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REVIEW

Laparoscopic donor nephrectomy: The Middle East experience

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KEYWORDS

Laparoscopic donor nephrectomy;
Middle East;
Transplantation;
Complications

ABBREVIATIONS

(L)(O)DN, (laparoscopic) (open) donor nephrectomy; ATN, acute tubular necrosis; AUBMC, American University of Beirut Medical Center; MESOT, Middle East Society for Organ Transplantation

Abstract ***Objectives:*** To summarize the experience of the Middle East in laparoscopic donor nephrectomy (LDN), to discuss the associated advantages and salient problems, to examine the learning curve encountered compared with that of the pioneering centres in the West, and the contribution of the regional centres to the worldwide experience.

Methods: We searched Medline and PubMed for all centres performing LDN in the Middle East. Questionnaires were e-mailed to the regional transplantation centres, and programme directors, and leading urological and transplant surgeons were contacted by telephone.

Results: LDN in the Middle East was first introduced in 2000; this approach has been pioneered and practised at seven transplant centres within five countries in the region, and was restricted to only three Arab countries, i.e. Lebanon, Egypt and Kuwait. Data collection yielded a total of 888 procedures over one decade, representing only 2% of the total of ≈50,000 transplants during the same period. Despite variability of accurate reporting the overall outcomes were similar to those of open DN. The spectrum of complications was comparable to that from major centres in the USA during their learning curve.

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Conclusions: The introduction of LDN in the Middle East has been gratifying. The relative hesitancy in introducing LDN in the rest of the Arab Middle East is multifaceted. The advantages conferred to the donor underscore the need for further expansion of this approach for kidney retrieval.

Introduction

The first laparoscopic donor nephrectomy (LDN) was performed at Johns Hopkins in Baltimore, Maryland, USA, in 1995, by Ratner et al. [1]. Soon after, several centres in the USA and Europe introduced LDN [2–5]. The overall experience was gratifying and it was evident that LDN is associated with less postoperative pain, a shorter hospital stay and a rapid return to normal activity. Several centres alluded to the possibility of expanding the potential donor pool, as there is a decrease in the disincentive to donate on the part of the donor because of this minimally invasive procedure [6,7].

The initial American and worldwide experience was also clouded by critics against laparoscopy, claiming a higher complication rate for the donor and recipient, based on the initial studies from Johns Hopkins University and the University of Maryland [8–11]. The same centres, as well as others, have responded to this criticism by modifying the technique, yielding improved success rates and overall results [12–15].

In this review we describe the Middle East experience with LDN that was initiated in 2000, 5 years after the initial report from Baltimore [16]. We attempted to compile the experience in the Middle East, including the Arab North African region as well as Iran, Turkey and countries served and registered in the Middle East Society for Organ Transplantation (MESOT).

Methods

We searched Medline and PubMed to explore all centres using LDN in the Middle East and North African regions. We used the following search terms: 'laparoscopic donor nephrectomy', 'laparoscopy nephrectomy transplantation', 'laparoscopy nephrectomy transplant', then these terms were combined with 'Middle East', 'Arab', 'Egypt', 'Lebanon', 'Iraq', 'Jordan', 'Syria', 'Turkey', 'Iran', 'Kuwait', 'Saudi Arabia', 'Bahrain', 'Qatar', 'Oman', 'United Arab Emirates', 'Tunisia', 'Morocco', 'Algeria', 'Libya', 'Sudan' and 'Pakistan'. In all, 46 results were obtained. An additional advanced search was done by sending a questionnaire by e-mail to the MESOT centres and regional transplant directors of respective centres (Fig. 1). Also, individual telephone calls were made to these transplant centres and leading urological surgeons, transplant surgeons and nephrologists in the region. All reports were compiled based on the chronology of reporting and starting dates, including the follow-up reports of the centres using LDN, provided that they included >40 patients in the overall experience, and that the technique used was pure laparoscopy or hand-assisted laparoscopic harvest.

Data were analysed emphasising donor demographics, LDN operative characteristics, especially ischaemia time, perioperative complications, donor and recipient outcomes, and overall results including morbidity and mortality. Comparisons were made with reported results from major series in the USA. Centres that reported <40 LDNs were excluded from the analysis, as were centres where no response was obtained or no publication was available at the time of data analysis (June 2011). Forty was chosen as an arbitrary number as experience with fewer LDNs was not felt to be contributory or relevant to the overall proficiency in laparoscopy and would not add to experience in the Middle East. Furthermore, the threshold of 40 transplants could be viewed as the minimum needed for a centre's learning curve.

