SKILL AND TALENT

Simplified renorrhaphy using self-retaining barbed suture during laparoscopic partial nephrectomy∗

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KEYWORDS
Laparoscopic partial nephrectomy; Renorrhaphy; Sutures

Abstract
Introduction and objectives: Laparoscopic partial nephrectomy (LPN) is a challenging procedure that requires quick and effective intracorporeal suturing that could limit widespread adoption. Refinements of surgery have improved warm ischemia times and facilitated renal reconstruction. We present a technique that makes renorrhaphy easier using self-retaining barbed suture (SRBS) weaving two threads.

Patients and methods: Two patients with carcinoma of the kidney, 3.4 and 1.5 cm, respectively, were subjected to the LPN. The SRBS is an absorbable polyglucanate with small projections along its axis which are anchored in the tissue, distributing the tension of the suture line and eliminating the need for knots. Renorrhaphy was performed using the SRBS by two continuous suture lines without knots, setting the sutures with clips of Hem-o-lok® and adjusting it with the technique of “sliding clip”, without placing “bolsters” inside the renal parenchymal defect.

Results: Operative time was 156 min and 163 min, intraoperative bleeding was 50 ml and 850 ml, the warm ischemia time was 14.3 min and 23 min and follow-up time was 7 months and 3 months in the first and second cases, respectively. The hospital stay was 5 days and there were no postoperative complications.

Conclusions: Simplified renorrhaphy using SRBS is effective, hemostatic, facilitates the renal reconstruction, and can help reduce the warm ischemia time.
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PALABRAS CLAVE
Nefrectomía parcial laparoscópica; Renorrafía; Suturas

Renorrafía simplificada empleando sutura barbada durante la nefrectomía parcial laparoscópica

Resumen
Introducción y objetivos: La nefrectomía parcial laparoscópica (NPL) es una intervención desafiante que requiere sutura intracorpórea rápida y efectiva, lo que limita su aplicación de forma extendida. Refinamientos de la cirugía han mejorado los tiempos de isquemia y facilitado la reconstrucción renal. Se presenta una técnica que simplifica al máximo la renorrafia empleando sutura barbada de auto-retención (SBAR) entrelazando dos hilos.

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Introduction

The development of laparoscopic and robotic surgery has allowed for the minimally invasive surgical procedures to obtain oncologic outcomes comparable to those of partial nephrectomy in renal masses smaller than 7 cm.\(^1\,\text{2}\) Laparoscopic partial nephrectomy (LPN) is a technically challenging procedure, which requires the acquisition of skills in advanced laparoscopic suture to perform renal reconstruction quickly under the pressure of the ischemia time. This makes this technique involve a long learning curve and a limited application to centers of excellence in laparoscopy.\(^2\,\text{3}\) Multiple refinements of the technique have been proposed to facilitate the preparation of the renorrhaphy during the LPN and decrease the ischemia times.\(^1\,\text{6}\,\text{7}\,\text{8}\)

Together, new suture materials have been developed, such as the so-called self-retaining barbed suture (SRBS), which has allowed for reconstructive procedures in a more simple and safe way.\(^7\,\text{9}\,\text{10}\,\text{11}\) In order to facilitate renal reconstruction during LPN, we present a simplified renorrhaphy technique using the SRBS.

Patients and methods

Two patients with renal mass <4 cm were included, suitable for treatment by partial nephrectomy. The first case was a 47-year-old male patient with an incidental renal mass of 3.4 cm in the union of the upper and middle third of the left kidney. The second case was a 52-year-old female patient with a history of non-Hodgkin's lymphoma, with a neoproliferative injury of 1.5 cm in the upper pole of the left kidney.

Both patients underwent LNP with the simplified renorrhaphy technique using SRBS by transperitoneal approach with 4 trocars.

The SRBS (V-Loc\(^\text{®}\) 90 Absorbable Wound Closure Device-Covidien) is a copolymer of absorbable polygluconate with small projections, in the form of bars or pins, which are deployed helically along the thread axis.\(^7\,\text{11}\) This suture has been used effectively in urological reconstructive procedures, such as the urethrevesical anastomosis during the robotic radical prostatectomy.\(^12\)

Using the principle described by Van Velthoven et al.\(^\text{13}\) for the urethrevesical anastomosis with a single knot, two suture wires were intertwined by their end to obtain 2 needles on a single thread with bidirectional barbs.\(^7\)

