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Hand-assisted laparoscopic live donor nephrectomy – initial experience

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Summary

Introduction. The advantages of minimally invasive live donor nephrectomy have been well documented, with no adverse effect on graft function. Minimal access nephrectomy has now become the standard of care in many units. We have adopted the hand-assisted laparoscopic live donor (HALLDN) technique, and present our initial experience with the first 24 cases.

Material and methods. HALLDNs were performed trans-peritoneally. Primary outcomes included total operative time, warm ischaemic time, time to discharge, and postoperative complications. Warm ischaemic time was measured from the time of clamping the renal artery to the time of perfusing the kidney on the back table.

Results. Mean total operative time was 143 minutes and mean warm ischaemic time 188 seconds. A downward trend was displayed for operative times. Mean time to discharge was 60 hours. A right nephrectomy was performed in 2 cases. No surgical morbidity is reported. We describe one donor mortality.

Discussion. Our results compare favourably with those documented in the literature. Aberrant renal vascular anatomy had no adverse effect on operative or warm ischaemic times. HALLDN proved beneficial in patients with a high BMI.

Conclusion. Surgical experience is vital when performing HALLDN. Overcoming the learning curve with an animal model is beneficial.

The advantages of minimally invasive live donor nephrectomy over the open technique have been well described; these include shorter hospital stay, better cosmesis, less postoperative pain, earlier return to work and, notably, significantly increased rates of donation.[1-3] Long-term graft function is equivalent when comparing the two techniques. Minimally invasive nephrectomy includes a number of different techniques: purely laparoscopic live donor nephrectomy (LLDN), hand-assisted laparoscopic live donor nephrectomy (HALLDN) and retroperitoneoscopic live donor nephrectomy (RLDN). Whichever technique is adopted, minimal access retrieval has now become the standard of care in most units.[4] We have adopted the HALLDN, and present this report describing our initial surgical experience in humans after overcoming the learning curve by using a porcine model[5] – vital when learning the procedure.[6] We do not address graft function in this paper.

Materials and methods

A total of 24 HALLDNs were performed between September 2008 and November 2010. Data collected included patient demographics, anatomy of the kidney procured, total operative time (TOT), dissection time to cross-clamping, warm ischaemic time (WIT), blood loss, time to discharge from surgical care (measured in hours) and postoperative complications. Dissection time to cross-clamp was calculated from skin incision to cross-clamping of the renal artery. WIT was calculated from the time of cross-clamping to the time when the kidney was perfused with preservative solution and placed on ice. There are no absolute contraindications to HALLDN, although extensive previous abdominal surgery remains a relative contraindication. Obviously, prospective donors need to be fit for surgery and have acceptable renal anatomy and function.

The presence of two functioning kidneys and the assessment of the vascular anatomy were determined with high-resolution computed tomographic (CT) angiography. The left kidney was selected over the right one when each kidney was equal in appearance and no abnormalities noted in the left kidney. Left nephrectomy was preferred over right owing to the longer left renal vein making the venous anastamosis technically easier. If a benign abnormality (e.g. simple renal cyst) was noted in either kidney, that kidney was selected for procurement, on the principle that the kidney with presumed superior function remains with the donor. All patients were admitted to the intensive care unit (ICU) postoperatively.

Operative technique

After appropriate positioning of the patient,[6] a 6 - 6.5 cm midline incision is made, centred on the umbilicus. This incision serves for the insertion of the Gelport (Applied Medical, CA, USA) and later extraction of the kidney. A trans-peritoneal approach is used. Two additional ports are inserted: a 12 mm port in the lower quadrant of the abdomen (working port – allows introduction of endovascular stapler) and another 10 or

12 mm port in the upper midline (camera). A third 5 mm port may be inserted for retraction of the liver or spleen and to allow better access for division of the left adrenal vein, if necessary. Dissection is performed using the harmonic scalpel, occasionally utilising the Ligasure device (Covidien, Boulder, CO, USA) for the division of large adrenal and gonadal veins. After both renal vein and artery have been adequately defined, the position of the vascular endostapler is tested before application. Once the vessels have been divided, the kidney is removed.