Results

Table 1 shows the experience with LDN in the Middle East region in chronological order based on the initial reports, taking into account the date of initiation of these procedures. The first transplant was performed at the American University of Beirut Medical Center (AUBMC) in Beirut, Lebanon, by our group in January 2000 [16]. This was followed by the initiation of LDN in Turkey at the SSK Tepecik Hospital in Izmir in October 2000, then Iran, at the Shahid Labbafi Nejad Hospital in Tehran in November 2000 [17–19]. After that there was a relative standstill in the region until 2003, when additional reports emerged indicating the adoption of the LDN transplant in Cairo, Egypt, then Safat, Kuwait, in 2005, Ankara, Turkey, in December 2005, and lastly Shiraz, Iran, in August of 2006 [20–23].

Several of these centres later published additional reports that were compiled and analysed to evaluate the overall Middle Eastern experience, as shown in Table 2. The overall reported LDN procedures from 2001 to 2011 (reflecting donors and recipients between 2000 and 2010) totalled to 888 LDNs. Of the seven centres in the Middle East, six used pure laparoscopy and one used hand-assisted laparoscopy (Namazi Hospital, Shiraz, Iran). The use of the Endocatch bag vs. hand retrieval was variable depending on the centre's experience.

AUBMC Registry for Lap Donor Nephrectomy (LDN)
Laparoscopic nephrectomy experience in the Middle East

1) Name of the program: ----------
2) Year started doing transplants: ----------
3) Total # of transplants performed at your center. -------- Give the year of inception until 2011: ---------
4) Average number of transplants per year: ----------
5) Total recipient of Live Donor Tx ----------; CADTx ----------
6) Proportion of Live Donor Transplant vs. total LRD & CAD: ----------
7) Do you perform Lap Donor Nephrectomy at your center: yes ----------, year started ----------
   No ----------, reason: ----------

If you perform Lap Donor Nephrectomy:

8) Did your live donor program move exclusively to laparoscopic technique? Yes/no ----------
   If yes, year switched to laparoscopy ----------
9) Do you perform pure lap or hand assist lap or both types of donor nephrectomy? ----------
10) Total number of Lap Donor Nephrectomy vs. Open Donor Nephrectomy since you started ----------; ratio lap/open % ----------
11) Have you had incidents of morbidity or mortality to donors – open: ----------
    Lap: ----------
    Recipient: ----------
12) Total number of right versus left lap donor Nx performed ----------; percentage: ----------
13) Incidence of ATN in recipients of lap donor nephrectomy: ----------
14) Total arterial or venous injuries: ----------
15) How many conversions to open ---------- ---; ratio/total ----------
16) Please state reasons for performing lap donor Nx at your center: ----------
17) At your center who performs the live donor nephrectomy (check the answer applicable):

- Urologist (trained laparoscopy)
- General surgeon (trained in laparoscopy)
- Transplant surgeon (trained in laparoscopy)
- Combination (laparoscopic general surgeon and laparoscopic urologist)

Who performs the transplantation?

- Urologic Tx surgeon
- General surgical Tx surgeon
- Combination

18) Additional comments regarding your LDN program and techniques: ----------

Contact number and ordinates:
Doctor: ---------- Mobile #: ----------
Title: ---------- Work #: ----------
Address: ---------- ---------- Fax #: ----------
University: ---------- Email: -------

Figure 1 The LDN questionnaire sent to the MESOT centres and directors of transplant programmes.

Conversion to open DN (ODN) varied widely among centres and was 1–20%, but when excluding the Izmir series, the conversion rate decreased to 1–7.5% [17,18]. One centre failed to report a conversion rate in 400 cases [20]. Two centres reported a marked diminution in the rate of conversion with experience and modification of the technique [14,15,18]. One centre also reported on cost containment by modification of technique [24]. Excluding the Wadi El Nile Transplant Center [20] that did not report conversions, the overall conversions were 23 of 488 (4.7%); most were secondary to arterial or venous bleeding in 13 of 23 (56.5%).

Assessing three centres reporting donor complications related to adjacent organ injury (Table 2), the numbers varied from 1 to 4 bowel injuries and several splenic (0–2) and liver lacerations (0–2) related to Veress needle insufflation or trocar-placement injury (overall 12 internal organ injuries of 670 operations, 1.8%)

Table 1 Single centre reports depicting pioneering institutions of LDN in the Middle East.

