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Outcome of Laparoscopic Live Donor Nephrectomy and Impact of Double Renal Arteries: Results From Two Transplant Centres

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OBJECTIVE: Live donor kidney transplantation is consistently superior to deceased donor kidney transplantation. Laparoscopic donor nephrectomy (LDN) is increasingly accepted as a safe and preferred surgical option. To evaluate the outcome of LDN and the impact of multiple arteries, a retrospective review was conducted on patients in two transplant centres.

METHODS: Fifty patients including eight with double vessels were studied. Standard left transperitoneal LDN was performed. Grafts including those with double vessels were prepared using the bench technique. Postoperative outcomes (up to 1 year) for donors and recipients were studied. The outcomes of recipients of a single or double vessel graft were compared.

RESULTS: All donors had an eventful recovery. No difference was found between the single and multiple vessels groups for operating time (168.21 ± 5.712 minutes *vs.* 197.50 ± 15.755 minutes) or hospital stay (3.21 ± 0.165 days *vs.* 4.13 ± 0.789 days). The recipient outcomes including hospital stay (10.17 ± 0.596 days *vs.* 12.13 ± 1.797 days) and creatinine levels at day 7 (106.53 ± 5.583 μmol/L *vs.* 107.13 ± 11.857 μmol/L) and 1 year (120.21 ± 6.562 μmol/L *vs.* 124.75 ± 11.857 μmol/L) were similar. No ureteric stricture or graft loss was noted at 1-year follow-up. Recipient complications included lymphocoele ($n = 2$), haematoma ($n = 3$ with 2 requiring exploration), sepsis ($n = 1$), renal artery stenosis ($n = 2$ with 1 stented), repeated anastomosis ($n = 1$), and incisional hernia ($n = 1$). No differences were noted between the two groups.

CONCLUSION: Our results showed that overall donor morbidity rate was low, as reflected by the short hospital stay. Also, the overall parameters of the recipients were good. In particular, no ureteric stricture was noted, and graft survival was 100% at 1 year. The outcomes of the reconstructed group, despite the technical challenge, were similar to those of the single-vessel group. [*Asian J Surg* 2010;33(2):70–5]

Key Words: laparoscopic donor nephrectomy, kidney transplantation

Introduction

Renal transplantation has become a well-established therapy and represents the best option for patients with end-stage renal disease. Live donor kidney transplantation is consistently superior to deceased donor kidney transplantation. To reduce the morbidity of donors, who are healthy individuals, laparoscopic donor nephrectomy (LDN) is increasingly accepted as a safe and preferred surgical option.[1–4]

We previously evaluated the feasibility of LDN in an experimental setting,[5] and subsequently established a clinical programme.[6] However, strict adherence to only

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single renal artery allografts means that up to 20% of potential donors will be rejected. Since 2005, our donor nephrectomy programme has included patients with double left renal vessels. Herein, we report the results of LDN in two transplant centres in Asia, and compare the perioperative outcomes of renal transplants that involved double versus single vessels.

Patients and methods

The donor nephrectomy series was compiled from two major transplant centres: Singapore General Hospital, Singapore, and the Prince of Wales Hospital, Hong Kong. Potential donors were evaluated using three-dimensional computed tomography angiography to determine the anatomy of the hilar vessels. Donors with double vessels and their corresponding recipients were extensively counselled regarding the possibility of increased operation time and morbidity associated with renovascular reconstruction.

We prefer left-sided kidney retrieval when possible. However, if left-sided vascular anatomy is complex but right-sided anatomy is straightforward, then, conventional open right donor nephrectomy is offered. Such cases represent a very small minority in our experience and are not reported here.

A standard transperitoneal laparoscopic approach is adopted. The renal artery is mobilized to the aorta-renal artery junction. The renal vein is mobilized to the anterior surface of the aorta, with the left adrenal, gonadal and lumbar vessels dissected and clipped. We prepare the exit wound but preserve the peritoneum to maintain the pneumoperitoneum. Previously, we used two 10-mm Hem-o-lok clips (Teleflex Medical, Durham, NC, USA) on the patient's side for routine vascular control of the renal artery and vein. The graft side is not clipped, so that the maximal length of the renal vessel is preserved for implant surgery. At this time, however, we use additional metal clips or laparoscopic ligation on the patient's side for extra safety. Even in the event of early arterial branching, we do not advocate flush transection of the artery, but rather proceed to bench reconstruction when indicated. Upon controlling and dividing the vessels and then the ureter, the peritoneum is opened for hand retrieval of the graft, bench flushing and dissection. In the case of multiple renal arteries, all branches are dissected to the aorto-renal artery junction, and the main trunk is controlled using two 10-mm Hem-o-lok clips and additional manoeuvres as described above, whereas the smaller branches are controlled using two 5-mm Hem-o-lok clips (Figure 1).

