Resumen.- OBJETIVO: Presentar nuestra experiencia inicial en tres casos en los cuales se realizó el clamping selectivo del polo inferior renal mediante la utilización de un novedoso clamp laparoscópico.

MÉTODO: Se realizaron tres nefrectomías parciales laparoscópicas con el clamping de Simon, evitando clamping hilar. Los pacientes presentaron una edad promedio de 67 años (rango 60 a 74 años), dos pacientes fueron masculinos. Todos presentaban un riesgo anestésico ASA II. El tamaño tumoral promedio fue de 2.2 cm (rango 2 a 2.4 cm) y todos los tumores eran de polo inferior. Dos tumores eran derechos y uno izquierdo.

RESULTADO: El tiempo operatorio promedio fue de 100 minutos (rango 70 a 120 min). El sangrado promedio fue de 16 ml (rango 0 a 50 ml). El tiempo promedio de isquemia caliente del polo clampado fue de 33 minutos (rango 30 a 40 min). Todos los pacientes fueron dados de alta al segundo día postoperatorio. No hubo complicaciones peri ni postoperatorias. Todos los márgenes quirúrgicos fueron negativos.

CONCLUSIÓN: El clamping de Simon permite una resección tumoral sin sangrado y una reparación del lecho tumoral en ausencia de daño renal colateral. Esperamos que en el futuro se desarrollen otros tipos de instrumentos que permitan la aplicación del clampaje selectivo a cualquier situación tumoral.

Keywords: Laparoscopy. Renal tumor. Partial nephrectomy. Renal ischemia.

INTRODUCTION

Given the current body of evidence, it’s beyond question the need to perform nephron sparing nephrectomy in all cases where it is technically possible. Nephron sparing is justified by the 26% prevalence of glomerular...
filtration under 60 ml/s in the healthy population and the identical oncological results between nephron sparing and radical nephrectomy in the treatment of T1 disease (1).

However, this evidence has spread at the same time as renal laparoscopic surgery was developing. Due to this fact many patients that could have been candidates of nephron sparing surgery underwent unnecessary nephrectomies in the hands of enthusiasts laparoscopic surgeons.

After laparoscopic radical nephrectomy was standardized, several authors developed techniques of laparoscopic nephron sparing surgery with different ways of renal pedicle clamping (1). Technical complexity and the need for fast renal suturing limited laparoscopic partial nephrectomy from becoming a common technique among urological surgeons.

To decrease ischemia time and to aid laparoscopic renal repair, the industry has developed different devices to make this technique easier and safer. The use of Lapra-tie (KC 200, Ethicon) and Hem-o-lok clips (Weck Closure Systems) in both extremes of the running suture used to repair the renal defect has decreased warm ischemia time and the development of new hemostatic agents has improved intra and postoperative bleeding.

However, not until recent years, laparoscopic surgeons have acquired the ability to perform renal selected ischemia by means of a novel clamp (Simon’s clamp Aesculap - Figure 1) (2). The particularity of this device is that it allows for selective ischemia of the tumor area avoiding warm ischemia of the rest of the renal parenchyma. We report our preliminary experience with the Simon’s clamp.

**CASE 1**

A 74 year old male, with history high blood pressure and left mastectomy for breast carcinoma was diagnosed a 2.4 cm right inferior pole renal mass during a routine abdominal ultrasound. CT scan confirmed the lesion and described it as hypervascular and heterogeneous (Figure 2). After counselling the patient on current small renal mass treatment options, laparoscopic nephron sparing surgery was decided. Surgical time was 110 minutes and bleeding was 50 ml. Warm ischemia time of renal pole was 30 minutes.

The patient evolved uneventfully and was discharged on the second postoperative day.