Centre [Reference]	Date of first report	Date of start of laparoscopic donor nephrectomy
American University of Beirut Medical Center, Beirut [16]	2001	January, 2000
SSK Tepecik Hospital, Turkey [18]	2004	October, 2000
Shahid Labbafi Nejad Hospital, Iran [19]	2003	November, 2000
Wadi El Nile Transplant Center, Cairo, Egypt [20]	2007	March, 2003
Hamed Al-Essa, Kuwait [21]	2007	May, 2005
Ankara University School of Medicine, Turkey [22]	2011	December, 2005
Namazi Hospital, Shiraz University of Medical Sciences, Iran [23]	2009	August, 2006

[19,20,25,26]. Vascular complications in the donor taken from three centres that reported them included one aortic bleed from the renal artery stump, two bleeds from renal arteries, one from a renal vein, one vena caval injury, one bleed from the adrenal vasculature and two lumbar vein bleeds [17,18,21,25,26]. Summing these data, the rate of vascular complications in the donor was 4.2%. Other complications in the donor varied widely and included pneumothorax, subcutaneous collections, wound infections, hydroceles and lymphoceles [20–22,25–27].

Re-operations in the donor were reported by Simforoosh et al. [19] and Buresley et al. [21], and were secondary to bleeding (one due to surgical site bleeding, one to adrenal bleeding and one to subcutaneous haematoma). There were no reported donor deaths in any of these series, but there was one that was not reported and became known to the author during presentations at meetings (personal correspondence) from early complications related to clip dislodgement or other technical issues.

Graft and patient survival rates were excellent; the graft survival rate at 1 year was 92–99%, and was equivalent to graft survival in ODN [17–20,22,23,25–27]. Causes of graft loss included oxalosis, recurrent pyelonephritis, thrombosis and immunological mediation. There were three early postoperative deaths in the recipients at two centres [19,21] within 3 months, two from secondary to pulmonary embolus and one from an unknown cause.

Vascular compromises to the allograft have been reported at a variable rate of 0–13.9%, including a few early arterial thromboses that might have affected early function, although this was not clearly alluded to in the reports. Urological complication rates in the recipient were 0–11.6% [17–20,25,26].

Complications included one each of distal ureteric necrosis, anastomotic leak, ureteric fistula, and simple ureteric injury that was successfully bench-repaired, and five urinary leaks, two of which developed a late stricture. The overall rate of ureteric complications was 2.1%. The reported utility of right vs. left kidney at all centres except the Namazi Hospital, Iran, was 0–27%.

Considering the entire data from Middle East centres except the SSK Tepecik, the mean (range) warm ischaemia time ranged from 46.5 (36–61) s to 8.7 (4–17) min. The mean (range or SD) operative times for donors ranged from 100.2 (82–112) to 239 (53.4) min, and the hospital stay ranged from 28.3 (8.3) h to 5.28 (3–14) days (excluding the AUBMC).

Discussion

After the initial LDN at the Johns Hopkins Hospital, several centres in the USA and Europe adopted LDN for retrieving kidneys, and LDN became the new standard, as opposed to ODN [1]. Of these, the University of Maryland in Baltimore and the University of Liège and the University of Louvain Medical School in Belgium were among the first to start LDN in the West [2–4]. The Japanese in the Hamamatsu University School of Medicine started retroperitoneoscopy-assisted DN in 1996 [28]. Many other centres worldwide followed this practice and started LDN in the ensuing 5 years. The AUBMC was the first to use LDN in the Middle East and was soon followed by the SSK Tepecik Hospital in Turkey, the Shahid Labbafi Nejad Hospital in Tehran and the Wadi El Nile Transplant Center in Egypt. However, the total number of centres adopting LDN in the Middle East since 2000 has remained few and did not exceed the seven centres mentioned in the results section [16,18–20].

The MESOT region services a population of >600 million, representing about 29 Middle Eastern and North African countries. It is estimated that these centres have >200 transplant centres. Assuming a kidney transplant rate of 9 per million population per year, the total number of transplants in the region is >6000 per year [29]. This can be extrapolated to 50,000 kidney transplant procedures every 10 years, which is the approximate number of transplants in the region (Bassam Saeed, MD; Chairman, MESOT Fellowship Program; personal communication). However, the total number of LDNs reported does not exceed 1000 (2% of total transplants), as indicated from the reported experience of the seven centres in the past 10 years (Table 2).