Surgical technique

The procedure starts with the dissection and exposure of the renal hilum, followed by the release of renal fat to clear tumor exposure. Using monopolar cautery, the resection line is demarcated from the ring of normal renal parenchyma surrounding the tumor. The barbed suture is introduced into the cavity, and a first suture is placed on the outer edge of the incision, leaving the securing knot of the 2 sutures on the outside of the renal capsule (Fig. 1A and B). We proceed to selective clamping of the renal artery with ‘Bulldog’ vascular clamp. Using cold cut, the tumor is resected maintaining suction with the cannula for clear exposition of the resection bed. Renorrhaphy starts with two continuous suture planes, one deep and one shallow without any knots. Using the needle that was previously passed, renal reconstruction began starting with the deep level, including repair of the collecting system defects when these occurred (Fig. 2A–C). The last suture on this plane passes through the thickness of the renal cortex to externalize the thread, and it is secured with a Hem-o-lok\(^\text{®}\) clip using the technique of the ‘sliding clip’ described by Benway et al.\(^\text{1,3}\) (Fig. 3A). In this maneuver, the surgeon tightens the wire and centers it in the jaws of the stapler, so as to place the staple on the suture; then, the clip is pushed perpendicular to the renal capsule, in order to slide it on the suture toward the kidney up to a suitable renal parenchymal apposition. With this it is possible to adjust and readjust the tension without the need for knot\(^\text{1,3}\) (Fig. 3B–D). Next, a second plane of renorrhaphy on a surface level for the closure of the renal capsule is performed, using the other needle and the remaining thread. The needle is passed through the parenchyma and the renal capsule, on both sides of the defect, again performing continuous suture. Unlike the previous plane, each point is fixed by placing Hem-o-lok\(^\text{®}\) clips applied according to the same technique of the ‘sliding clip’ (Fig. 4A and B). The clamp of the renal artery is released and the hemostasis is checked. Two Hem-o-lok\(^\text{®}\) clips are placed at the level of the last suture for safety. A Jackson-Pratt drainage is introduced and the clamp is removed by an endobag. Additionally, the suture line is covered with a loose sheet of Surgicel.
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Results

The operative time was 156 and 163 min, the intraoperative bleeding was 50 ml and 850 ml, the warm ischemia time was 14.3 and 23 min, and the follow-up time was 7 and 3 months in the first and second case, respectively. In both patients, the hospital stay was 5 days and there were no postoperative complications. In the second case, there was inadvertent slippage of the Bulldog vascular clamp during the renorrhaphy, therefore, an intraoperative bleeding occurred, requiring blood transfusion.

Discussion

The LPN is a complex surgical technique with a long learning curve, and with significant complication rates, even in expert hands, intra- and postoperative bleeding, urinary fistulas, transfusion requirements, and positive surgical margins can often occur. That is why its application has been limited to centers with high experience in laparoscopy. However, contemporary innovations, in particular the advent of robotic surgery and the refinements of renorrhaphy, have simplified the procedure, shortening the learning curve, and reducing ischemic times, expanding its applicability as a real alternative to open surgery. These innovative renorrhaphy techniques can make the LPN more accessible to many laparoscopic urologists outside the academic centers of excellence.

Barbed sutures have recently been introduced, which are useful in complex reconstructive procedures, as they present retainers (by way of barbs or pins) that enable to evenly distribute the tension along the suture line and maintain optimal apposition of the tissues to obtain a better closure. Its application in renal reconstruction during the LPN has been described; however, there are few publications so far. Shikanov et al. conducted the first study on swine using barbed suture for closure of the collecting system and the renal parenchyma. Sammon et al. described that they adopted the SRBS in their standard practice for conducting the LPN, due to the advantages of shortening the learning curve and reducing the ischemic times.

To our knowledge, this is the first article in the Spanish medical literature to use the barbed suture in the LPN. As evidenced in the above-mentioned series, we believe that because the SRBS pins are anchored to the tissues, in addition to ensuring a good apposition, it enables to achieve a hemostatic closure of the renal parenchyma. These characteristics also prevent the suture line from loosening, avoiding the need to maintain a constant traction on the thread with the non-dominant hand of the surgeon, allowing them to have both hands free. This facilitates renorrhaphy and it could be favorably reflected in the ischemic time.