Results

Of a total of 24 patients, 14 were female and 10 male. Six donors had a body mass index (BMI) greater than 27. Two patients underwent right and the remaning 22 left nephrectomy. Reasons for the right nephrectomies included a renal cyst of the right kidney, and a duplicated renal artery of the left kidney, in the respective donors. Mean operative time was 143 minutes (Table I). A learning curve was displayed with TOTs (Fig. 1). Three patients had prolonged TOTs. The first patient had a TOT of 280 minutes and a BMI >30, and excessive peri-nephric fat was present. The second patient had a TOT of 210 minutes owing to a duplicated ureter and an excessive lymph leak around the aorta, which needed to be controlled. There was no technical cause for a prolonged TOT of 180 minutes for the third. Mean dissection time to cross-clamping was 117 minutes (Table I). Similarly, a learning curve was displayed with dissection times to cross-clamp (Fig. 2). Mean WIT was 188 seconds (Table I). One patient had a prolonged WIT of 360 seconds owing to failure to reload the vascular stapler. The remaining patients had WITs of less than 240 seconds. A learning curve was not displayed with WIT (Fig. 3). Three patients had aberrant venous anatomy with early bifurcation of the renal vein, necessitating ligation of the gonadal, adrenal and lumbar veins, which are otherwise not routinely divided. In one patient, the left renal vein did not cross the aorta to drain into the inferior vena cava (IVC), preferentially coursing directly into the retroperitoneum behind the aorta. Regarding renal artery anatomy, in one patient the renal artery bifurcated 5 mm from its origin and, in another, an accessory lower pole artery, not documented on pre-operative imaging, was found intra-operatively. Both necessitated dual implantation. The resultant TOT and WIT for aberrant renal vessel anatomy is shown in Table II. One patient had 50% stenosis of the renal artery due to atherosclerotic plaque. The artery was divided above the stenosis. There was minimal intra-operative bleeding in all patients. Mean hospital stay was 60 hours.

There were no morbidities. One patient died 1 week postoperatively. Surgery had been uncomplicated with no bleeding from either staple line prior to closure. Haemodynamically and metabolically normal, the patient was transferred to high care instead of the intensive care unit. When the patient presented with hypotension, he was

TABLE I. RESULTS OF PRIMARY OUTCOMES

Outcomes	Mean (range)
Total operating time (minutes)	**143 (90 - 300)**
Dissection time to cross-clamp (minutes)	**117 (65 - 270)**
Warm ischaemic time (seconds)	**188 (108 - 360)**
Time to discharge (hours)	**60 (36 - 108)**

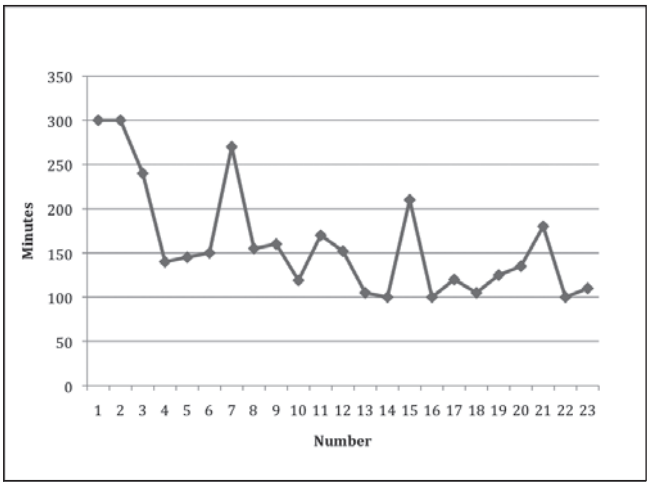

Fig. 1. Trends of total operating time (TOT) in minutes.