Table 2 Demographics of laparoscopic donor nephrectomy (LDN) and corresponding transplants at 7 major Middle Eastern centres that initiated LDN in the region taken from select reports.

Variable	Centre, [Ref]						
	Beirut [25]	Izmir [17]	Tehran [19]	Egypt [10]	Kuwait [26]	Ankara [22]	Shiraz [25]
Date of last report	2005	2004	2005	2007	2007	2011	2009
Donor							
Demographics							
No. of cases	70, P, EBE	40 (P, EBE)	100 (P, HE)	400 (P, HE)	80 (P, HE)	98 (P, HE)	100 (Hand assist-HE)
Side, R/L, *n*/*N* (%)	12/58 (20.7)	7/33 (21)	0	71/329 (21.6)	5/75 (6.7)	11/87 (12.6)	Not reported
Conversion, *n* (%)	3 (4.3), All bleed 0	8 (20) 4 from bleed, 5 (5) 2 from bleed 3 difficult dissection	1 (1)	Not reported	6 (7.5) 3 from bleed		
Complications							
Organ injury	2 Liver, 1 BS injuries, managed laparoscopically	Not reported	1 BS injury, 2 splenic lacerations	4 BS injury 2 splenic lacerations	Not reported	Not reported	Not reported
Other, *n* or (%)	2 Lumbar vein bleed, 1 RA stump bleed, 1 Px	1 Vena cava injury, 2 bleeding from RA 1 bleeding renal vein	1 Reop from surgical site bleed, 2 sc collections: overall (17)	5 Wound infections 2 hydrocele	4 Chest infection 2 reops (adrenal bleed, sc haematoma) 8 lymphoceles	1 Lymphocele	0
Recipient/graft							
Complications, *n* (%)							
ATN	5 (7.1) 4 resolved spontaneously, one needed 2× dialysis	(12.5)	11 (11)	17 (4.3) (4 requiring dialysis)	6 (7.5) 3 requiring dialysis	Not reported	2 (2)
Urological	0	5 (11.6) incl 1 distal ureter necrosis +1 anastomotic leak	At least 1 ureteric fistula from older report	1 ureteric injury (bench repair) 12 mild subcap haematomas 5 urinary leak (2 late stricture)	Not reported	Not reported	Not reported
Vascular	0	6 (14)	0	1 RA thrombosis 3 RA stenosis	Not reported	1 RA stenosis 1 RA thrombosis	0
Acute rejection	2	(20) 1 reop from arterial bleed	2 (2)	Not reported	8 (10)	(11.2)	Not reported
Graft survival, %	97.9 at 1 year 2 graft loss (oxalosis, PN)	92 at 1 and 3 years	93.8 at 1 year	92.7 at 1 year	Not reported	99, 1 graft loss due to thrombosis	98, 2 rejections (immunological causes)
Patient survival, %	100 at 1 year 100	97.2 at 1 year, 100 93.6 at 3 years (last 2011 report)	2 deaths within 3 months (pulmonary emboli)	Not reported	1 death at 6 weeks, unknown cause		

The relative paucity of centres using LDN could be related to several factors. The field of laparoscopy in urology and transplantation could have arrived late to the region, and a few centres have actually adopted laparoscopic ablative urological procedures in the Middle East to date. Furthermore, the relative reluctance in using a new procedure that involves a live donor is evident by the fact that many centres continue to resist the expansion of this service, i.e. using LDN for transplantation.

At the AUBMC we have stopped using ODN for many reasons. Our experience with LDN has been very gratifying. The rapid recovery and recuperation of live donors support the use of LDN vs. ODN. As live donors are obviously healthy individuals with altruistic motives, it is unethical to advise a more morbid procedure like ODN. The classical scepticism regarding donor safety is no longer valid, as the procedure has been time-tested in most centres in the West, and shows equivalent results in terms of donor risks but a more favourable donor recovery and shorter hospitalization for LDN than ODN. As to the quality of the kidney retrieved, our centre as well as others has shown equivalent renal function with a long-term follow-up [19,22,25–27,30].