The most demanding surgical step during the LPN is the suture of the renal defect, which is why the refinements during the evolution of the technique focus on simplifying the renorrhaphy. In a review article recently published by Ghani and Anderson, the three major innovations that have simplified renal reconstruction are shown. The first is the implementation of renorrhaphy by means of continuous suture, allowing for a quicker closure and providing a better initial hemostasis. Similarly, Cáceres et al. recently reported a series of 60 patients undergoing LPN applying the closure by means of continuous suture with good results. The second relevant refinement corresponds to the concept of the knotless suture facilitating the procedure by eliminating the need to knot, fixing the thread with staples (Lapra-Ty® or Hem-o-lok®). However, during robotic surgery, this maneuver had a limitation, since this technique requires the assistant to place the clip, the responsibility of the adjustment of the suture line of the renorrhaphy lies with them. This motivated Benway et al. to devise the third refinement, called 'sliding clip' renorrhaphy, using a Hem-o-lok® to allow the surgeon a precise control over the tension of the suture line and to reset it. Currently, this maneuver is considered the method of choice to adjust the knotless thread, because it provides a closing pressure higher than other techniques, without tearing the renal parenchyma.

Finally, we consider that the placement of the bolster of
Figure 2  Following the tumor resection, the raffia of the deep plane is started, by means of a continuous suture line, which includes the repair of defects of the collecting system. (A and B) Schematic view. (C) Laparoscopic view.

Figure 3  ‘Sliding clip’ technique for adjustment of the suture line using a Hem-o-loc® clip without knotting. (A) The surgeon tightens the thread and centers it between the jaws of the stapler of the Hem-o-loc®. (B) Placement of the clip on the suture. (C) The laparoscopic clamp pushes down the clip by sliding it on the thread toward the renal capsule. (D) The adjustment of the clip is made up to achieving an adequate apposition with the renal parenchyma.
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Figure 4  Raffia of the surface plane for the closure of the renal capsule by means of a second line of continuous suture. (A) Schematic view. The needle passes through the parenchyma and the renal capsule, on both sides of the defect, and each suture is fixed by placing Hem-o-lok® clips applied according to the technique of the 'sliding clip'. (B) Laparoscopic vision of the culminated renorrhaphy, where the apposition of the tissues at the level of the line of the defect and the presence of the fixation and tension adjustment clips.

Various materials within the defect of the renal parenchyma should fall into disuse, as its routine practice has been questioned and its application could rather complicate the raffia and prolong the ischemic times. Tsivian et al.,\(^2\) and Weight et al.\(^3\) concluded that the use of these hemostatic elements must be reserved for those patients with large renal defects. There are no studies showing benefits of the conventional use of the bolster beyond the surgeon's sense of 'feeling safe'.\(^3\) Based on these refinements, we decided to apply them to our center with a technique that simplifies the renorrhaphy of the LPN to the maximum, jointly using the SRBS to add the benefits of this material in facilitating the raffia and reducing the ischemic times.\(^7,11\) In the simplified renorrhaphy, we made two continuous sutures without knots, fixing the threads with clips and adjusting to the technique of the 'sliding clip', and without the use of bolster.

The effectiveness of the renorrhaphy in two suture planes has been widely described.\(^1-7\) Most authors agree on making a deep plane by means of a continuous suture line that may include the pyelo-calyceal systems. The closure of the second plane, however, is made with an interrupted suture line for safety by many.\(^2,3,9,10,12\) In our cases, we make the two planes of the renorrhaphy with continuous suture, for being the fastest and easiest technique, but also considering the qualities of apposition and hemostasis of the barbed suture, together with fixation of the thread with Hem-o-lok® clips between each suture, readjusted with the technique of the 'sliding clip', we can say that we obtained a safety equal or higher than that of a conventional interrupted plane.

Our second patient had intraoperative bleeding due to accidental and inadvertent displacement of the Bulldog clamp, thus requiring transfusion. Some authors\(^1,2\) have reported this complication of poor control of the renal pedicle. Nevertheless, we believe that in our case the SRBS facilitated the raffia and enabled to perform it more quickly and effectively to control the hemostasis.

Thus, we conclude that simplified renorrhaphy using SRBS is a relatively simple technique, which significantly facilitates renal reconstruction, is effective to ensure an adequate hemostasis, and could decrease the ischemia times. However, in order to obtain satisfactory results, it should be reserved for renal tumors of up to 4 cm, of peripheral anatomic location, to ensure full accessibility of the tumor defect and to allow for an appropriate placement of the suture. More studies are needed to determine the definitive role of the SRBS and of the simplified renorrhaphy during the LPN.

Conflict of interest

The authors declare that they have no conflict of interest.

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