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Original Article

Minimally invasive nephrectomy for inflammatory renal disease

Paula Andrea Peña [a], Lynda Torres-Castellanos [b], Germán Patiño [c], Stefanía Prada [b], Luis Gabriel Villarraga [b], Nicolás Fernández [d,e,f,*]

[a] *Pontificia Universidad Javeriana, School of Medicine, Bogotá D.C., Colombia*
[b] *Department of Urology, Hospital Universitario San Ignacio, Pontificia Universidad Javeriana, School of Medicine, Bogotá D.C., Colombia*
[c] *Division of Urology, Hospital Universitario San Ignacio, Pontificia Universidad Javeriana, Bogotá D.C., Colombia*
[d] *Division of Urology, Hospital Universitario San Ignacio, Pontificia Universidad Javeriana, School of Medicine, Bogotá D.C., Colombia*
[e] *Department of Urology, Fundación Santa Fe de Bogotá, Colombia*
[f] *Division of Urology, Hospital for SickKids, University of Toronto, Toronto, Canada*

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Abstract *Objective:* Once chronic inflammatory renal disease (IRD) develops, it creates a severe peri-fibrotic process, which makes it a relative contraindication for minimally invasive surgery (MIS). Our objective is to show that laparoscopic nephrectomy (LN) is a surgical option in IRD with fewer complications and better outcomes.
Methods: Retrospective review of patients who underwent a modified-surgical laparoscopic transperitoneal nephrectomy was performed. Data search included all operated patients between May 2013 and May 2018 that had a pathology result with any renal inflammatory condition (xanthogranulomatous pyelonephritis, chronic nephritis, and renal tuberculosis). We describe intra-operative variables such as operative time, blood loss, conversion rate, postoperative complications and length of hospital stay.
Results: There were 51 patients who underwent laparoscopic nephrectomy with a confirmatory pathology report for IRD. We identified four (8%) major complications; three of them required transfusion and one conversion to open surgery. The mean operative time was 233±108 min. Mean estimated blood loss was 206±242 mL excluding the conversion cases and 281±423 mL including them. The mean length of hospital stay was 3.0±2.0 days.

* Corresponding author. Department of Urology, Hospital Universitario San Ignacio and Pontificia Universidad Javeriana, Bogotá D.C., Colombia.
E-mail addresses: fernandez.j@javeriana.edu.co, nicolasfernandezb@gmail.com (N. Fernández).
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Conclusion: Laparoscopic nephrectomy for IRD can safely be done. It is a reproducible technique with low risks and complication rates. Our experience supports that releasing the kidney first and leaving the hilum for the end is a safe approach when vascular structures are embedded into a single block of inflammatory and scar tissue.
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1. Introduction

Inflammatory renal disease (IRD) is a group of chronic conditions that affect the kidney and develops an inflammatory process that extends beyond the renal parenchyma [1]. This process can be promoted by obstruction of the urinary tract specially by stones [1]. These chronically non-functioning kidneys are removed in most cases when they are associated with pain, recurrent urinary tract infections, or renovascular hypertension [1,2].

In the past decades, the open nephrectomy has been considered as the standard of care for this condition. However, this approach is related to wide, painful incisions with higher risk of surgical site infections, higher analgesic dose requirements, longer hospital stays and prolonged convalescence periods [1,2]. Due to the significant inflammatory process, the difficult dissection of the renal pedicle and adhesions to adjacent organs, makes this operation a technically demanding approach for minimally invasive surgery (MIS). In fact, some physicians consider IRD a relative contraindication for MIS [1—5]. MIS conversion rates in these type of cases is about 28% [1]. In addition, laparoscopic nephrectomy (LN) requires extensive experience for minimizing vascular and adjacent organ injuries that can be present in 18% of the procedures [3—7].

According to Robson's surgical description, the renal hilum should be approached before perirenal or ureteric dissection is performed, however we want to present our experience treating patients with IRD who benefit from a different surgical technique. Hereby we present a modified surgical approach where we start dissection outside Gerota's fascia leaving the hilum to the end [7,8].