The pioneering experience with LDN at four major centres in the USA has had a major impact on the development of LDN elsewhere in the USA and around the world [31–35]. There were many lessons learned from these initial experiences, including modifications of the LDN technique and modifications of management, both at the level of the donor and the recipient, at the Johns Hopkins Hospital. The initial experience with 227 kidneys transplanted revealed a major problem with the harvesting of right vs. left kidneys. The initial series showed a total of 17 right kidney retrievals, of which three were lost to vascular thrombosis secondary to technical difficulties in the donors (18%), which was rarely encountered in ODN. These amounted to three of the initial eight right LDNs. By modifying the technique of retrieval to allow for a longer right renal vein, and decreasing the tension at the anastomosis by complete mobilization of the external iliac vein, the authors were able to reduce this heightened risk of graft loss in the subsequent right LDN [31]. Similarly, in a follow-up series from the Johns Hopkins Medical Institutions, Su et al. [32] reported on 381 patients, of whom only 19 (5%) were right-sided. Graft thrombosis occurred in five of these patients, indicating that the problem continued to exist albeit at a lower frequency. The total graft losses in this series were eight of 381, secondary to technically related vascular thrombosis. There were ureteric complications in 24 patients (6.3%). The total vascular thromboses rate was 2.1% in this series and had decreased from the initial series. Notwithstanding the above, any technical graft loss in live donor transplantation is devastating for the donor and the recipient, and should not occur (and is rare in ODN).

The University of Maryland experience was somewhat more favourable and in the initial series of 320 LDNs reported by Jacobs et al. [33] the total number of right kidneys used was 29, i.e. 4%. Conversion was needed in five of the 320 (1.6%) due to incomplete placement of the vascular stapler across the renal artery, renal artery and vein bleeding, iliac artery laceration, obesity and renal vein laceration. Open splenorrhaphy was required 12 h after surgery in another donor, due to haemorrhage. The mean warm ischaemia time during retrieval in the series was 2.5 min, and the total blood loss continued to decrease as more LDNs were performed. The most significant finding in these early series was the relatively high rate of ureteric complications, amounting to 7% of the recipients and seen mostly in the first 130 cases. These included ureteric stenosis and ureteric ischaemia/necrosis (urine leak) in 22 patients. The authors mention their modifications, including a wide ureteric resection encompassing the whole contents of Gerota's fascia and peri-ureteric tissue during the ureteric harvesting, that had not been well observed in the initial 130 donors. There were some early graft losses in the recipients that were attributed to the harvest-related delayed graft function in 2% of the kidneys [33].

At the University of California Los Angeles, the experience was similar, in that very few right kidneys were used according to their initial report (three of 300, 1%). The mean (SD) warm ischaemia time was 4 (2) min and the estimated blood loss was lower than for ODN, equivalent to 80 (50) mL [34]. There were intraoperative major complications in only 0.6% of cases. Postoperative major complications were limited to one rhabdomyolysis and two chylous ascites in the donor.

Similarly, the experience from the North-Western University Medical School in Chicago reported by Leventhal et al. [35] showed paucity in the utility of the right kidney in that only six of 500 LDNs (1.2%) were right-sided. There were nine conversions (1.8%) and the overall graft survival rate in the recipients was 97.6%, equivalent to ODN. Postoperative complications were not significant and amounted to 31 of 500 (6%). There was delayed graft function and acute tubular necrosis (ATN) requiring dialysis in one patient. The overall patient survival rate in the series at follow-up was 481 of 500 (96.2%). The data reported from the Cleveland Clinic Foundation showed a higher utility of the right kidney, at 20.3% in the series of Ng et al. [36].

This centre advised the use of the retroperitoneal approach for harvesting the right kidney rather than the traditional pure laparoscopic approach, to obviate the early problems with right kidney retrieval [36].

In summary, the experience in the USA at four pioneering centres showed a relative paucity in the use of the right kidney compared with ODN, and a higher incidence of delayed graft function and vascular thrombosis related to technical faults in harvesting, particularly in early series, reflecting the steep learning curve. Similarly, the initial period witnessed a change in the spectrum of donor complications in LDN compared to ODN, innately related to the procedure of laparoscopy, and included an increase in splenic, liver and bowel complications that had not been seen in contemporary ODN series. The increased graft losses in the early series were attributed to technical faults and relative inexperience in LDN, or the involvement of laparoscopic surgeons who were inexperienced in LDN or had limited exposure to transplantation. It is also possible that laparoscopic surgeons involved in LDN could not anticipate or calculate for potential problems that could occur in the recipient due to short renal vessels, or skeletonized donor ureter, that is rarely the case in ODN, which had been practised and mastered for >40 years. Nevertheless, the resurgence of these complications during the steep learning curve at the pioneering centres helped to obviate these problems with LDN when initiating new programmes at other USA centres and worldwide, including the Middle East. Table 3 lists updated series from four major institutions in the USA that pioneered and continue to use LDN [32,35,37,38].

