vascular technique in multiple artery grafts.

	N	%
Carrel aortic patch	24	37.5
Side-to-side anastomosis of 2 arteries	11	17.2
End-to-side anastomosis of inferior polar artery in main renal artery	6	9.4
Carrel aortic patch reduction	6	9.4
Inferior polar artery anastomosis in Carrel aortic patch	3	4.7
Carrel aortic patch + superior polar artery ligature	2	3.1
Carrel aortic patch + end-to-end anastomosis of inferior polar artery with inferior epigastric artery	1	1.6
Side-to-side anastomosis of 2 arteries + superior polar artery ligature	1	1.6
End-to-side anastomosis of accessory arteries in the main artery + end-to-end inferior polar artery anastomosis with inferior epigastric artery + superior polar artery ligature	1	1.6

Table 3 – Vascular technique in situ in grafts with multiple arteries.

End-to-side anastomosis of external iliac artery and end-to-end inferior polar artery with inferior epigastric artery	5 (7.8%)
End-to-end anastomosis in inferior epigastric artery and superior polar artery ligature	4 (6.2%)

Table 4 – Vascular complications among single (group 1) and multiple (group 2) arteries grafts.

	Artery Stenosis	Artery Thrombosis	Vein Thrombosis	Total
Group 1 (N = 292)	6 (2.1%)	1 (0.3%)	2 (0.7%)	9 (3.1%)
Group 2 (N = 64)	0	0	2 (3.1%)	2 (3.1%)

p = 1.00

Doppler ultrasonography was routinely performed in the second or third day after transplant in order to evaluate vascular flow as well as the urinary system. Renal arteriography was performed for the diagnosis of arterial stenosis. Significant arterial stenosis was considered when an obstruction greater than 50% on the artery diameter was found. The diagnosis of urinary complications was achieved by ultrasonography and cystography. Cystography was performed every time there was a suspicion of a urinary fistula.

Delayed graft function was defined as the need of at least one dialysis session after transplant. The mean follow up of patients was 2.2 years (1 - 1,822 days). Patients were followed at the outpatient unit, initially once a week during the first month after transplant, then once a month for the following 3 months and then each 6 months for the entire life.

Statistical analysis was done using the chi square test, corrected for continuity according to Yates, Fisher exact test and the non-parametric Kruskal Wallis test. *P* < 0.05 was considered statistically significant.

RESULTS

Eleven vascular complications occurred (3.1%). Overall, renal artery stenosis occurred in 6 patients (1.7%), renal vein thrombosis in 4 patients (1.1%) and renal artery thrombosis in 1 patient (0.3%).

In group 1, 6 patients (2.1%) developed renal artery stenosis, 2 (0.7%) vein thrombosis and 1 patient (0.3%) arterial thrombosis. Among patients with renal artery stenosis, 4 patients had grafts from living donors and 2 from cadaveric donors. Two patients required surgical repair. Two patients with renal vein thrombosis and 1 patient with renal artery thrombosis received cadaveric donors grafts (graft nephrectomy was performed). In group 2, 2 patients (5%) developed vein thrombosis. Graft nephrectomy was performed in both cases (Table-4).

In group 1, 8 (2.7%) urinary fistulae occurred (6 patients had grafts from living donors and 2 from cadaveric donors. Six patients required surgical repair and two patients were treated by bladder drainage).

In group 2, 3 (4.7%) urinary fistulae and 1 (1.6%) ureteral stenosis occurred (all patients had grafts from cadaveric donors). Urinary fistulae were treated surgically in 2 patients and by bladder drainage in one. The obstruction at the ureterovesical anastomosis required surgical repair. The incidence of fistulae was higher among multiple arteries grafts, but no statistically significant difference was found (Table-5).

Regarding the other surgical complications, we found in group 1, 9 lymphoceles (3.1%), 9 infections of the surgical incision (3.1%), 4 incisional hernias and 4 hematomas of the iliac fossa (1.4%). In group 2, 8 lymphoceles (12.5%), 2 infections in surgical site (3.1%) and 1 incisional hernia (1.6%) occurred (Table-6).

Table 5 – Urological complications among single (group 1) and multiple (group 2) arteries grafts.

	Urinary Fistula	Ureteral Stenosis	Total
Group 1 (N = 292)	8 (2.7%)	0	8 (2.7%)
Group 2 (N = 64)	3 (4.7%)	1 (1.6%)	4 (6.3%)

p = 0.3333

Table 6 – Other surgical complications among single (group 1) and multiple (group 2) arteries grafts recipients.

	Group 1 (N= 292)	Group 2 (N = 64)	
Lymphocele	9 (3.1%)	8 (12.5%)	<i>p</i> = 0.0015 *
Infection of surgical incision	9 (3.1%)	2 (3.1%)	<i>p</i> = 0.985
Incisional hernia	4 (1.4%)	1 (1.6%)	<i>p</i> = 0.905
Hematoma of iliac fossa	4 (1.4%)	0	<i>p</i> = 0.347
Lymphorrhea	3 (1%)	0	<i>p</i> = 0.416
Dehiscence of surgical incision	2 (0.7%)	0	<i>p</i> = 0.504
Total	31 (10.7%)	11 (17.2%)	

Delayed graft function occurred in 85 patients in group 1 (29.1%) and in 23 patients in group 2 (35.1%) (*p* = 0.295). Mean serum creatinine at 30th postoperative day was 1.81 mg/dL in group 1 and 2.46 mg/dL in group 2 (*p* = 0.271).