Reconstructive options include bench reconstruction in the side-to-side (common ostium) or end-to-side (smaller branch to main trunk) manner, or a separate anastomosis to the recipient (smaller branch to the inferior epigastric artery). Side-to-side reconstruction is preferred when the two branches are of similar size, and typically, interrupted 7-0 Prolene sutures (Ethicon Inc., Somerville, NJ, USA) are used. End-to-side reconstruction is employed when there is substantial discrepancy in size, and interrupted 8-0 or 9-0 Prolene sutures are used; often aided by a small angiocatheter across the anastomosis. The reconstructed artery is tested for leakage by running the perfusant (Eurocollin's solution; Fresenius Medicare, Bad Homburg, Germany) through the ostium of the main renal artery. Alternatively, for small lower-pole branches, the recipient's inferior epigastric artery is used for direct anastomosis when deemed suitable during recipient surgery, which is performed concurrently in the room next to the donor and bench surgery. The main arterial and venous anastomoses are otherwise performed using continuous 6-0 Prolene sutures in the standard manner. A postoperative renal nuclear scan is performed to check for complete vascular perfusion, and supplemented by Doppler ultrasound when necessary.

A retrospective review of donor and recipient outcomes was conducted. The outcomes of patients with a single versus multiple renal arteries were compared. Statistical analysis was carried out using SPSS version 13.0 (SPSS Inc., Chicago, IL, USA). One-way analysis of variance was performed to test for differences between the two study groups. A p value < 0.05 was considered to be statistically significant.

Results

Among 50 laparoscopic transplantations, eight patients had double renal arteries. Bench reconstruction was carried out for six patients to facilitate a single common graft arterial anastomosis, with four cases of end-to-side (small branch to main trunk) and two of side-to-side (branches of equal size) reconstruction. A separate anastomosis was performed for two patients by joining the smaller branches to the recipient's inferior epigastric artery after the main anastomosis was completed.

The patient demographics are listed in Table 1. Follow-up information for up to 1 year was available for all but nine patients (all 9 had single vessels). There was no

