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Video Assisted Minilaparotomy Surgery (VAMS) - Live Donor Nephrectomy: 239 Cases

Koon Ho Rha[1,3], Yu Seun Kim[2], Soon Il Kim[2], Young Joon Byun[1,3], Sung Joon Hong[1,3], Kiil Park[2], and Seung Choul Yang[1,3]

Departments of [1]Urology, [2]Surgery, and [3]Urological Science Institute, Yonsei University College of Medicine, Seoul, Korea.

We have devised a new surgical method of video-assisted minilaparotomy surgery-live donor nephrectomy (VAMS-LDN), which is a hybridized form of laparoscopic and open surgeries that combines the advantages of both. We present the findings of our series of 239 consecutive patients. Since 1993 we have performed 239 successful VAMS-LND. All 239 healthy kidney donors' characteristics and their postoperative courses were retrospectively reviewed and the data were compared to 95 open donor nephrectomies performed during the same period. The mean age and weight of the patients were 37.9 ± 11.0 years and 62.4 ± 7.9 kg, respectively. The mean operating time was 154 ± 41 minutes, which was similar to open donor nephrectomy but shorter than laparoscopic donor nephrectomy. There were no major intraoperative complications except two tears to lumbar veins which required transfusion. The mean warm ischemic time was 2.1 ± 0.7 minutes, which was equal to open donor nephrectomy. The patients experienced less postoperative pain and recovered quicker than the open donor nephrectomy patients. VAMS-LDN is a safe and minimally invasive technique for live donor nephrectomy, incorporating advantages of both conventional open and laparoscopic methods. We suggest that VAMS-LDN is a viable option for living donor kidney transplantation.

Key Words: Minilaparotomy, laparoscopy, living donors, nephrectomy

INTRODUCTION

Live donor nephrectomy (LDN) has evolved in the direction of minimizing patient discomfort and enhancing surgical safety. In 1990, Clayman et al. first performed laparoscopic nephrectomy in a patient with benign kidney disease by applying the principle of laparoscopic surgery.[1] From this experience, Ratner et al. applied the laparoscopic assisted technique in LDN.[2]

As the laparoscopic donor nephrectomy has the advantages of reducing postoperative pain, smaller wound, rapid recovery and shorter hospital stay, it has been performed as minimally invasive technique that can replace conventional open abdominal surgery.[3,4] However, the problems of this technique are the steep learning curve and the higher risk of early functional impairment of the transplanted kidney due to the reduction of blood flow in the kidney caused by increased abdominal pressure bypneumoperitoneum.[5,6] Other problems include the short renal pedicle,[7] higher incidence of ureteral complication, increased complication on right sided donors due to shorter stump[8,9] and increased medical cost due to the use of disposable equipments.

Since 1991, we have been performing video assisted minilaparotomy surgery - live donor nephrectomy (VAMS-LDN) which combines the advantages of conventional open nephrectomy and laparoscopic nephrectomy.[9] The characteristic of this technique is that it provides surgical space by minilaparotomy without dividing muscles. It utilizes a surgical traction system which provides both direct vision throughminilaparotomy and simultaneous magnified, telescopic view on monitor. The procedure can immediately be converted to open surgery if any problem occurs. In addition, the advantages of the technique are high safety rate and low morbidity rate because it does not require pneumoperitoneum which reduces

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Reprint address: requests to Dr. Seung Choul Yang, Departments of Urology and Urological Science Institute, Yonsei University College of Medicine, 134 Shinchon-dong, Seodaemun-gu, Seoul 120-752, Korea. Tel: 82-2-361-5800, Fax: 82-2-312-2538, E-mail: urology@yumc.yonsei.ac.kr

urine volume and increases cardiopulmonary complications.[10] Hence, we report here the technique and outcome of 239 cases of VAMS-LDN that we performed from 1993 to 2003.

