ORIGINAL ARTICLE

Robotic partial nephrectomy with selective parenchymal compression (Simon clamp)

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Abstract
Objective: To present our initial experience using selective renal parenchymal ischemia, without hilar clamping, in robotic-assisted partial nephrectomy.

Materials and methods: In four patients with T1a renal tumor we performed robotic-assisted partial nephrectomy, using the Simon’s clamp (Aesculap®). It provides selective parenchymal compression without the need of vascular clamping. All patients had exofitic renal tumors in polar location. Renal parenchymal reconstruction was done as the standard technique.

Results: The median age was 49.6 years (42–59), 3 male and 1 female patient. Median operative time was 71.6 min (40–120). Mean estimated bleeding was 250 ml (50–400). Average tumor size was 3.25 cm (1.5–5.3). There were no complications and the average hospital stay was 3.5 days (1–7). The pathology was informed as renal cell carcinoma in three patients and one hemorrhagic cyst. The surgical margins were negative.

Conclusion: Our preliminary results show that selective renal parenchymal compression, with the Simon’s clamp, provides an alternative to vascular control in selected patients with polar renal tumors.

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PALABRAS CLAVE
Nefrectomía parcial; Cirugía robótica; Laparoscopia; Tumor renal; Cirugía conservadora de nefronas

Nefrectomía parcial robótica con compresión selectiva del parénquima (pinza de Simon)

Resumen
Objetivo: Presentar nuestra experiencia inicial en nefrectomía parcial robótica (NPR) realizando compresión selectiva del parénquima renal, sin pinzamiento del hilio renal.

Material y métodos: Se realizó NPR utilizando el sistema robótico da Vinci S HD con abordaje transperitoneal y compresión selectiva del parénquima renal a 4 pacientes con masa tumoral exofítica de localización polar. Se utilizó la pinza de Simon laparoscópica (Simon’s clamp) para preservar el parenquima renal.

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clamp Aesculap®) sin control vascular del hilio renal. La reconstrucción renal fue la utilizada regularmente.

**Resultados:** La edad promedio fue de 49,6 años (42-59) con una relación hombre/mujer 3:1. El tiempo operatorio promedio fue de 71,6 min (40-120). El sangrado estimado promedio fue de 250 ml (50-400). El tamaño tumoral promedio fue de 3,25 cm (1,5-5,3). No hubo complicaciones peripooperatorias ni postoperatorias. La estancia media hospitalaria fue de 3,5 días (1-7). No hubo complicaciones hemorrágicas intra ni postoperatorias. El examen patológico de las lesiones reveló carcinoma renal en 3 casos y quiste hemorrágico en un caso. No hubo márgenes quirúrgicos positivos.

**Conclusiones:** Nuestros resultados preliminares muestran que la NPR con compresión regional del parénquima renal es una alternativa quirúrgica factible en pacientes seleccionados y tumores de localización polar, proporcionando un campo quirúrgico adecuado para la resección tumoral.

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**Introduction**

The incidental finding of renal tumors has been a consequence of the frequent application of imaging techniques in the study of non-specific abdominal symptoms. This change has resulted in a migration of the diagnosis of renal tumors of lower size and better nuclear differentiation, subject to sparing renal surgery.**1** Laparoscopic partial nephrectomy (LPN) was initially applied to tumor lesions smaller than 4 cm, of favorable anatomical location (T1a), expanding then to tumors of technically more complex location and larger lesions (T1b).**2,3** However, laparoscopic surgery is technically difficult, it requires a long learning curve, and it is not exempt from serious complications. This type of procedure is restricted to experienced surgeons because of the risk of vascular injury during the dissection and transient occlusion of the renal hilum, as well as the need to reduce the warm ischemia time during tumor resection, minimizing the deterioration of the renal function.**3,4**

In 2009, Simon et al. described performing LPN with renal parenchymal compression and without renal hilar occlusion in 3 patients with tumor of polar location, using laparoscopic Simon’s clamp (Simon’s Clamp Aesculap AG, Tuttlingen, Germany).**5** We further describe our initial experience with robotic partial nephrectomy (RPN) performing selective renal parenchymal compression without renal hilar clamping using Simon’s clamp.

**Materials and methods**

We review the surgical results in 4 patients who underwent renal parenchymal compression, without vascular control, of a personal series of 60 robot-assisted partial nephrectomies. The data were collected prospectively and analyzed retrospectively. Preoperative evaluation included computed tomography and/or MRI, with vascular phase reconstruction. We studied the tumor location, the size, the clinical stage, the operative time, the compression time of the renal parenchyma, the pathological stage, the surgical margins, and the complications.

**Surgical technique**

We used the transperitoneal pathway in all cases. The patient is placed in lateral decubitus position and secured to the operating table, with protection of pressure zones. We conduct Veress needle pneumoperitoneum classically. All the procedures were performed with a technique with 4 robotic arms and 30° optics, using 2 additional trocars: one for the helper and the other for the laparoscopic Simon’s clamp (Figs. 1 and 2). The renal hilum is dissected identifying the vein and artery, which are marked with a vascular elastic for eventual control if necessary. Laparoscopic Simon’s clamp is placed (Aesculap AG, Tuttlingen, Germany) through a 12-mm trocar (Fig. 3) around the tumor, 1–2 cm proximal to the resection line producing regional ischemia. The tumor is dissected with cold scissors and renal reconstruction is subsequently performed with Monocryl® 3-0 continuous suture in the calyceal-vascular plane and a second parenchymal plane with separated sutures of Vicryl® 2-0 with CT-1 needle, with the Hem-O-Lok® staple sliding technique described by Benway et al.**6** According to our

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**Figure 1** Open laparoscopic Simon’s clamp.