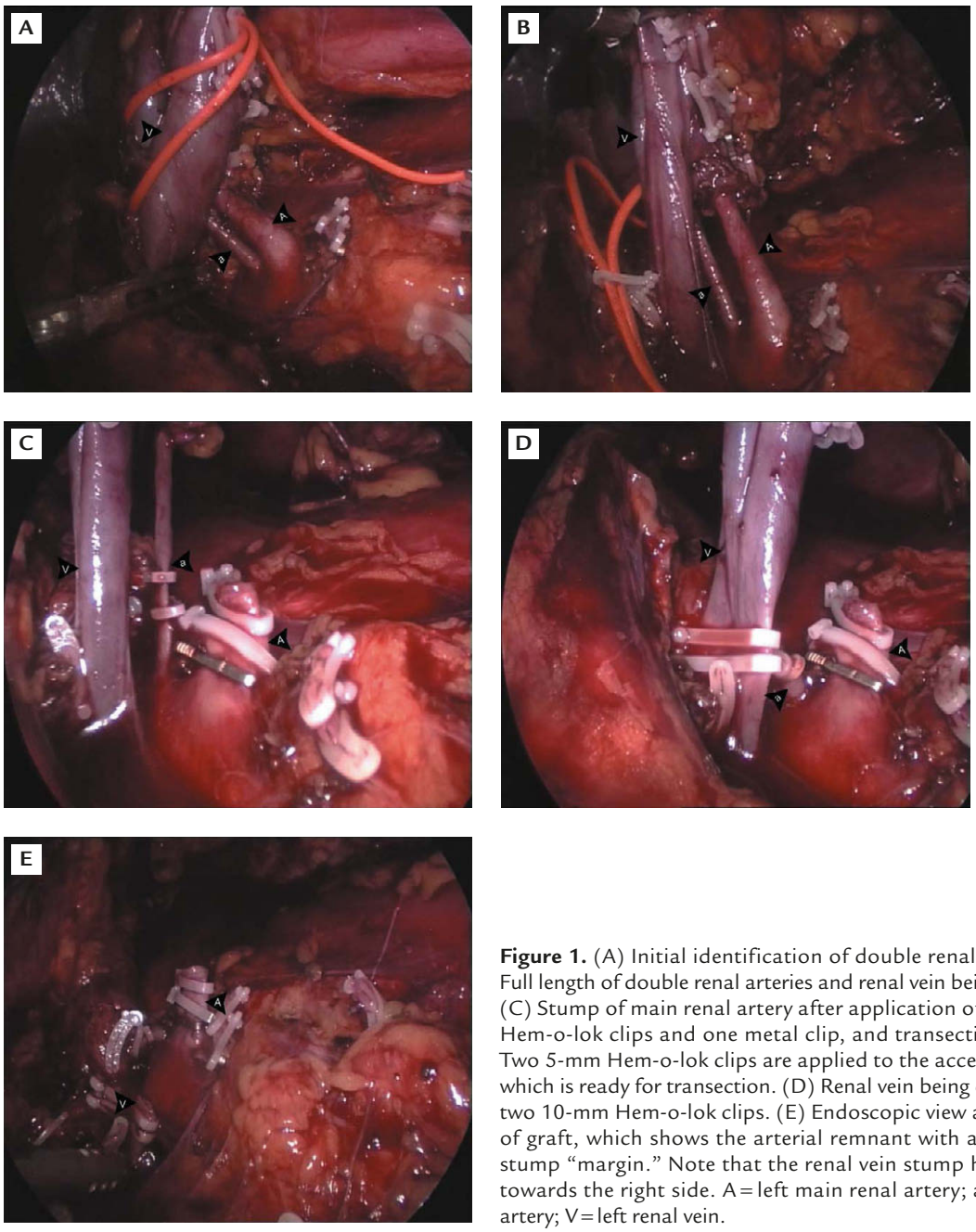

Figure 1. (A) Initial identification of double renal arteries. (B) Full length of double renal arteries and renal vein being dissected. (C) Stump of main renal artery after application of two 10-mm Hem-o-lok clips and one metal clip, and transection of vessel. Two 5-mm Hem-o-lok clips are applied to the accessory branch which is ready for transection. (D) Renal vein being controlled by two 10-mm Hem-o-lok clips. (E) Endoscopic view after retrieval of graft, which shows the arterial remnant with a good safety stump "margin." Note that the renal vein stump has retracted towards the right side. A = left main renal artery; a = accessory artery; V = left renal vein.

difference between the two groups (single *vs.* multiple vessels) for either age or sex for donors and recipients. There was also no difference between the two groups for operating time (168.21 ± 5.712 minutes *vs.* 197.50 ± 15.755 minutes) or hospital stay (3.21 ± 0.165 days *vs.* 4.13 ± 0.789 days). No major complication or conversion was encountered in the donor group. The recipient outcomes, including operating time, hospital stay and creatinine levels at day 7, upon discharge and at 1 year, were similar (Table 2). No ureteric stricture or graft loss was noted.

The complications are summarised in Table 3. Among three postoperative haematomas, two required exploration and drainage. Both were in the double vessel group, but bleeding could not be identified at the anastomosis/reconstruction suture lines. Perfusion of the entire graft, including the ureter, was ascertained during the exploration, which confirmed that all branches that supplied the graft were intact and patent.

Discussion

LDN was popularized more than 10 years ago. Jacobs et al[2] have reported the initial 3-year experience at the University of Maryland. Among 320 consecutive laparoscopic live

donors, the mean ischaemia time was 2.5 minutes, and 98% of grafts showed immediate graft function.

The issues at hand include whether the donor morbidity rate is acceptable, and whether the grafts are optimal. With increasing experience, the ureteric stricture rate, which was high in the initial studies, has decreased significantly by paying attention to preserving the ureteric blood supply.[7,8] More importantly, adjustments have been made to ensure safe control of the main vessels.[9,10]

However, renovascular anatomy remains highly variable, and double (or even multiple) vessels are not infrequently noted in donor evaluation.[11] Options include using the right kidney (if the anatomy is straightforward) or adopting a reconstructive technique for double vessels for a left-sided graft.

Several studies have reported reconstruction results with a 1-year graft survival rates of 91–98%.[7,12–14] No difference has been noted in outcomes between recipients with single versus multiple vessels. Hsu et al[12] used the left side in 90% of 277 cases, and left LDN was their preferred approach; multiple vessels were present in up to more than 20% of cases in their series. Similarly, in the 6-year experience of the Maryland group[3] in a series of 738 cases, 96% were left-sided donor procedures and the mean number of arteries was 1.3.