Final surgical specimen analysis showed a 2 cm renal cell carcinoma, Fuhrman 2 with negative margins and the absence of perirenal fat invasion (G2 pT1a).
CASE 2

A 68 year old male patient with a history of renal stones and high blood pressure is diagnosed with a 2 cm left inferior pole renal lesion during a routine renal ultrasound. A CT scan showed that the lesion was contrast enhanced. Laparoscopic partial nephrectomy was indicated. Surgical time was 120 minutes and bleeding was minimum. Warm ischemia time of renal pole was 40 minutes. The patient was discharged on postoperative day two. Pathological analysis showed a 2 cm clear cell renal carcinoma, Fuhrman 1 with negative margins (G1 pT1a).

CASE 3

A blind 60 year old female patient with a history of moderate chronic obstructive pulmonary disease was diagnosed with a right renal lesion during a routine abdominal ultrasound. A 2.5 cm right renal lesion was confirmed during CT scan. The lesion was located on the lower pole and enhanced with contrast. The patient underwent laparoscopic partial nephrectomy. Surgical time and bleeding was 70 minutes and 0 ml respectively. Warm ischemia time of renal pole was 30 minutes. The patient evolved uneventfully and was discharged on postoperative day two. A 2 cm oncocitoma was found on final pathological analysis.

Demographic data and surgical outcomes are summarized on Table I.

Surgical technique

Under general anesthesia, bladder and orogastric catheters are placed, and the patient is placed on a right or a left flank position depending on which kidney is operated.

Antibiotic prophylaxis is done with a first generation cephalosporin. Using a Veress needle a 12 mmHg pneumoperitoneum is created. Classic laparoscopic partial nephrectomy trocar disposition is used adding a 12 mm epigastic trocar for clamp introduction (Figure 3). Mobilization of the right or left colon is performed in order to view the inferior pole of the kidney. After opening Gerota’s capsule, the lower renal pole parenchyma is exposed. The clamp is then introduced through the epigastric trocar and placed on the lower renal pole taking care to leave enough margin to avoid clamp slipping (Figure 4). The clamp is gradually closed until a cleft in the renal parenchyma is evident and a resistance at the clamp grip is felt. The tumor border is then marked using a monopolar hook and tumor resection is performed (Figure 5). Once tumor resection is complete with satisfactory margins, the first continuous suture is done using a 3-0 vycril with a SH needle. Final repair is completed by interrupted suture using the technique described by Gill et al. (1).

DISCUSSION

Whether it be laparoscopic or open, nephron sparing surgery is mainly limited by warm ischemia time. Time needed to perform partial nephrectomy is directly related to tumor location, size, surgeon skills and surgical approach. Renal artery clamping is necessary in order to keep renal bleeding to a minimum allowing for better visualization and easier parenchyma repair.

Predominant aerobic metabolism makes renal parenchyma very sensible to warm ischemia. Early studies in canine models suggested that warm ischemia could be well tolerated for 30 to 90 minutes (3). However, to extrapolate these results to a human model is at least speculative taking into account that most renal units that undergo partial nephrectomy have at least one or more intrinsic anomalies (3). The cellular damage associated with ischemia and reperfusion has been well documented in the transplanted kidney. After a clamp is placed on the renal artery, vascular and inflammatory changes take place, which in turn lead to arteriolar vasoconstriction determining a decrease in glomerular filtration rate and urine production. Also free radicals associated with these changes cause glomerular damage (3). Routine manitol infusion may decrease these changes and prevent renal damage (3). During warm ischemia, adenosine triphosphate is converted to adenosine monophosphate releasing energy that will be used for cellular function and integrity. When this energy is consumed cellular environment

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex</th>
<th>Age</th>
<th>ASA</th>
<th>Tumor size (cm)</th>
<th>Tumor location</th>
<th>Op time (min)</th>
<th>Op bleeding (ml)</th>
<th>WIT (min)</th>
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Table I. RK – right kidney, FK – Left kidney, WIT – warm ischemia time, RCC – renal cell carcinoma.
changes to anaerobic, membrane transport fails allowing for massive influx of salt and water into the cell leading to edema and cell death (4). Although warm ischemia time is controversial, recent studies suggest that it should not exceed a 20 minute limit whenever possible (5).