2. Materials and methods

After obtaining Hospital San Ignacio review board approval, we retrospectively reviewed the records of 51 patients who underwent a LN for IRD in a large tertiary-care center between May 2013 and May 2018. Included cases were the following: Interstitial nephritis, chronic pyelonephritis, renal tuberculosis and xanthogranulomatous pyelonephritis.

Medical records of all patients were reviewed. The analyzed variables included patient's demographics, preoperative diagnosis based on images (computed tomography [CT], magnetic resonance imaging [MRI], ultrasound and/or renal scintigraphy), and intraoperative variables such as operative time, blood loss, need for open conversion, length of hospital stay, intra and postoperative complications following the Clavien-Dindo classification.

After data collection, we calculated the mean and standard deviation of the operative time, blood loss and length of hospital stay for all 51 patients, including both, those who required conversion and those who did not. Then, we did the same statistical analysis excluding patients with conversion to open surgery. Following this, we obtained the percentage of patients with mild and severe peri-surgical complications. We applied the Clavien-Dindo's classification to the post-surgical complications.

3. Surgical technique

LN was considered an option for all inflammatory renal units, preferring transperitoneal approach for all cases. Patient positioning and prepping follow the usual laparoscopic approach in a semi lateral decubitus position. No significant bed breaking is usually required. Patient is well secured and padded to the surgical table, as tilting might be necessary during the procedure. For trocar placement, we use three trocars of 10 mm for adult patients and for pediatric patients 3 mm or 5 mm depending on patient's weight. For the placement of the first trocar we always perform a Hasson's open technique at the base of the belly-button. Subsequent trocars are placed at the subcostal region at Palmer's point and the other trocar above the iliac spine at the anterior axillar line. If the case can be completed with those three ports, we try to avoid the need of a fourth one. The fourth port is usually needed to retract the liver. For this purpose, we used a trocar of 5 mm.

For right cases, we begin to mobilize the colon by reflecting it medially with Ligasure®. Ureter is identified and dissected towards the lower pole of the kidney. We tend to avoid ureteral ligation if mobilization of the colon seems easy, otherwise an early ligation and transection of the ureter are performed with polymer locking ligation system and Ligasure®. The Gerota's fascia is not opened in the majority of cases.

If possible, we try to reach the hilum and expose it, but if it is too challenging, we complete the kidney's dissection first by releasing the adhesions circumferentially and leaving the hilum for the end. Sometimes hilar vessels are so severely compromised that it is difficult to dissect each vascular structure separately. In those cases, we perform transection in-block using a vascular stapler. Kidney is then extracted through the umbilical port by extending the incision as much as needed. We use drainage systems in selected cases, for instance, if there is significant spillage of purulent secretions during the procedure. Indwelling urethral catheter is left in place for 1 day. Recently, we

have been performing transversus abdominis plane (TAP) blocks for postoperative pain control in all of our patients.

4. Results

We included 51 patients with any IRD in the histopathology report who underwent modified-laparoscopic nephrectomy technique. The demographic data of our cohort are summarized in Table 1. Left side nephrectomy was performed in 59% of the cases. A positive history of urolithiasis was present in 49% of the cases, followed by urinary tract infections (UTI) (37%), high blood pressure (HBP) (31%) and Type II diabetes mellitus (DM II) (10%). We identified 14 patients with anatomic abnormalities of urinary tract.

All patients had presurgical diagnoses according to renal and urinary tract image that suggested a probable cause of renal dysfunction or severe damaged kidney. We identified two cases of nephron-intestinal fistulas (pyeloduodenal and pyelocolonic) at the moment of surgical dissection, two cases (5%) as mis-diagnosed neoplasia, four (10%) cases of pyonephrosis and one case (3%) of emphysematous pyelonephritis. Most of the cases had severe pyonephrosis (60%). According to pathology results, there were six cases (12%) of xanthogranulomatous pyelonephritis (XGP), 43 cases (84%) of chronic nephritis, one case of renal abscess and one case of renal tuberculosis.