Operative technique[9,10]

VAMS-LDN was performed as described.[9,10] Under general anesthesia, patients were placed in the flank position, a 5-7 cm transverse incision was made on the lateral abdomen, and the subcutaneous fat and fascia were separated. After splitting the abdominal muscles without cutting, the peritoneum and fascia were detached. A piercing laparoscopic trocar was inserted through the space between the peritoneum and fascia and connected to the upper deck of retractors (Fig. 1, 2). The surgical view was maintained by placing a 10 mm laparoscopic trocar on the approximately 5 cm lower left side of the major incision area, inserting a 30 degree laparoscope, connecting a monitor, and thus utilizing the enlarged view by laparoscope as well as the minilaparotomy view (Fig. 3). The surgical space was secured by connecting the newly developed blade to the table mount retractor system (Thompson Surgical, Inc, Michigan, USA). By applying surgical instruments used in conventional open abdominal surgery and in laparoscopic surgery such as endoclip, laparoscopic scissors, grasper, etc., the ureter was resected first, followed by the kidney and renal pedicles. In the resection of the ureter, the peritoneum covering the ureter was deflected by inserting a piercing peritoneal retractor. The resection of the kidney was performed in order of the lower pole of kidney, lateral margin, upper pole and adrenal gland. In cases with thick fat layer around the kidney, the fat was removed first to secure the surgical view. The venous branches of the gonadal and lumbar vein were tied with extracorporeal knots. After the preparation of nephrectomy was completed, the ureter was resected. Prior to the handling of the renal hilum, the kidney area was covered with a disposable plastic, endocatch bag in preparation for the removal of the donor kidney by minilaparotomy. This allowed the simultaneous moving of the resected kidney and the cutting of the renal hilum and thus reduced the warm ischemic time (Fig. 4). The renal artery was sutured with endoclips. The renal vein was sutured by Satinsky forceps followed by suturing with 5-0 prolene after the removal of the resected kidney. A drainage tube was inserted in the area where the trocar had been inserted and the surgery was completed.

RESULTS

From 1993 to July 2003, 239 healthy kidney donors underwent VAMS-LDN at our hospital. The average weight of the study population was 62.4 ± 7.9 kg and the average age was 37.9 ± 11.0 years. The nephrectomy of the left kidney was performed on 187 patients and right side on 52 (Table 1). The characteristics of 95 patients who underwent LDN by open surgery during the same period was comparable to those who underwent

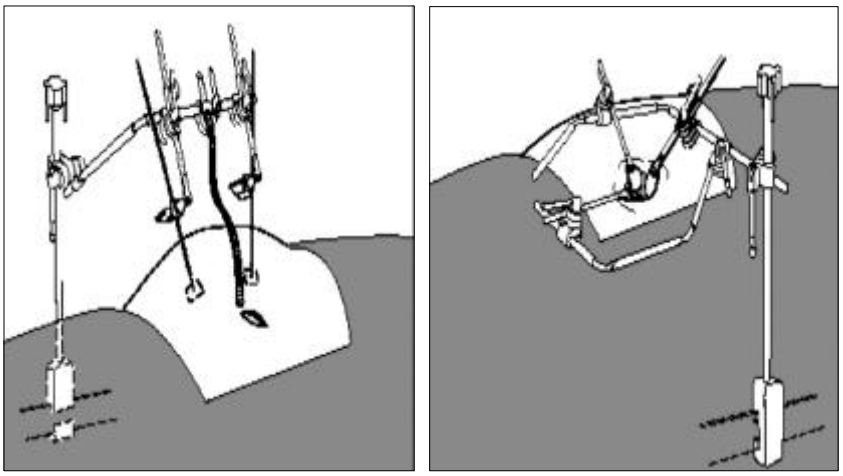

Fig. 1. Schematic setup for video- assisted minilaparotomy live donor nephrectomy. Abdominal wall elevators combined with conventional table mount retractors are used to create ample retroperitoneal surgical space.