**Figure 2** Closed laparoscopic Simon’s clamp.
Figure 3 Operative photography of right robotic partial nephrectomy. The Simon’s clamp is observed placed through a suprapubic 12-mm port.

protocol, we did not perform freeze biopsy during the procedure.

Results

Perioperative data are summarized in Table 1. The mean operative time, from the initial incision to the skin closure, was 117.6 min (range 54-205 min). The average estimated bleeding was 250 ml (50-400), obtaining a clean surgical field, and there were no perioperative complications. The mean hospital stay was 3.5 days (range: 1-7 days). The average tumor size was 3.6 cm (1.5-5.3). The pathologic examination of the lesions revealed renal carcinoma in 3 cases with negative surgical margins and hemorrhagic complex cyst in one case.

Discussion

During the last 10 years, partial nephrectomy has become the gold standard for the treatment of renal masses smaller than 7 cm with equivalent oncologic outcomes to radical surgery, better preservation of the renal function, and overall survival compared with radical nephrectomy in selected patients.

The contemporary techniques of partial nephrectomy (open, laparoscopic, and robotic) typically include temporary clamping of the renal hilum, creating an operative field with little bleeding, allowing for precise tumor resection and subsequent adequate renal repair. Castillo et al. emphasize that the considerations that must be made regarding the LPN deal with the possible complications related to the dissection and a delicate treatment of the renal pedicle. The hilar clamping produces ischemic injury in the kidney, which may compromise the long-term functional results.

Lane et al. conducted a study which analyzes the preoperative and postoperative creatinine to estimate the glomerular filtration rate in 1169 patients who underwent partial nephrectomy; they concluded that the warm ischemia time is the most important modifiable surgical risk factor risk in the decline of the renal function after partial nephrectomy, demonstrating the need for a warm ischemia time ≤30 min to prevent permanent kidney damage. However, some researchers have suggested that every minute is vital when the renal hilum is clamped during the PN.

Early withdrawal of the renal hilum clamp has been described after the first suture plane during kidney repair in patients where full clamping of the renal hilum was applied, in order to reduce the warm ischemia time. However, this technique has been limited to surgeons with extensive experience in laparoscopy. We also used radiofrequency ablation in the resection site without renal hilum clamping, minimizing the warm ischemia, although with the drawback that tissue carbonization occurs at the surgical margin, limiting the pathology review.

Gill et al. recently described a technique for RPN called ‘zero ischemia’ without clamping of the renal hilum, in which hypotension is induced by inhalation of anesthetic gas (isoflurane), in order to completely remove the surgical ischemia to the renal remnant; requiring preoperative administration of intravenous crystalloids to expand the intravascular volume, Swan-Ganz catheter in the pulmonary artery, intraoperative measurement of the central venous pressure, arterial catheter, transesophageal echocardiography, and bispectral electroencephalography, among others.

It has been reported that the changes in serum creatinine and intraoperative oxygenation profiles improved during partial nephrectomy in pigs using parenchymal selective compression or partial clamping of the renal artery, as compared with completely clamping of the renal artery.

Verhoest et al. described the use of the laparoscopic Satinsky clamp for temporary clamping of the renal parenchyma during the LPN; however, this mechanism is not able to keep the pressure of occlusion constant.

In 2009, Simon et al. described performing LPN with selective control of the renal parenchyma without renal hilar occlusion in 3 patients with polar localization tumor, using the laparoscopic Simon’s clamp (Aesculap® AG, Tuttingen, Germany). The 3 patients had scarce bleeding without perioperative complications and negative surgical margins.

Viprakasit et al. described the use of the Simon’s clamp in RPN in 3 selected patients, which showed no perioperative complications and had negative surgical margins.

We recently presented our initial experience in robot-assisted LPN. In this paper we describe the technique and initial experience in RPN with renal parenchymal compression by using a Simon’s clamp without clamping of the renal hilum; in our limited experience we show a surgical field with minimal bleeding during tumor resection. The virtues

Table 1 Demographic characteristics of the patients.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
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<tbody>
<tr>
<td>Male/female</td>
<td>3/1</td>
</tr>
<tr>
<td>Age (years)</td>
<td>49.6 (42-59)</td>
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<tr>
<td>Body mass index</td>
<td>27.1 (32-22)</td>
</tr>
<tr>
<td>ASA</td>
<td>1.6 (1-3)</td>
</tr>
<tr>
<td>Side (right/left)</td>
<td>2/2</td>
</tr>
<tr>
<td>Tumor location</td>
<td></td>
</tr>
<tr>
<td>Upper pole</td>
<td>2</td>
</tr>
<tr>
<td>Lower pole</td>
<td>2</td>
</tr>
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of the da Vinci robotic system in image magnification and articulation of the instruments are widely known; particularly the use of the fourth robotic arm has many advantages, such as kidney mobilization and support, being able thus to show a better angle for the Simon’s clamp placement around the renal parenchyma, and it also gives us the opportunity to have a better view of the plane of tumor resection and comfortable renal reconstruction. Our preliminary results are encouraging, since all patients had little bleeding, no perioperative complications, and negative resection margins. We believe that this technique can play an important role in reducing the potential renal damage associated with complete clamping of the renal hilum.

Conclusion

Our initial experience shows that robotic partial nephrectomy with clamping of the renal parenchyma and without renal vascular control is a viable alternative in the conservative management for patients with stage T1 renal tumors, of polar anatomical location.

Conflict of interest

Dr. Octavio A. Castillo holds the position of Proctor of the da Vinci robot (Intuitive Surgical Inc.) for Latin America. The remaining authors declare no conflict of interest.

References