Four patients (8%) developed severe intraoperative complications that risked patients' life. There were two cases of vascular injury, one in the inferior vena cava and the other in the superior segmental branch of renal artery. In the first case, there was bleeding of 2 500 mL; we converted to open surgery, and clamped inferior vena cava; a vascular surgeon assisted us in the vascular repair. In the second case, we clamped proximally the superior segmental branch of renal artery; with a non-absorbable synthetic suture, we approached both sides of the artery and proved that there were not blood leaks. It did not required conversion to open surgery. There was also one diaphragmatic injury and one colon perforation. The hemidiaphragmatic left-sided injury was corrected by a chest surgeon; however he first did a thoracostomy previous correction. The colon perforation produced hemoperitoneum (bleeding of 1 150 mL), with subsequent hypovolemic shock, poly-transfusion requirement and right hemicolectomy done by the gastrointestinal surgeon. Three of these complications required transfusion.

Additionally, to the two conversion cases previous mentioned, there was a third case consisting in a pyelocolonic fistula that required right hemicolectomy. The total conversion rate to open surgery was 5%. From the three cases of conversion, two were right sided and two had HBP.

For post-operative complications, there were four (8%) cases classified as severe and four as mild complications (6%). Two patients received full anticoagulation after the procedure for acute myocardial infarction (AMI) and pulmonary thromboembolism (PTE) respectively. One patient required reintervention for evisceration 5 days after first surgery with no other complications. Other developed postoperative pleural effusion not related to diaphragmatic lesion relieved with thoracostomy. Mild complications consisted in two cases of surgical site infection (SSI) that were treated with antibiotics, one dehisced the skin incision and one presented ileum that resolved with medical treatment (the same one that presented the AMI) (Table 2). All these patients with postoperative complications were 50% right-sided and 50% left-sided. Four of them had HBP and one had DM II.

The mean operative time for patients who did not required conversion to open surgery was 223±99 min, for the conversion ones was 400±144 min and for all the 51 patients was 233±108 min, ranging between 90 min and 660 min. The mean estimated blood loss for patients who did not required conversion to open surgery was 206±242 mL, for the conversion ones was 1 483±898 mL and for all the patients was 281±423 mL, with a range of 50–2 500 mL. The mean length of hospital stay after surgery was 3.0±2.0 days, being longer for the converted ones compared to the no converted ones (5.7±2.0 days *vs.* 2.9±2.0 days), ranged between 1 and 13 days (Table 3).

Table 1 Demographic data of patients with inflammatory renal disease.

Demographic data	*N*=51
Age, range, year	1–68
Sex, *n* (%)	
Women	39 (76)
Men	12 (24)
Side, *n* (%)	
Right	21 (41)
Left	30 (59)
Personal history, *n* (%)	
Urolithiasis	25 (49)
UTI	19 (37)
HBP	16 (31)
VUR	7 (14)
DM II	5 (10)
Ureteral stricture	11 (21)
Primary obstructive megaureter	1 (2)
Duplex collecting system	1 (2)
Neurogenic bladder	1 (2)

DM II, type II diabetes mellitus; HBP, high blood pressure; UTI, urinary tract infection; VUR, vesicoureteral reflux.

Table 2 Post-operative complications classified by Clavien-Dindo's grading system.

Post-surgical complications	Clavien-Dindo score	*N*=51
Pleural effusion	IIIa	1
Dehiscence	I	1
SSI	II	2
Ileum	II	1
AMI	IVa	1
PTE	IVa	1
Evisceration	IIIb	1

AMI, acute myocardial infarction; PTE, pulmonary thromboembolism; SSI, surgical site infection.

Table 3 Operative data on inflammatory renal conditions.