However, Carter et al[15] reported an increased incidence of ureteric complications with multiple vessels but good results for 49 laparoscopic right donor nephrectomies (42 single vessels). The group recommended consideration of right donor nephrectomy. We noted that their incidence of ureteric complications (17%) was disproportionately high compared with that of other series with high numbers of multiple vessels. Renovascular complications remain our concern for right-sided grafts in view of reports of graft loss, especially in earlier experience.[16]

Very recently, Paramesh et al[17] have reported the results of 218 grafts with single vessels and 60 with multiple vessels procured laparoscopically. They noted a small increase in ureteric complications (8.3% *vs.* 2.3%; $p = 0.06$), a significantly higher incidence of rejection (23.3% *vs.* 10.1%; $p = 0.01$), and poorer 5-year graft survival for the multiple vessel group. They have postulated that the greater perioperative damage of multiple vessel grafts could have caused

Table 1. Demographics of donors and recipients receiving living donor renal transplantation

	Single vessel	Multiple vessels	*p*
Patients (*n*)	42	8	
Mean donor age (yr)	40.21 ± 1.45	44.00 ± 2.93	0.271
Donor sex *n* (%)			–
Male	18 (42.86%)	0 (0%)	
Female	24 (51.14%)	8 (100%)	
Recipient age (yr)	38.35 ± 1.947	35.25 ± 4.034	0.500
Recipient sex *n* (%)			–
Male	20 (47.62%)	3 (37.5%)	
Female	22 (52.38%)	5 (62.5%)	

Table 3. Complications in recipients after renal transplantation

	Single vessel	Double vessel
Lymphocoele	2 (treated conservatively)	–
Haematoma	1	2 (both explored)
Sepsis	1	–
Renal artery stenosis	2 (one stented)	–
Repeat anastomosis (reclamped)	1	–
Incisional hernia	1	–

Table 2. Intraoperative ischaemic time and serial follow-up of serum creatinine in recipients after renal transplantation

	Single vessel	Multiple vessels	*p*
First warm ischaemia (min)	5.10 ± 7.148	4.625 ± 0.4978	0.618
Second warm ischaemia (min)	37.33 ± 2.084	33.50 ± 2.854	0.393
Cold ischaemia (min)	33.28 ± 6.840	38.75 ± 11.906	0.736
Discharge creatinine (μmol/L)	107.78 ± 6.117	111.13 ± 14.901	0.937
Postoperative d 7 creatinine (μmol/L)	106.53 ± 5.583	107.13 ± 11.857	0.681
Postoperative 1 yr creatinine (μmol/L)	120.21 ± 6.562	124.75 ± 11.857	0.681
Recipient hospital stay (d)	10.17 ± 0.596	12.13 ± 1.797	0.377

the higher incidence of rejection and decreased graft function, which eventually led to more graft loss due to chronic allograft nephropathy. Despite these findings, the group has not changed its policy of using multiple arterial grafts, although they do inform patients of the increased possibility of rejection and lower rate of graft survival. Saidi et al[18] have reported on the long-term follow-up of 319 patients with a single vessel and 31 with multiple vessels, and have reported comparable 5-year graft survival rates between the two groups (91.5% *vs.* 87.1%). They also have reported increased use of allografts with multiple arteries in recent years, increasing from 4.1% to 16% in the most recent 100 cases.

Our laparoscopic donor experience has been predominantly based on left-sided retrieval, and we are inclined to stay with the standard retrieval technique to enhance the reproducibility of the procedure. In addition, we are concerned about the possible discrepancy in length between the right renal artery and right renal vein during implantation. We do not want to jeopardise patient safety by stretching the renal vein–inferior vena cava junction, nor the status of the graft when the vein is short. However, we are heavily involved in vascular access for haemodialysis, which provides the necessary experience in dealing with small vessels. Our objective remains to facilitate the final anastomosis to the recipient's major vessel, with minimal warm ischaemia time. To that end, we prefer to perform reconstruction on the bench, with the added advantage of being able to test the integrity of the suture lines by gentle infusion of the perfusant. We have developed a very simple "graft-in-ice-bag" system, in which the graft is always protected by ice during the vascular anastomosis, with the vessels sticking out of small holes in the bag, thus allowing extended anastomosis time without inflicting warm ischaemia.

Our results show that the overall donor morbidity rate was low, as reflected by the short hospital stay. In addition, the overall parameters of the recipients were good. In particular, no ureteric stricture was noted and graft survival was 100% at 1 year. Last, the outcomes of the reconstructed group, despite the technical challenge, were similar to those of the single-vessel group.

The limitations of the study include its retrospective nature. However, follow-up data are almost complete because both centres operate in a concentrated population and have a territory-wide electronic record system. The number of reconstruction cases was small and thus might not demonstrate a difference with the main group, and serum creatinine is a crude indicator of renal status. However, numerous other factors could affect graft function, including the donor's age and the degree of tissue match. We do perform a renal nuclear scan in all patients to verify perfusion of the entire graft.

A reconstruction rate of 16% is in line with the overall expected rate of vascular abnormality, which suggests that we have not been biased towards choosing single-vessel allografts. In Asia, the live donor rate remains at a low percentage of total annual transplantations. It is crucial to maintain a high overall standard for the laparoscopic donor programme and to be well versed in reconstruction when a potential donor with double vessels presents.

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