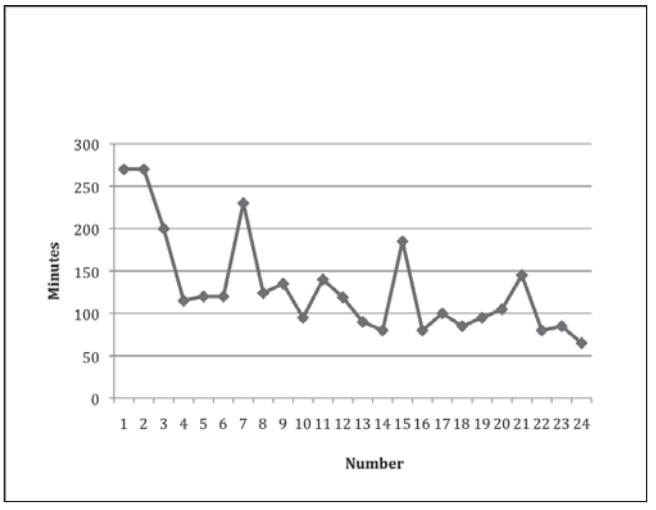

Fig. 2. Trends of dissection time to cross-clamp in minutes.

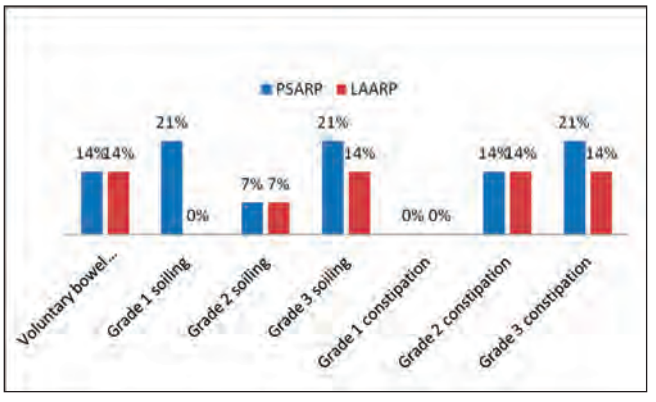

Fig. 3. Trends of warm ischaemic time (WIT) in seconds.

TABLE II. TOTAL OPERATING TIME (TOT) AND WARM ISCHAEMIC TIME (WIT) AS A RESULT OF COMPLEX RENAL VESSEL ANATOMY

Renal vein anatomy	Total operating time in minutes (mean TOT)	Warm ischaemic time in seconds (mean WIT)
Early bifurcation – gonadal, adrenal, lumbar veins ligated	**119 (143)**	**180 (188)**
Early bifurcation – dissection over aorta	**160 (143)**	**240 (188)**
Complex venous anatomy – ligated gonadal, adrenal veins	**152 (143)**	**240 (188)**
Dissection of vein deep into retroperitoneum	**90 (143)**	**120 (188)**
Renal artery anatomy		
Bifurcation 5 mm from aorta	**110 (143)**	**185 (188)**
Accessory artery to lower pole kidney	**120 (143)**	**180 (188)**

TOT = total operating time; WIT = warm ischaemic time.

repeatedly diagnosed with, and treated for, an opiate overdose, delaying referral to the operating surgeon for over 6 hours. Although immediately operated on, the delayed diagnosis and inappropriate medical management of an arterial staple line bleed lead to haemorrhagic shock and ultimately multi-organ failure and death.