Parameter	No conversion to open surgery, $n=48$ (94%)	Conversion to open surgery, $n=3$ (6%)	Total, $n=51$
Operative time, mean±SD, min	223±99	400±144	233±108
Estimated blood loss, mean±SD, mL	206±242	1 483±898	281±423
Days hospitalized, mean±SD, day	2.9±2.0	5.7±2.0	3.0±2.0

5. Discussion

The inflammatory renal conditions develop an inflammation process compromising the renal parenchyma and adjacent renal structures [1]. IRD is usually secondary to renal infections promoted by obstruction of the urinary tract, specially by stones [1]. In our Colombian context, complicated urolithiasis has become a very frequent disease due to the delay of surgical intervention which leads to the development, in most cases, of chronic non-functional inflammatory kidneys [9]. Because of this, it is important to reduce the morbidity and mortality of these patients by selecting the best surgical approach.

The demographic data reported in the present article highlight the predominance of these diseases in women (76%), described also in other publications [10,11]. The most common comorbidities were urolithiasis and UTI, as reported in the literature [10–12]. The pyeloduodenal fistula was related to XGP, previously reported by one of the authors due to its low rate presentation [13]. In other studies, similar to the present one, reported that hydronephrosis, kidney enlargement, poor excretion of contrast medium and air in the urinary tract were some of the common findings in urologic imaging [10]. The misdiagnosed neoplasia is also a frequent feature, especially in XGP, considered the "Great imitator" [11,14–16].

The nephrectomy is the first line of treatment for a chronic non-functioning inflammatory kidney disease, especially when patients present severe lumbar pain, recurrent urinary tract infections or renovascular hypertension [4,17]. The minimally invasive nephrectomy is the modality of choice for benign renal diseases; however, inflammatory conditions have been considered a relative contraindication for this surgical approach [4,17]. Most surgeons prefer to perform open surgery for IRD due to the technical challenging dissection of these kidneys. Most recently, surgeons have accumulated a vast experience in laparoscopy, supporting the possibility of performing LN for IRD [1,2]. However, complications and conversion rates are not uncommon [4,6,7,18].

Since Robson's technical description of early vascular control and subsequent dissection of the rest of the kidney, surgeons have continued to perform nephrectomies with this principle [8]. In our series we modified this approach and left the hilum for last. Dissection was completed by mobilizing the kidney, usually around Gerota's fascia. Authors who have performed a similar approach have reported a 28% conversion rate due to intraoperative vascular or intestinal injuries [1].

In 1998 Doehn et al. [19] reported that there were no significant differences in operative times and complication rates between laparoscopic and open nephroureterectomy in patients with benign renal disease (including IRDs). Additional to this, minimally invasive approach has lower needs of postoperative analgesics, shorter hospital stays, shorter times to achieve full ambulation and faster returns to daily activities [19]. Tobias-Machado and associates [3], also reported 20 successful minimally invasive procedures, including transperitoneal and retroperitoneal approach, as a feasible option for IRDs. In this way, these publications allowed urologists to consider the LN a suitable option for IRD, however it needed more research.

Of the 51 patients in our cohort, we documented only four (8%) surgical severe complications and four (8%) severe post-surgical complications classified by Clavien-Dindo grading system. If we compare these results to Duarte et al. [1], we had similar surgical and post-surgical complications. These results allowed us to confirm that the LN can have minimal complications despite the abundant adhesion and fibrosis process.

Liang et al. [2] analyzed the experience in LN with a method of outside Gerota's fascia dissection and en-block ligation and division of the renal pedicle similar to our reported cases. They reported 11% of conversions to hand-assisted laparoscopy and only one conversion to open nephrectomy. Mean operative time was 99.6±29.2 min, blood loss was 75.2±83.5 mL and average hospital stay was 4.8±1.4 days [2]. Comparing these results to our study, we had longer operative time and more bleeding, considering the conversion and non-conversion groups. Nonetheless, we had lower conversion rates (6%) and our length of hospital stay was shorter compared to theirs (3.0±2.0 days). We used a similar laparoscopic technique by beginning with renal release at the lower pole completing the dissection outside Gerota's fascia dissection, then lifting the upper pole preserving the adrenal gland and finally resecting the renal pedicle en-block or dividing them and occluding the vascular structures with Hem-O-Lok vascular clips. These studies are the most recent researches about this topic, concluding both that laparoscopic nephrectomy has minimal morbimortality in those patients with IRD.

