



## Use of Nonabsorbable Polymer Ligaclip in Hand-Assisted Laparoscopic Nephrectomy for Living Donor

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### ABSTRACT

**Background.** Laparoscopic living donor nephrectomy for kidney transplantation is a technique that began in South America only recently. This procedure offers several advantages compared with open nephrectomy due to the minor pain, better cosmetic results, and shorter length of hospital stay. Herein we have described our experience with the use of nonabsorbable polymer ligaclip (NPL) to control the renal artery, vein, and ureter in hand-assisted laparoscopic donor nephrectomy (HALN).

**Methods.** We performed a review of 85 HALNs for renal transplantation at our institution between January 2004 and August 2007. We evaluated the preoperative characteristics of the donor, surgical parameters, and complications.

**Results.** Fifty six percent of donors were men. Mean donor age was 34.4 years (range = 18 to 60). Left-sided nephrectomy was performed in 85%. Mean surgical time was 132 minute (range = 90 to 240) and among the last 35 nephrectomies, 120 minute (range = 90 to 180). Mean warm ischemia time was 240 seconds (range = 120 to 420). Conversion rate was 1.1%. Mortality was one case (1.1%) secondary to an episode of massive pulmonary thromboembolism. Mean length of hospital stay was 2.5 days (range 2 to 5) and mean blood loss, 125 mL. No complication related to the NPL was observed.

**Conclusions.** Laparoscopy living donor nephrectomy was a safe procedure for kidney transplantation. The training and experience of the surgeon was reflected in shorter times of surgery. The NPL was safe and cost-effective, not increasing morbidity of the procedure.

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**L**APAROSCOPIC NEPHRECTOMY has arisen as an attractive alternative to the open technique for kidney donation, offering advantages of a shorter hospital stay, decreased postsurgical pain, and better cosmetic results.<sup>1</sup> Likewise, it has meaningfully increased the pool of living donors, thereby contributing to diminish the wide gap between donors and recipients. Following the first laparoscopic nephrectomy in 1995,<sup>2</sup> the technique has evolved with the hand-assisted modification. The ligature and control of the kidney hilum constitute critical steps during any type of nephrectomy, especially using the laparoscopic approach. The endovascular gastrointestinal anastomosis is the standard method in the United States. Nevertheless, the malfunction of stapler and meaningful loss of vessel length add morbidity to the procedure with the necessity for conversion to an open surgery.<sup>3,4</sup> The high cost of the stapler makes it more difficult to use in the countries of the third world. Likewise, the use of titanium clips has been reported, but it provides poor hemostatic security taking

into account its easy displacement.<sup>5</sup> The nonabsorbable polymer ligaclip is an interesting option. We sought to test the security and cost-effectiveness of this technique.<sup>6</sup> The objective of our study was to report experience with first 85 hand-assisted laparoscopic nephrectomies wherein the artery, vein, and ureter were controlled with nonabsorbable polymer ligaclips.

### MATERIALS AND METHODS

We performed retrospective review of the clinical records of 85 patients who underwent hand-assisted laparoscopic nephrectomy for living donor kidney retrieval using nonabsorbable polymer ligaclips to control the renal vessels and ureter between January

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2004 and August 2007. The last 70 nephrectomies were performed by the same surgeons.

We analyzed demographic characteristics as well as hospital stay, surgical time, intraoperative blood loss, warm ischemia time, and surgical complications of the donors. The donor evaluation included urography and scanography with an angiographic stage and three-dimensional reconstruction.

The technique of laparoscopic nephrectomy used a patient in the lateral decubitus position. The hand port was a Pfannenstiel-type or middle infraumbilical 7-cm incision and two 10-mm trocars at the middle clavicular line and the posterior axillary line. Intra-abdominal pressure was maintained at 15 mm Hg. The whole procedure was hand-assisted. At the beginning of manipulation of the renal hilum, we administered furosemide 20 mg intravenously. No intraoperative heparin was administered in the last 35 cases.

The colon was mobilized medially by means of an incision in Told fascia with sequential dissection of ureter and renal hilum using the LigaSure device or harmonic scalpel. The control of tributaries of the renal vein (gonadal, suprarenal, and lumbar veins) was performed with nonabsorbable polymer ligaclip (5 mm) two nonabsorbable polymer ligaclips (10 mm) were placed on the ureter, artery, and renal vein, which were sectioned and the kidney extracted through the hand port incision. Finally, the kidney was immersed in the bench with solution HTK 1000 mL. The procedure ended with hemostasis, withdrawal of the hand port, and closing the incisions. The warm ischemia time was defined as the time from clamping of renal artery of donor until the organ was placed in the bench.

## RESULTS

The donors included men 48 (56%) with overall mean age of 34.4 years (range = 18 to 60). The nephrectomy was left-sided in 72 cases (85%). The mean surgical time was 132 minutes (range = 90 to 240), and in the last 35 nephrectomies, 120 minute (range = 90 to 180). The site of extraction was a transverse suprapubic incision in 58 cases (68%). From patient 50 on, we did not use systemic heparin before control of the vessels. The warm ischemia time was 240 seconds (range 120 to 420). The mean length of stay was 2.5 days (range = 2 to 5). Among all of the cases, nonabsorbable polymer ligaclips were used to control artery, vein, and ureter without any complication related to this element. None of the patients required transfusions; the mean of blood loss was 125 mL (range = 50 to 1000).