Discussion

HALLDN can be performed either trans- or retroperitoneally and has been reported to be safer than LLDN, allowing more prompt control of bleeding and shorter operating and warm ischaemic times than the latter.[7,8] However, a recent meta-analysis comparing the two showed no difference in operating and warm ischaemic times or graft function.[4] Some surgeons also prefer LLDN for small donors, arguing the presence of less intraperitoneal space with the hand-assisted technique.[9] In a randomised controlled trial, Wolf *et al.*[1] found shorter operating times and WIT with open live donor nephrectomy (OLDN) compared with HALLDN, but no difference in graft function. In contrast, Greco *et al.*[10] found shorter TOT and WIT in the HALLDN group when compared with OLDN; however, this was a retrospective series and an experienced endoscopic surgeon performed the surgery. Our mean TOT (143 minutes) compares favourably with TOT from the literature, documenting 206,[1] 165[10] and 191[11] minutes, respectively. Our mean WIT (188 seconds) also compares favourably with that reported in the literature, of 183,[1] 156[12] and 175[13] seconds. A high BMI was found not to delay TOT or WIT in our series. Large amounts of peri-nephric fat, however, increased TOT. We found in obese patients that laparoscopic surgery was technically easier than, and preferred to, open surgery. Furthermore, aberrant venous or arterial anatomy did not negatively affect operating or warm ischaemic times (Table II). Although we had no patients with multiple renal veins, this anatomical variant has been shown to be a risk factor for delayed graft function.[14]

Two patients in the study had multiple renal arteries, but there were no complications with the reconstruction. Multiple renal artery anastamoses are now no longer regarded as a contra-indication to transplantation, with no documented effect on graft function; however, pre-operative imaging is crucial[15] to plan the vascular reconstruction.

Although the left kidney is preferable owing to the longer renal vein, we found no difficulties with harvesting of the right kidney. Generally, the renal vein of the right kidney is shorter, with concerns of venous thrombosis post anastamosis. Furthermore, the renal artery is in a retrocaval position, making dissection more challenging. Hoda *et al.* reported right HALLDN as being technically safe and feasible. It must be noted that, during right HALLDN, an additional port may be required to elevate the liver. The dissection, however, is similar to that of left HALLDN. We prefer to utilise the harmonic scalpel for dissection, preferring the LigaSure device to divide the larger adrenal and gonadal veins when necessary. We used the harmonic scalpel exclusively for the last 8 cases. Overall, the different types of laparoscopic technique have similar outcomes regarding graft function and decreasing postoperative morbidity. With the advent of laparoscopic nephrectomy, potential morbidity was an initial concern. These complications include bleeding, ureteric injury, and injury to the bowel and solid organs. With growing experience, these complications have been considerably reduced, consequential to changes in operative technique.[16] Donor mortality remains a potential reality in live kidney donation, and it is clear that there is an under-reported incidence from reputable international centres.[4]

In conclusion, our initial series of HALLDNs resulted in similar primary outcomes to other series in the literature. Patients undergoing live kidney donation are healthy, fit patients not benefiting from the surgical procedure. Therefore, technical proficiency is essential when undertaking the laparoscopic procedure, and adequate surgical experience is essential. We feel that using an animal model to overcome the learning curve is vital if in a centre without the necessary expertise.

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Under the auspices of The Colleges of Medicine of South Africa

Month	Date/s	Place	
July 2011	1	Port Elizabeth Endo Day	
	19 - 21	Wits	D. Bizos
	22	Wits – lap. suture course	D. Bizos
	19 - 21	Stellenbosch (Panorama Medi-Clinic)	E. Myburgh
	22	Lap. – Stellenbosch	
August 2011	23 - 25	Cape Town	Paul Goldberg
	26	Cape Town Endo Day	
	24 - 26	Durban	Bugsy Singh
September 2011	30 Aug - 1 Sept	Limpopo	F. Ghoor
	2	Limpopo Endo Day	
	14 - 16	Port Elizabeth	Sats Pillay
	13 - 15	Bloemfontein	Esme le Grange
	16	Bloem – lap. suture training	
Pretoria Controversies SASES	**3 - 4 October 2011 20 - 23 October 2011**	**Pretoria Drakensburg**	**To be confirmed**
October 2011	25 - 27	East London	Mark Bunting
	28	East London – lap. cholecystectomy	
	5 - 7	Durban	Bugsy Singh
November 2011	1 - 3	Wits	
	4	Wits – lap. suture training	D. Bizos
	16 - 19	Durban	Bugsy Singh
December 2011	30 November - 1 December	Wits	
	2	Wits	

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