XGP is a chronic inflammatory process in most cases due to renal parenchyma infection secondary to tract urinary obstruction [20]. In 2007, Vanderbrink and associates [21] reported LN had longer operative times but shorter postoperative hospital stay compared to open surgery, without any differences in blood loss, transfusion rates or analgesics. Lima et al. [22] found that the time to control renal vessels (32±18 min), renal length greater than 12 cm and right-sided nephrectomy were some predictive factors associated with a higher conversion rate in laparoscopic approach. In our cohort, there were six cases of XGP, with

only one conversion, one severe intraoperative complication (diaphragmatic perforation) and no postoperative complications. Since this study was retrospective, it was difficult for us to have all the length of all the kidneys, however we could see that there was more conversion to open surgery for right-sided patients, and for patients who had HBP. In the postoperative complications, most of the cases had HBP and one DM II.

The non-functioning tuberculous kidney was also considered a relative contraindication for LN, not only for its technical difficult dissection, but also because of the high risk of spillage of caseous material into the peritoneal cavity with subsequent dissemination of the disease [23]. Nevertheless, in a more recent publication Kim et al. [18] described the experience in 12 patients with renal tuberculosis managed with LN, who presented minor complications and only one conversion. In this study we reported a single case of tuberculous pyelonephritic nonfunctioning kidney, with excellent outcomes, no conversion required, no leaking of caseous material and no postoperative complications.

Finally, our study has a series of limitations. It is a retrospective design that took the study subjects from a single center of Colombia. In this way, we have a limited sample with results that could not be extrapolated to all the population; however, it suggests the idea of minimally invasive surgery in patients with IRD. In the same way, we had lack of control group of open nephrectomies. This gives way up to perform prospective studies and clinical trials that compare open approach and minimally invasive nephrectomy with this modified surgical technique, which could support the laparoscopic approach as the first-line treatment done by expert urologists.

6. Conclusion

Laparoscopic nephrectomy for IRD can safely be done. It is a reproducible technique with low risks and complication rates despite the surgical challenge it represents. Our experience supports that releasing the kidney first and leaving the hilum for the end is a safe approach when vascular structures are embedded into a single block of inflammatory and scar tissue. There were minimal surgical and post-surgical complications, few conversions to open nephrectomy, blood loss, operative time and days hospitalized. As we accumulate clinical experience with laparoscopy, we will decrease even more the morbimortality of this approach in IRD.

Conflicts of interest

The authors declare no conflict of interest.

Author contributions

Study concept and design: Nicolás Fernández.
Data acquisition: Paula Andrea Peña.
Data analysis: Paula Andrea Peña, Luis Gabriel Villarraga.
Drafting of manuscript: Paula Andrea Peña, Lynda Torres-Castellanos, Stefanía Prada.
Critical revision of the manuscript: Nicolás Fernández, Lynda Torres-Castellanos.

