
Open Versus Laparoscopic Live Donor Nephrectomy: A Focus on the Safety of Donors and the Need for a Donor Registry

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Purpose: A review of the existing literature showed that the subject of live donor nephrectomy is a seat of underreporting and underestimation of complications. We provide a systematic comparison between laparoscopic and open live donor nephrectomy with special emphasis on the safety of donors and grafts.

Materials and Methods: The PubMed® literature database was searched from inception to October 2006. A comparison was made between laparoscopic and open live donor nephrectomy regarding donor safety and graft efficacy.

Results: The review included 69 studies. There were 7 randomized controlled trials, 5 prospective nonrandomized studies, 22 retrospective controlled studies, 26 large (greater than 100 donors), retrospective, noncontrolled studies, 8 case reports and 1 experimental study. Most investigators concluded that, compared to open live donor nephrectomy, laparoscopic live donor nephrectomy provides equal graft function, an equal rejection rate, equal urological complications, and equal patient and graft survival. Analgesic requirements, pain data, hospital stay and time to return to work are significantly in favor of the laparoscopic procedure. On the other hand, laparoscopic live donor nephrectomy has the disadvantages of increased operative time, increased warm ischemia time and increased major complications requiring reoperation. In terms of donor safety at least 8 perioperative deaths were recorded after laparoscopic live donor nephrectomy. These perioperative deaths were not documented in recent review articles. Ten perioperative deaths were reported with open live donor nephrectomy by 1991. No perioperative mortalities have been recorded following open live donor nephrectomy since 1991. Regarding graft safety, at least 15 graft losses directly related to the surgical technique of laparoscopic live donor nephrectomy were found but none was emphasized in recent review articles. The incidence of graft loss due to technical reasons in the early reports of open live donor nephrectomy was not properly documented in the literature.

Conclusions: We are in need of a live organ donor registry to determine the combined experience of complications and long-term outcomes, rather than short-term reports from single institutions. Like all other new techniques, laparoscopic live donor nephrectomy should be developed and improved at a few centers of excellence to avoid the loss of a donor or a graft.

Key Words: kidney, nephrectomy, living donors, laparoscopy, kidney transplantation

Recent review articles provided a systematic review of LLDN and compared its safety and efficacy to those of the gold standard, OLDN.^{1,2} The investigators concluded that LLDN seems to be at least as safe and efficacious as OLDN. Nevertheless, after a thorough estimation and updating of the existing literature we observed that, although the previous conclusion is true, some important information must be added. Understanding this information may affect our recommendations regarding the optimal situations required for LDN for the purpose of donor safety and graft efficacy.

MATERIALS AND METHODS

A medical literature search of the PubMed database from inception to October 2006 was performed to identify all articles relating to laparoscopic and open donor nephrectomy. Inclusion criteria were studies of all types comparing the laparoscopic and open approaches to LDN. Moreover, all

prospective and large retrospective studies (greater than 100 donors) discussing the results of laparoscopic or open donor nephrectomy were included. Only studies specifically of living kidney donors and recipients with end stage renal failure were included for review. Studies in which patients underwent laparoscopic nephrectomy for any other purpose were excluded unless the results of LDN could be separated from other indications, as were studies using hybrid open laparoscopic approaches without laparoscopic instruments for vascular division and kidney removal. The included articles contained information on at least 1 of certain outcomes, that is perioperative and postoperative morbidity and mortality of the donors, intraoperative and early postoperative factors, graft function, and survival and convalescence. Case reports describing donor complications directly related to the surgical technique of the open and laparoscopic approaches were also included in this review. Table 1 lists the studies included in the current review.

RESULTS

The review included 69 studies. There were 7 randomized controlled trials (level I–II),^{3–9} 5 prospective nonrandomized studies (level II),^{10–14} 22 retrospective controlled studies

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TABLE 1. *Studies included in review*

Study Type	Evidence Based Level	No. Studies
Randomized, controlled	I-II	7 ³⁻⁹
Prospective, nonrandomized	II	5 ¹⁰⁻¹⁴
Retrospective, controlled	III-2	22 ¹⁵⁻³⁵
Retrospective, noncontrolled	III-3	26 ³⁶⁻⁶¹
Case report	IV	8 ⁶²⁻⁶⁹
Experimental study	IV	1 ⁷⁰

(level III-2),¹⁵⁻³⁵ 26 large, retrospective, noncontrolled studies (level III-3),³⁶⁻⁶¹ 8 case reports (level IV)⁶²⁻⁶⁹ and 1 experimental study⁷⁰ (table 1). Special emphasis was put on donor and graft safety, which are issues not adequately cited in previous reviews. Table 2 shows the comparison between LLDN and OLDN.