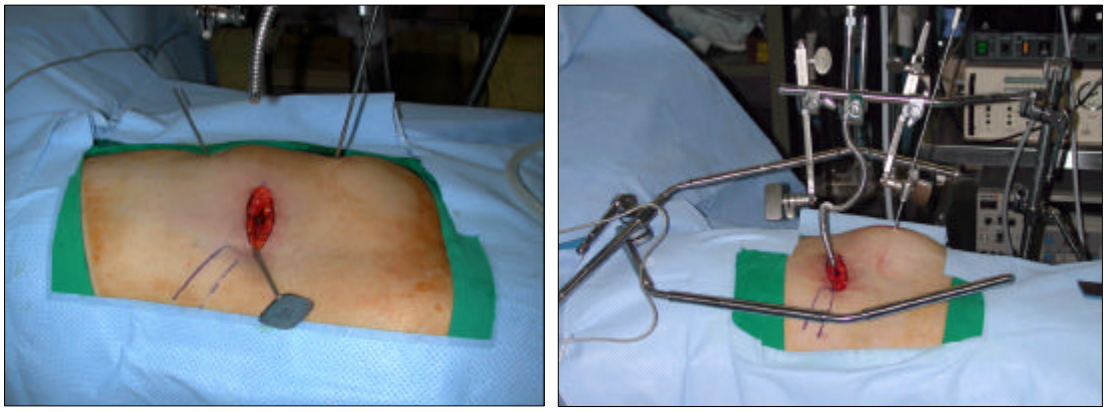

Fig. 2. Piercing retractor is introduced between the peritoneum and abdominal wall, which is attached to the retractor system.

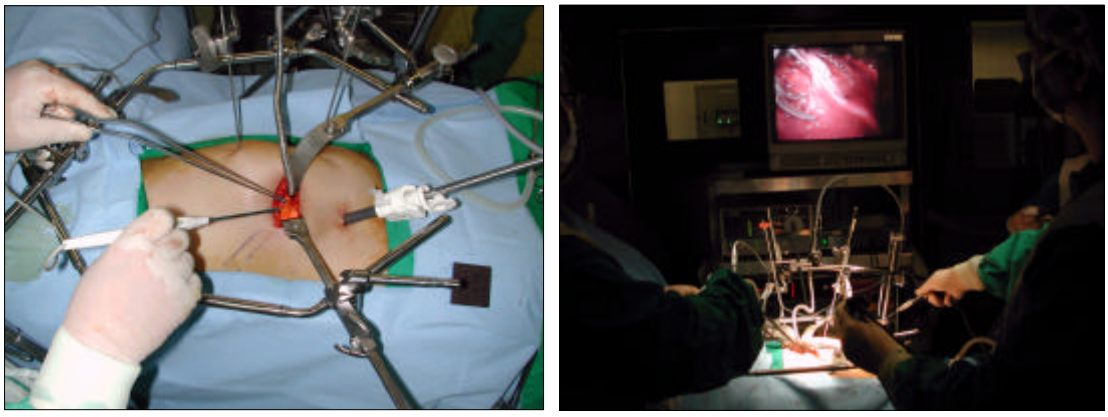

Fig. 3. While watching the video monitor or under the direct vision through the minilaparotomy wound, both conventional surgical and laparoscopic instruments are handled through the minilaparotomy.

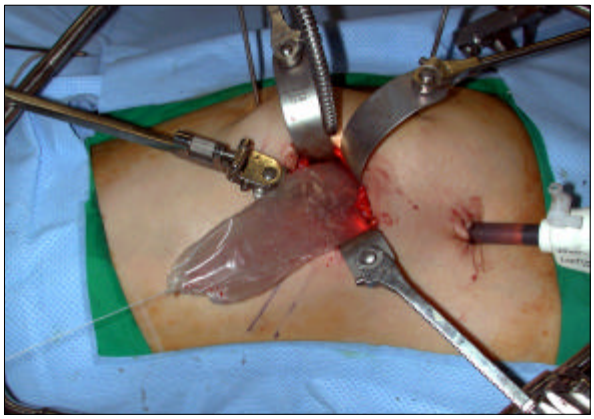

Fig. 4. Plastic entrapment bag is introduced before clamping the renal pedicle, thereby reducing the warm ischemic time.