References

[1] Duarte RJ, Mitre AI, Chambô JL, Arap MA, Srougi M. Laparoscopic nephrectomy outside gerota fascia for management of inflammatory kidney. J Endourol 2008;22:681—6.
[2] Liang M, Yanlan Y, Guangju G, Gonghui L. Laparoscopic nephrectomy outside gerota fascia and *en bloc* ligation of the renal hilum for management of inflammatory renal diseases. Int Braz J Urol 2018;44:280—7.
[3] Tobias-Machado M, Lasmar MT, Batista LT, Forseto PH, Juliano RV, Wroclawski ER. Laparoscopic nephrectomy in inflammatory renal disease: proposal for a staged approach. Int Braz J Urol 2005;31:22—8.
[4] Shekarriz B, Meng MV, Lu HF, Yamada H, Duh QY, Stoller ML. Laparoscopic nephrectomy for inflammatory renal conditions. J Urol 2001;166:2091—4.
[5] Manohar T, Desai M. Laparoscopic nephrectomy for benign and inflammatory conditions. J Endourol 2007;21:1323—8.
[6] Rassweiler J, Fornara P, Weber M, Janetschek G, Fahlenkamp D, Henkel T, et al. Laparoscopic nephrectomy: the experience of the laparoscopy working group of the German Urologic Association. J Urol 1998;160:18—21.
[7] Keeley FX, Tolley DA. A review of our first 100 cases of laparoscopic nephrectomy: defining risk factors for complications. Br J Urol 1998;82:615—8.
[8] Robson CJ, Churchill BM, Anderson W. The results of radical nephrectomy for renal cell carcinoma. J Urol 1969;101:297—301.
[9] Quiñones A, Arenas J, Fernández N. Medical and social prognostic factors associated with urolithiasis in patients undergoing flexible ureteroscopy and laser lithotripsy. Urol Colomb 2016;27:67—73.
[10] Korkes F, Favoretto RL, Bróglio M, Silva CA, Castro MG, Perez MD. Xanthogranulomatous pyelonephritis: clinical experience with 41 cases. Urology 2008;71:178—80.
[11] Malek RS, Eldert JS. Xanthogranulomatous pyelonephritis: a critical analysis of 26 cases and of the literature. J Urol 1978;119:589—93.
[12] Arvind NK, Singh O, Ali Q, Gupta SS, Sahay S. Laparoscopic nephrectomy in xanthogranulomatous pyelonephritis: 7-year single-surgeon outcome. Urology 2011;78:797—801.
[13] Puerto NA, Torres CL, Ramos UJG, Silva HJM, Rueda TC, Cataño CJG. Fístula pieloduodenal en paciente con pielonefritis xantogranulomatosa: primer reporte de caso en Latinoamérica. Urol Colomb 2017;26:229—33.
[14] Khaira HS, Shah RB, Wolf JS. Laparoscopic and open surgical nephrectomy for xanthogranulomatous pyelonephritis. J Endourol 2005;19:813—7.
[15] Petronic V, Buturovic J, Isvaneski M. Xanthogranulomatous pyelonephritis. Br J Urol 1989;64:336—8.
[16] Zorzos I, Moutzouris V, Korakianitis G, Katsou G. Analysis of 39 cases of xanthogranulomatous pyelonephritis with emphasis on CT findings. Scand J Urol Nephrol 2003;37:342—7.
[17] Joshi AA, Parashar K, Chandran H. Laparoscopic nephrectomy for xanthogranulomatous pyelonephritis in childhood: the way forward. J Pediatr Urol 2008;4:203—5.
[18] Kim HH, Lee KS, Park K, Ahn H. Laparoscopic nephrectomy for nonfunctioning tuberculous kidney. J Endourol 2000;14:433—7.
[19] Doehn C, Fornara P, Fricke L, Jocham D. Comparison of laparoscopic and open nephroureterectomy for benign disease. J Urol 1998;159:732—4.

[20] Rosoff JS, Raman JD, Del Pizzo JJ. Feasibility of laparoscopic approach in management of xanthogranulomatous pyelonephritis. Urology 2006;68:711—4.
[21] Vanderbrink BA, Ost MC, Rastinehad A, Anderson A, Badlani GH, Smith AD, et al. Laparoscopic versus open radical nephrectomy for xanthogranulomatous pyelonephritis: contemporary outcomes analysis. J Endourol 2007;21:65—70.
[22] Lima M, Miyaoka R, Moro J. Laparoscopic nephrectomy for xanthogranulomatous pyelonephritis—Are there predictive factors for success? Clinics (Sao Paulo) 2012;67:907—9.
[23] Gupta NP, Agrawal AK, Sood S. Tubercular pyelonephritic nonfunctioning kidney—Another relative contraindication for laparoscopic nephrectomy: a case report. J Laparoendosc Adv Surg Tech 1997;7:131—4.