DONOR

Safety

Mortality. Although in a recent review Tooher et al stated that no mortality has been reported following LLDN and OLDN,¹ a thorough search of the literature showed that some reports were overlooked. Vastag recorded 5 donor deaths after LLDN in the United States.⁷¹ They were not published as case reports. Two kidney donors died of embolism, another died of acute hemorrhage and a fourth died of respiratory failure. The cause of death of a fifth donor is uncertain. Moreover, Matas et al reported 2 donor deaths and 1 donor in a persistent vegetative state after LLDN.¹⁵ In addition, 1 donor death after laparoscopic nephrectomy due to cerebral gas embolism was recently reported at a specialized transplant center.⁶² In a large, randomized study 2 deaths were reported in the LLDN group, including 1 from early cardiopulmonary arrest and the other from pulmonary embolism.⁴ Table 3 lists the causes of donor death after LLDN.

By 1974 for OLDN 5 donor deaths had occurred in the early postoperative period.³⁷⁻³⁹ Between 1974 and 1980 no perioperative mortalities were reported. From January 1980 to January 1991 Najarian et al surveyed all members of the American Society of Transplant Surgeons about donor mortality at their institutions.³⁶ Among 19,368 living donor nephrectomies they documented 5 early deaths and estimated that the perioperative mortality associated with

TABLE 2. *LLDN vs OLDN*

	LLDN	OLDN
No. donor deaths	11	10
No. graft losses due to technical problems	15	0
Warm ischemia time range (mins)	2-17	2-12
Operative time range (mins)	105-420	75-310
% Donor morbidity range:		
Periop bleeding	1-17	0.3-3
Intraop transfusion	0-10	0-5
Postop transfusion	1-7	3-5
Gastrointestinal complications	0-1.6	0-0.6
% Recipient morbidity range:		
Acute rejection episodes	2-30	3-44
Total complications	0-31	0-19
Ureteral complications	2-11	0-6.3
Delayed graft function	0-12	0-14
% 1-Yr survival range:		
Graft	93-100	91-100
Recipient	97-100	93-100

TABLE 3. *Causes of death after LLDN*

References	No. Deaths	Death Cause (No.)
Vastag ⁷¹	5*	Pulmonary embolism (2), acute intraop bleeding (1), respiratory failure (1), unspecified (1)
Matas et al ¹⁵	3*	Pulmonary embolism (1), acute introap bleeding (1), unspecified (1)
Boghossian et al ⁶²	1	Cerebral gas embolism (1)
Simforoosh et al ⁴	2	Cardiopulmonary arrest (1), pulmonary embolism (1)

* Possible overlap.

OLDN in the United States was at least 0.03%.³⁶ Pulmonary emboli were the major cause of death. Since 1991, no perioperative mortalities have been recorded following OLDN.^{34,61}

Conversion rate. The rate was 0% to 13.3%.^{10,40,41} Reasons for conversion were vascular injuries (renal artery, renal vein, aorta, inferior vena cava, lumbar veins, adrenal vessels and common iliac artery), device failures and misapplications, and splenic and bowel injuries.^{30,40,42-45}

Perioperative complications. There was a trend toward higher estimated blood loss in open than in laparoscopic procedures, although the difference was not always statistically significant. Whether the laparoscopic procedure was hand assisted did not seem to make a difference in these comparisons.¹⁷

For LLDN the rate of perioperative (before hospital discharge) bleeding was 1% to 17%.^{18,31,40,41,43,47} For OLDN it was 0.3%⁴⁸ to 3%.⁴¹ The intraoperative transfusion rate was 0% to 10% for LLDN^{19,32,40,41,49} and 0% to 5% for OLDN.^{19,40,41,44,49} The postoperative transfusion rate for LLDN was 1%⁴³ to 7%.⁴⁰ The rates for OLDN were 3%⁴⁰ and 5%.⁴⁴

Some rare complications were recently reported in donors during or shortly after LLDN. Metwalli et al reported a case of visual impairment after LLDN.⁶³ The visual deficit was secondary to ischemic optic neuropathy after LLDN. Rehman et al reported rhabdomyolysis complicated by acute renal failure in a muscular donor with a high body mass index after LLDN.⁶⁴ The donor was successfully treated without dialysis and renal function returned to normal after 20 days. The kidney recipient had a normal postoperative course. Caumartin et al recently reported on a living donor with chylous ascites as a complication of LLDN.⁶⁵ Bladder perforation during LLDN was recorded in 2 donors during extraction of the kidney through a Pfannenstiel incision.⁶⁶ Chung et al reported spontaneous, unremitting gross hematuria 1 week after LLDN due to clip slippage from the divided ureter.⁶⁷

Postoperative complications. Gastrointestinal complications in terms of bowel injury, bowel obstruction, internal hernia and pancreatitis were more common with LLDN.^{1,2,15} On the other hand, pulmonary complications (atelectasis, pneumothorax, pulmonary congestion and hypoxia) as well as thrombotic complications (deep vein thrombosis, thrombophlebitis and pulmonary embolism) were more common with OLDN.^{1,2,15} Wound complications, including wound infection or abscess, wound hematoma or

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