There was conversion in one case (1.1%), because injury to the renal vein could not be controlled by laparoscopy. There was one major complication, corresponding to 1.1% of the cases, secondary to an intraoperative injury to the left colon, which required reintervention because of abdominal sepsis. Currently, the patient has normal renal function, namely, creatinine 1.2 mg/dL, clearance creatinine 104 mL/min, and negative proteinuria at 1 year after surgery. This value was similar to the recipient: creatinine 1.0 mg/dL, clearance creatinine 125 mL/min, and negative proteinuria at 2 years after transplantation. The mortality rate was one case (1.1%) secondary to an episode of massive pulmonary thromboembolism. Anatomic variants (multiple vessels and ureter) and previous abdominal sur-

gery did not contraindicate the laparoscopic nephrectomy in any donor.

## DISCUSSION

Laparoscopic living donor nephrectomy is considered a unique procedure, because it involves subjecting healthy patient to a major surgical procedure with its inherent risks, seeking to benefit another patient. Currently, laparoscopic nephrectomy is the gold standard to handle the living kidney donor. The benefits are multiple compared with the open technique, namely, shorter hospital stay, rapid return to work, less postsurgical pain, and better cosmetic results. These benefits probably contributed to a meaningful increase in donation rates as registered by UNOS in 2001, when the number of living donors exceeded the number of cadaveric donors for the first time.<sup>1</sup>

The incidence of renovascular complications in the laparoscopic nephrectomy in our experience was 1.1%, comparable with the results of Leventhal et al,<sup>1</sup> which were 1.4%, and other series.<sup>7</sup>

The decision to not use systemic heparin before control of the renal vessels was not reflected by thrombosis, as described by Baldwin<sup>6</sup> and Colin.<sup>8</sup> The surgical technique has had several modifications over time: transperitoneal versus retroperitoneal approaches, the use of hand assistance with or without a hand port, and the application of robotic assistance.<sup>9</sup>

The utilization of a hand port facilitates the insertion of the surgeon's hand into the abdominal cavity; it is the most common modification identified in the literature. The hand-assisted laparoscopic nephrectomy reduced the surgical and the warm ischemia times with less blood loss and reduced risks of graft damage.<sup>10</sup> Supporting the experience published by other centers, we decided to perform all laparoscopic living donor nephrectomies using a transperitoneal hand-assisted method with hand port. Our unique conversion rate (1.1%) compared favorably with 2.97% in the meta-analysis performed by Kokkinos et al.<sup>10</sup>

Multiple devices have been used to control the renal artery and vein, namely, stapler, nonabsorbable polymer ligaclip, extracorporeal knot, intracorporeal knot, combination of nonabsorbable polymer ligaclip with titanium clip, and use of nonabsorbable polymer ligaclip alone.<sup>3,4,11</sup> We used the nonabsorbable polymer ligaclip for all of the vessels and ureter, as opposed to other surgeons who used the LigaSure device to seal venous and arterial branches.<sup>12</sup>

Although the use of a stapler is the standard technique in the United States, it is well known that it diminishes the length of the vessel by approximately 5 mm,<sup>13</sup> which increases the risk of thrombosis after transplantation. In addition, stapler malfunction has been reported in 1.7% cases,<sup>3</sup> reflecting a greater severity of bleeding and an increased risk of conversion to an open technique in up to 75% of cases. A total of 60 problems related with malfunction of mechanical suture have been documented in the database of the Food and Drug Administration.<sup>11</sup> In our

experience there was no dislodgement of the nonabsorbable polymer ligaclip, avoiding conversion to an open technique for this reason.

An other important disadvantage is the high cost of the stapler device in Colombia, South America. In our institution, the cost is US\$1167.00, including the stapler device and three reloads to control the artery, vein, and ureter, compared with nonabsorbable polymer ligaclip, which costs US\$90.00, including 12 ligaclips. The use of nonabsorbable polymer ligaclips offers several advantages to preserve the length of the vessel, providing a mechanism of closing that diminished the possibility of displacement of the ligaclip compared with titanium clips.<sup>6</sup>

Our results compare favorably with those of Baldwin et al's series of 50 patients, where there was no meaningful morbidity, namely, conversion to open surgery, damage in the vessels, blood transfusions.<sup>6</sup>

The learning curve in laparoscopic living donor nephrectomy diminishes the risk of complications, including that for hand-assisted laparoscopic nephrectomy. Our results showed reduced surgical times and decreased technical difficulty after each surgeon had performed more than six of these procedures.<sup>14,15</sup> Our surgical times decreased significantly after the first 50 procedures. Likewise the warm ischemia time was 240 seconds, similar to that reported in the literature.<sup>1</sup> Gaston et al published their experience with 100 cases of radical laparoscopic nephrectomy for cancer, there was mean operative time after the first 50 cases.<sup>15</sup>

Evaluation of the preoperative renal vascular anatomy is fundamental to select the kidney to be extracted. Currently, a computed tomography angiogram with three-dimensional reconstruction is most often used, because of offering minor cost, time, and morbidity compared with traditional angiography with excretory urography; it excludes urinary tract stones better than the magnetic resonance.<sup>16,17</sup> Even though it was not the objective of our study, it is important to note that we used procedure urography through scanography with angiography and three-dimensional reconstruction to evaluate the kidneys of living donors in all cases, which is a recent technique in our country that has been infrequently used to evaluate the kidneys of living donors for the purposes of transplantation.

In conclusion, our results support the advantages, security, efficacy, and low cost of the use of nonabsorbable polymer ligaclip to control renal vessels and ureter during hand-assisted laparoscopic nephrectomy, demonstrating a

low rate of conversion or of major intraoperative complications.

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