Warm ischemia during partial nephrectomy is associated with an increased risk of acute renal failure when compared with partial nephrectomy without hilar clamping. However this is not reflected on a higher rate of dialysis. Despite this not being associated with a higher dialysis rate, decreased renal function increases risk of cardiovascular morbidity and non-cancer related death (4).

Predominantly exofitic tumors without parenchyma invasion may be excised without renal pedicle clamping. Nevertheless, patients treated without clamping have increased intraoperative blood loss (5 % vs. 2%) and increased risk of urinary fistulas (5% vs. 1%) than those treated with pedicle clamping.

Nephron sparing surgery performed by selective clamping of renal pole by means of manual compression or by the aid of a parenchyma clamp is associated with less glomerular damage than complete pedicle clamping.

The clear advantages of laparoscopy over open surgery in terms of postoperative pain, hospital stay and convalescence make this approach preferable in most cases. However, limitations previously described make laparoscopic partial nephrectomy not always feasible. Recent developments aim to lessen collateral nephron damage during laparoscopic partial nephrectomy. This maybe achieved by perfecting repairing techniques and decreasing warm ischemia time or by performing selective warm ischemia in which repairing time becomes irrelevant.

Selective ischemia of tumor area is a frequent practice in open surgery and can be done by manual compression or by the use of different suture techniques like the one described by Kim et al. This idea was adopted by laparoscopic surgeons giving birth to hand assisted laparoscopic partial nephrectomy (1). However, this was gradually displaced by the development of safer pedicle clamping techniques. Also, nephron sparing laparoscopic nephrectomy with hand assistance generally requires an incision larger than the tumor treated. Currently hand assistance techniques are used during the early stages of the learning curve or when a conservative treatment of a large tumor (more than 4 cm) is attempted.

With the intention of avoiding renal pedicle clamping during laparoscopic partial nephrectomy, Guillonneau et al compared 12 patients with vascular clamp against 16 without renal pedicle control during nephron sparing laparoscopic nephrectomy. Blood loss in the no-clamp group was significant greater (708 vs. 270 ml; p=0.014) ass was operation time (3 vs. 2 hours; p=0.004). However, post operatory creatinine levels were not significantly different (1.3 vs. 1.45 mg/dl; p=0.08) (6). The authors demonstrated that some vascular control whether hilar or peritumoral should be attempted in order to minimize intraoperative bleeding.

During early laparoscopic partial nephrectomies, pedicle clamping was performed by introducing bulldog clamps commonly used in open surgery through the 12 mm trocar incision. Although arterial compression was effective, intracorporeal manipulation was difficult and a vicryl suture was attached in order to avoid accidental loss in the abdominal cavity.

It was then that Rosales et al described their Rummel clamp, which was made using common and easy to find elements (7). After that, several companies have
developed different clamps, Satinsky (Storz) and bull-dogs clamps specific for laparoscopic approach (Aesculap), which facilitated placement and removal during surgery.

Despite the clear technological progress that makes secure vascular clamping possible, the maximum ischemia time that a kidney can resist has not changed. That is why focus has shifted to performing a correct peritumoral vascular control and avoiding unnecessary injury to the remaining parenchyma.

For this purpose the Simon clamp was developed allowing for laparoscopic nephron sparing nephrectomy without pedicle clamping in polar tumors. The first experience recently published by Simon was in 3 cases with tumors of 2.4, 2.6 and 3.2 cm respectively with excellent vascular control (2). However, there hasn’t been any experience published in the Ibero-American literature.

Although renal pedicle clamping may be avoided in these cases, we suggest renal pedicle dissection in order to be ready in the event of requiring an emergency clamping in case of massive bleeding.

**CONCLUSION**

This clamp is a contribution to the continuous evolution of laparoscopic techniques. The Simon clamp allows for tumor resection without bleeding and for renal defect repair without collateral renal injury. We hope that in future the development of other instruments will allow selective clamping in any tumor location.

**REFERENCES AND RECOMMENDED READINGS**

(*of special interest, **of outstanding interest)