The Middle East experience in LDN was favourably influenced by the early USA experience, as it lagged behind it. Thus the significant problems observed in the early Baltimore series were obviated. Before applying LDN at the AUBMC we initiated the procedure in the animal laboratory and went on to observe LDNs in Baltimore [16]. This experience was crucial in assuring success of the initial five LDNs that were performed with a rather long warm ischaemia time of 5.2 (1.1) min, but with no effect on the overall graft function or survival. Follow-up reports from our centre showed improved graft quality and rapidity of return to normal by applying technical modifications of LDN [14]. These were shown in a series of 51 consecutive cases before and after several modifications were introduced, that included the reduction of pneumoperitoneum and early introduction of the EndoCatch bag and sharp dissection of the renal vessels. There were no major complications in this series and all grafts functioned immediately, reconfirming the safety of LDN. A follow-up report that prospectively evaluated LDN vs. ODN further reinforced the safety of this procedure and the need for a multidisciplinary approach using advanced laparoscopic and transplant techniques to refine the technique of LDN [30]. Finally, the utility of right kidney retrieval vs. all kidneys was shown to be acceptable in our series (21%), and similar to the ratio seen in ODN [25,26]. This ratio was similar to that in the Cleveland Clinic series, but not to the other two pioneering centres in the USA (4–5% use of the right kidney), indicating the relative and continued bias towards the use of the left kidney because of its longer vein and easier harvest [32,33,36]. The AUBMC series has not shown any risk to the donor or recipient, and there was no major morbidity or mortality in >100 transplants to date [16,25,26,30].

In the LDN series from Turkey, Gürkan et al. [18] reported on 31 LDNs and 84 ODNs. There were many urological (25%) and vascular complications (25%) compared with 11.1% and 22.2% for ODN. These ranged from ureteric stenosis to ureteric necrosis that could be related to suboptimal ureteric harvesting. This was appreciably higher than in the other Middle Eastern series and the early pioneering series from the USA. In a follow-up report by the same institution, Kaçar et al. [19] reported a lower ureteric complication rate (equivalent to that in the early USA series, of 10%). In this more recent series of 40 LDNs from October 2000 to September 2003, there was a 20% conversion rate, primarily secondary to difficulties in dissection and to bleeding. The urological and vascular complication rates were 11.6% and 13.9%, respectively. Most of the complications were noted in the early series. There was no major donor or recipient morbidity or mortality in this series, and the 1-year graft survival rate was 92%. Aboul-Fettouh et al. [20] (Cairo, Egypt) reported on a series of 400 consecutive cases, with improved donor benefits and lower morbidity rates, without compromising the anatomical and physiological outcome of donors or grafts. However, this series included 17 cases of ATN and delayed graft function, and one case of graft thrombosis. Of the patients who had ATN, four required dialysis and the overall graft survival rate was 92.7% at 1 year, which could be viewed as relatively low for living-donor transplants. There were urinary leaks in five patients, requiring corrective surgery. This series did not report any conversions.

In the report of Genc et al. [22] (Ankara, Turkey) the authors described their experience with 98 LDNs

Table 3 Demographics of LDN reported at four major centres.

Centre	Side (% R/L)	Operative	Warm ischaemia	Conversion rate, %
Johns Hopkins [32]	5.3	253 (55.7)	4.9 (3.4)	2.10
Univ. of Maryland [37]	3.9	202.1 (52.4)	2.82 (1.5)	1.60
UCLA [34]	1.2	190 (range 135–370)	4 (2)	0
Northwestern University [35]	1.2	NA	2.6 (0.5)	1.8

performed by pure laparoscopy. The operative time was significantly shorter in the LDN than in the ODN group and there was one loss from 98 kidneys, secondary to arterial thrombosis in the LDN, but no significant differences in the quality of life or graft function. This series again showed the devastating risk of vascular compromise and arterial thrombosis that is rare in ODN and continues to occur in the early LDN experiences.