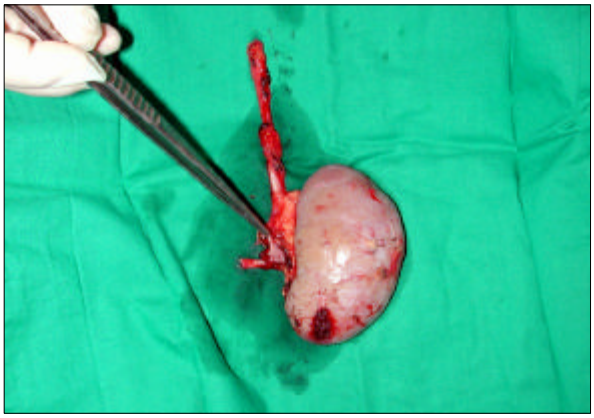

Fig. 5. Harvested kidney shows adequate lengths of renal vessels and ureter.

VAMS-LDN (Table 1).

Surgery was successful in all of the 239 patients who underwent VAMS-LDN. The mean total surgery time was 154 ± 41 minutes and the mean

Table 1. Patient Characteristics

	VAMS Donor Nephrectomy	Open Donor Nephrectomy
No. of patients	239	95
No. male: female	125 : 114	56 : 39
Mean patient age (± SD), yrs	37.9 ± 11.0	43.7 ± 6.8
Mean weight ± SD (kg)	62.4 ± 7.9	67.2 ± 3.1
No. right: left	52 : 187	35 : 60
No. renal artery single: multiple	193 : 46	75 : 20

Table 2. Results of 239 Video-Assisted and 95 Open Live Donor Nephrectomies

	VAMS LDN (Mean ± SD)	Open LDN (Mean ± SD)	p value
Operating time (min)	154 ± 41	138 ± 15	0.25
Blood loss (cc)	193 ± 182	115 ± 13	0.29
Warm ischemia time (min)	2.1 ± 0.7	2.2 ± 0.8	0.42
Oral intake resumed (hr)	18.1 ± 4.8	34.6 ± 9.3	< 0.01
Full ambulation resumed (day)	1.6 ± 0.6	3.4 ± 1.7	< 0.01
Analgesics (mg, Morphine equivalent)	23 ± 11	46 ± 16	< 0.01

warm ischemic time was 2.1 ± 0.7 minutes, which were comparable to open abdominal surgery. In all cases, we were able to obtain a sufficient length of the ureter and the renal blood vessel for successful implantation of the ureter and the pedicles in the recipient (Fig. 5). The mean estimated blood loss was 193 ml and transfusion was required in 2 cases (1%) in which the hemorrhages were from the lumbar veins. The incision was not extended, except in one case in which securing the surgery space was difficult due to the distension of the small intestine caused by the administration of nitrous oxide during anesthesia. Patients started the oral uptake at an average of 18.1 ± 4.8 hours after surgery. Except in two patients, analgesic drugs were not required for more than one day. The mean analgesic dosage was 23 ± 11 mg of morphine equivalent. Patients started to ambulate at a mean of 1.6 ± 0.6 days after surgery (Table 2). Compared with the 95 patients who underwent LDN by open surgery during the same period, although estimated blood loss was larger in patients undergoing minilaparotomy, the difference was not statistically significant. The difference of warm ischemic time was also not significant. In regard to analgesic use, VAMS-LDN required significantly less pain control ($p < 0.01$). Similarly, the times to the initiation of oral intake and ambulation were shorter ($p < 0.01$) (Table 2).

DISCUSSION

Laparoscopic nephrectomy has been widely performed since the first report by Clayman et al. in 1990. It reduced postoperative pain, length of hospital stay and the time required to return to normal daily life.[1] Since the first success of laparoscopic LDN by Ratner et al. in 1995 at Johns Hopkins Hospital, laparoscopic LDN has been widely accepted.[3,4] In LDN, the priority is the safety and comfort of the kidney donors. From the point of view of recipients, sufficient length of the blood vessel and the ureter must be provided and the ischemic time must be minimized to reduce kidney damage.[11,12] Open surgery carries more pain due to a long incision, longer recovery time

and more cosmetic problems for donors. Laparoscopic nephrectomy is an alternative to overcome such obstacles. However, it has limits in terms of safety and the function of the transplanted kidney.