Renal graft losses were due to arterial or venous thrombosis and occurred in 3 (1.0 %) grafts with single artery, and in 2 (3.0%) grafts with multiple arteries. No patient died due to surgical complications in the single artery group. In the multiple arteries group, 2 patients died (3%) due to urinary fistulas followed by septicemia.

COMMENTS

Theoretically, a higher risk of surgical complications to the living donor and to the recipient is associated to the renal graft with multiple arteries. At the beginning of the renal transplantation era, this fact was considered as a contraindication to the procedure. Nowadays, multiple vessels are not considered a problem anymore neither to open nor to laparoscopic nephrectomies. We did not have any laparoscopic donor nephrectomy during the period studied. Recent studies have demonstrated that laparoscopic donor

nephrectomy of kidneys with multiple renal vessels is safe and effective, providing kidney donor and allograft outcomes comparable to those of open surgery (13,14).

Several mechanisms causing vascular complications have been postulated such as faulty suture technique producing incomplete intimal reapproximation with secondary intraluminal fibrosis, postoperative hypotension, hypercoagulable state, atherosclerosis of the donor or recipient vessels, trauma to the donor artery during perfusion, wide disparity in vessel size, torsion of the graft during performance of the anastomosis, kinking of artery and angulation of the vein owing to improper location of the graft or to the anastomosis (15,16).

Multiple renal arteries have been associated with a higher rate of vascular complications, including arterial thrombosis and renal artery stenosis (14). Several techniques for bench or in situ reconstruction of multiple renal arteries have been described in order to reduce the incidence of these vascular complications (10). In grafts from cadaver donors, the Carrel aortic patch is the standard technique of vascular reconstruction in renal transplants with a single and multiple arteries (17).

In this study, we reviewed the incidence of surgical complications in transplants with multiple arteries and compared them with transplants with 1 artery performed in the same period. As the number of transplants with multiple arteries is small, the occurrence of complications is low and the statistical analysis may be impaired.

Arterial stenoses occur in a range of 0.8 to 12.4% of all renal transplants (10,17). In our casuistic, there were 6 cases (1.7%) of renal arterial stenosis, all of them in grafts with single artery. All cases were diagnosed through Doppler ultrasonography and confirmed by arteriography. Revascularization is recommended in those cases in which arterial stenosis is considered the cause of intractable hypertension and/or declining renal function and when the obstruction is greater than 50% (6). A variety of surgical procedures have been performed including resection of the stricture segment, bypass grafting methods, lysis of adhesions, patch angioplasty, and dilatations (18). In 2 cases, the stenotic portion was resected and re-anastomoses performed. The remaining 4 cases were treated clinically as the hypertension could be treated with anti-hypertensive drugs satisfactorily and renal function remained stable.

Renal vascular thrombosis caused graft loss in 5 patients, all of them with a single artery. In our series, we did not find any arterial thrombosis in kidney graft with multiple arteries.

According to the literature, the incidence of urological complications range from 3% to 34% with an associated mortality ranging from 0% to 60% (10,11). In our casuistic, the incidence of urinary complications in grafts with a single artery was lower than that in grafts with multiple arteries, but without statistically significant difference. Urinary fistulae in grafts with multiple arteries occur at an incidence of 2.2% to 4.8% (17). In this study, three cases (4.7%) of urinary fistula occurred with a mortality index of 3.1% due to this complication.

Lymphoceles occur in 1% to 12% of all kidney transplants (19). We found a significant higher incidence of lymphocele in grafts with multiple arteries (12.5%) compared to grafts with a single artery (3.1%), $p = 0.0015$). The lymphocele occurs due to deficient ligature of lymphatic vessels during dis-

section of iliac vessels of recipient and/or during dissection of graft vessels, acute rejection, or drugs used after surgery, such as steroids, diuretics, heparin, mophetil mycophenolate and others (20). In grafts from cadaveric donors, the visualization of the lymphatic vessels is almost impossible after perfusion and ligature is commonly not performed. Usually the lymphatic vessels are more abundant in grafts with multiple arteries and so they are vulnerable to insufficient ligature, therefore, speculate that this fact can explain the higher occurrence of lymphocele among grafts with multiple arteries.

Wound infection ranges between 2% and 43% and is associated mainly to diabetes, urinary fistulas, hematomas and after graft nephrectomies (21). In our study, we had an incidence of 3.1%, and no difference occurred between grafts with single and multiple arteries.

Delayed graft function was more frequent among grafts with multiple arteries, but without statistically significant difference, and this fact can be explained by the manipulation necessary for vascular reconstruction in these grafts, causing an increase in warm ischemia period. Although we did not analyze this aspect in this article, it is clear that warm ischemia time is longer in transplants with multiple arteries and this may influence the immediate function of the graft. Consequently, serum creatinine on the 30th postoperative day was higher in this group but, again, no statistically significant difference was found.

The losses of grafts due to surgical complications were, in the whole, due to vascular complications. In our series, 2 deaths occurred among patients with multiple arteries that presented with urinary fistula associated to sepsis. Again, this mortality alerts to the great potential danger of these surgical complications.

CONCLUSION

In this study, there was no significant difference in the occurrence of vascular and urologic complications, as well as delayed graft function when we compared grafts with single and multiple arteries. The incidence of lymphoceles was significant higher among grafts with more than 1 artery.

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