Similarly, in the series from Tehran, Simforoosh et al. [19] showed the safety of LDN compared to ODN, for the first time using a prospective randomized trial. Their data showed a relatively high use of left kidneys (97%), low conversion rate (1%), and low complication rate in donors and recipients. In a follow-up report by the same authors [24], they suggested modifications of technique introduced to obtain longer right renal veins, by tying the renal vein at the juncture of the IVC.

Buresley et al. [21] (Safat, Kuwait) showed the safety of LDN in 80 donors. There was relatively little use of the right kidney (five, 7.5%). There were six conversions (9%), mostly related to difficulty in identifying the ureter or to bleeding, and there were no major complications reported in the donors, but there was one early death of a recipient from an unknown cause at 6 weeks after transplantation.

Nikeghbalian et al. [23] (Shiraz, Iran) reported on 100 pure LDNs with hand extraction, with conversion to ODN in 5% and a warm ischaemia time of 5.2 (2–8) min. There were no vascular thromboses or technical mishaps in this series, and the authors reconfirm the minimally invasive nature of LDN compared to ODN, and an equivalent graft and recipient outcome.

There were other centres in the Middle East that introduced LDN, but were not included in this series either because there were too few LDNs (< 30) or unavailability of peer-reviewed published reports to date. These include the Hotel-Dieu de France hospital in Lebanon, that performed a total of 40 hand-assisted LDNs, with favourable results (Maroun Moukarzel, personal communication, 2011) and the Jeddah Kidney centre, King Fahd General Hospital, Jeddah, Saudi Arabia, that has used pure LDNs since 2002, with gratifying results (Abdullah Awad, personal communication).

Overall, the Middle Eastern experience in LDN has been very satisfactory. There were no reported major complications in the donor in 888 reported cases. Furthermore, there were no major differences in graft and recipient outcomes between LDN and ODN. There was a relatively high conversion rate in some series (reaching 20%), indicating the low threshold for conversion by some surgeons for haemorrhagic complications, which is acceptable when starting LDN. While several Middle Eastern centres had gained experience from the steep learning curve in the major USA centres, thus reporting relatively favourable results, it is possible that the scrutiny of follow-up and the accuracy of reporting fall short of those in the West. We have noted a great discrepancy and variability in the reporting of conversions and major complications among centres using LDN. While there were no deaths reported in any of the 888 donors, we are aware through personal communications at meetings of at least two major complications and one death that might have occurred because of a dislodged clip after surgery. We are also aware of at least five graft losses due to vascular or technical mishaps that have occurred during harvesting. We therefore urge for a very objective and clear registry, not only for cadaveric transplants but also for live-donor transplants in the Middle East and the Arab world.

We recognize that there are many shortcomings in this review, as reporting on the Middle East experience in LDN is clouded by inconsistencies and variability in reporting, as well as the initiation of programmes. Also, some centres might not have published their updated series.

Finally, the inclusion of all single-centre reports in one Table is associated with inherent problems of interpretation, especially that the variables included in each series were heterogeneous, making it difficult to draw solid conclusions.

In conclusion, the introduction of LDN in the Middle East has been gratifying and has underscored the advantages to the donor. The relative hesitancy in introducing such programmes in the rest of the Arab Middle East (currently only three countries, Lebanon, Kuwait and Egypt, have reported on LDN) is multifactorial and might relate to misconceptions on the part of transplant programmes in embarking on a new surgical procedure. Nevertheless, the continued reports of favourable and equivalent outcomes in the recipients when receiving LDN underscores the importance of this novel approach for kidney retrieval. More importantly, the advantages conferred on the donor undergoing LDN underline the need for further expansion of this approach for transplantation. It is well recognized that the kidney donor is not a regular patient, but rather a unique individual who has nothing to gain from the surgical procedure. This concept, which has been continuously and repetitively emphasized in the West, has yet to be recognized by the Middle Eastern governments and transplant organizations alike. It is evident that the Middle East region currently faces innate problems particularly with regard to the donor's integrity and the need for protection and advocacy [39]. Furthermore, the region has its problems in organ trafficking that will need to be addressed in conjunction with using benign procedures, although more costly, simply to protect the donor from the increased morbidity that is associated with ODN. These factors will need to be weighed when discussing LDN and its expansion. Several centres, including ours, have offered educational programmes to surgeons and urologists to develop laparoscopic skills, especially

advanced laparoscopy, and have presented live demonstrations illustrating LDN. Such courses will be carried out more often in the future, to ensure the widespread use of LDN.

Conflict of interest

There are no conflicts of interest.

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