VAMS has been developed by combining the advantages of conventional open abdominal nephrectomy and laparoscopic nephrectomy.[9] The surgical technique involves confirming the anatomical structure by simultaneously combining direct examination via minilaparotomy with the magnified image on a monitor. As a surgical view equivalent to open abdominal surgery can be secured by applying the developed piercing abdominal muscle and the peritoneum retractor, this surgical technique is safe for the resection of the renal vessels and the ureter. In addition, the cost of surgery can be minimized by eliminating the need for disposable instruments. Hemorrhage that occurs frequently during laparoscopic nephrectomy can be managed readily because the hemorrhage area can be pressed directly through minilaparotomy. Furthermore, suture repair does not require expertise in laparoscopic surgery. The ischemic time of less than 3 minutes was comparable to that of open surgery, which is significantly shorter than that of laparoscopic nephrectomy. The surgery time of approximately 140 minutes, was not longer than that of open surgery (Table 2). It has been reported that the increased intraperitoneal pressure during laparoscopic nephrectomy may compromise renal blood flow and consequently delayed functional impairment of the transplanted kidney.[13-15] To reduce warm ischemic time, we used a plastic entrapment bag. The bag can be inserted readily through minilaparotomy, thereby reducing warm ischemic time.[16] In fact, the mean time required for the ligation of the renal artery, excision, and kidney perfusion through a perfusate was 2.1 minutes, which was comparable to open abdominal surgery and significantly faster than the 6.3 minutes reported in the literature for laparoscopic LDN.[12] During LDN, special care is required for resection of the renal artery, renal vein, urethra vein and other major structures as they are directly related to the surgical success. The disadvantages of laparoscopic LDN are that it involves numerous procedures in the vicinity of the renal blood vessels and that a new incision has to be made if an accident occurs during the surgery. Since minilaparotomy LDN is performed after securing a sufficient surgery area in the retroperitoneum and the 3-dimensional surgical view is provided by a monitor and minilaparotomy, its safety is equal to that of open abdominal surgery. The surgery can be performed successfully without difficulty in the case of the resection of the right side kidney or in cases of multiple arteries. The hemorrhage volume during minilaparotomy LDN was not significantly different from that of conventional open abdominal surgery. As all surgical procedures in VAMS-LDN are performed in the retroperitoneum, it is a physiological method without unnecessary violation of the peritoneum. Hence, it does not the risk of complications such as bowel adhesion, and furthermore, if the donor requires abdominal surgery, VAMS does not carry an unnecessarily high risk due to the donation of the kidney.

It is well established that postoperative pain in laparoscopic LDN is less than that in open surgery. Our data demonstrated that the analgesic dose administered after VAMS-LDN was lower than that of open surgery. The mean analgesic dose after VAMS-LDN was 23 mg, which was lower than the dose required after open surgery generally or than the 46 mg that has been reported in the literature for conventional laparoscopic nephrectomy.[12] This may be because the application of minilaparotomy, avoiding the resection of the abdominal muscles, which are only separated, and thereby reducing injury to the intercostals nerves. Since, decreased pain is related to faster recovery to physical activity and ambulation, this lack of resection is an important advantage of minilaparotomy. Furthermore, in terms of renal function in the recipient, minilaparotomy was comparable to conventional open surgery.[17]

Considering the cosmetic aspect, LDN, as opposed to other forms of laparoscopic surgery, requires incisions. Instead of 4 - 5 trocar incisions, minilaparotomy can be completed with only one incision for both video and minilaparotomy. This minimally invasive surgical technique can therefore increase the potential number of donors by decreasing their concerns about donating their kidney because of the risk of postsurgical complications.

In conclusion, VAMS-LDN is a surgical method which features the advantages of both conventional laparoscopic surgery and open abdominal surgery without CO_2 gas insufflation, through its combination of direct three-dimensional surgical view and magnified laparoscopic view. In addition, as postsurgical pain and operative complications are minimized, this surgical technique can be considered as a form of LDN able to improve the quality of life of the donors.

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