Open surgery versus retroperitoneal laparoscopic nephrectomy for renal tuberculosis: a retrospective study of 120 patients

Su Zhang ¹, You Luo ¹, Cheng Wang ¹, Hu Xiong ¹, Sheng-Jun Fu ¹, Li Yang Corresp. ¹

¹ Department of Urology, Lanzhou University Second Hospital, Lan Zhou, China

Corresponding Author: Li Yang
Email address: professoryanglj@163.com

Background Laparoscopic renal surgery has been widely used in the treatment of renal diseases. However, there is still little research about its application in addressing renal tuberculosis. The purpose of this study is to retrospectively investigate the surgical results of laparoscopic and open surgery for nonfunctional tuberculous kidneys.

Methods Between May 2011 and June 2016, 120 nephrectomies were performed in patients with a nonfunctional tuberculous kidney. Of these, 69 patients underwent retroperitoneal laparoscopic nephrectomy, and 51 patients underwent open nephrectomy. Data about the patients’ characteristics and surgical outcomes were collected from their electronic medical records. Outcomes were compared between these two groups.

Results Our results showed that a number of renal tuberculosis patients presented no significant symptoms during their disease. Lower urinary tract symptoms (LUTS) were the most common at a rate of 73/120, followed by flank pain or accidentally discovery (66/120), urine abnormality (30/120) and fever (27/120). Patients who underwent open surgery were similar to laparoscopic patients with regard to sex, BMI, location, previous tuberculous history, grade, anemia, adhesion, hypertension, diabetes and preoperative serum creatinine level, but were generally older than laparoscopic patients. There were no significant differences between open and laparoscopic surgery in estimated blood loss, transfusion, postoperative hospital days and perioperative complication rate. However, the median operation time of laparoscopic operation was much longer than open surgery (180 [150-225] vs 135 [120-165] minutes, P<0.01). Seven of the 69 laparoscopic operations were converted to open surgery because of severe adhesions.

Conclusion Laparoscopic nephrectomy is as an effective treatment as open surgery for a nonfunctional tuberculous kidney, although it requires more time during the surgical procedure. No significant differences in other surgical outcomes were observed.
Open surgery versus retroperitoneal laparoscopic nephrectomy for renal tuberculosis: a retrospective study of 120 patients

Su Zhang*, You Luo*, Cheng Wang, Hu Xiong, Sheng-Jun Fu, Li Yang.

Institute of Gansu Nephro-Urological Clinical Center, Institute of Urology, Department of Urology, Key Laboratory of Urological Disease of Gansu Province, Lanzhou University Second Hospital, Lanzhou, Gansu, China

Corresponding Author:

Li Yang

No. 82 Cuiyingmen, Lanzhou, Gansu, 730000, China

Email address: professoryangli@163.com.

Su Zhang and You Luo contributed equally to this work.
Abstract

Background

Laparoscopic renal surgery has been widely used in the treatment of renal diseases. However, there is still little research about its application in addressing renal tuberculosis. The purpose of this study is to retrospectively investigate the surgical results of laparoscopic and open surgery for nonfunctional tuberculous kidneys.

Methods

Between May 2011 and June 2016, 120 nephrectomies were performed in patients with a nonfunctional tuberculous kidney. Of these, 69 patients underwent retroperitoneal laparoscopic nephrectomy, and 51 patients underwent open nephrectomy. Data about the patients’ characteristics and surgical outcomes were collected from their electronic medical records. Outcomes were compared between these two groups.

Results

Our results showed that a number of renal tuberculosis patients presented no significant symptoms during their disease. Lower urinary tract symptoms (LUTS) were the most common at a rate of 73/120, followed by flank pain or accidently discovery (66/120), urine abnormality (30/120) and fever (27/120). Patients who underwent open surgery were similar to laparoscopic patients with regard to sex, BMI, location, previous tuberculous history, grade, anemia, adhesion, hypertension, diabetes and preoperative serum creatinine level, but were generally older than laparoscopic patients. There were no significant differences between open and laparoscopic
surgery in estimated blood loss, transfusion, postoperative hospital days and perioperative complication rate. However, the median operation time of laparoscopic operation was much longer than open surgery (180 [150-225] vs 135 [120-165] minutes, P<0.01). Seven of the 69 laparoscopic operations were converted to open surgery because of severe adhesions.

Conclusion

Laparoscopic nephrectomy is as an effective treatment as open surgery for a nonfunctional tuberculous kidney, although it requires more time during the surgical procedure. No significant differences in other surgical outcomes were observed.
**Introduction**

In recent years, the resurgence of tuberculosis has become a subject of global interest, particularly for developing countries, due to drug resistance of the *Mycobacterium tuberculosis* and population mobility (Organization). Renal tuberculosis is a kidney-destructive disease and comprises one of the most common types of extrapulmonary tuberculosis (Fader et al. 2010). In many patients, the disease has already progressed to the end stages before they consult their doctors. The standard treatment for a nonfunctional tuberculous kidney is a nephrectomy combined with anti-tuberculosis chemotherapy. The laparoscopic technique was considered contraindicated for resecting a kidney with tuberculosis because the disease caused severe adhesion and perinephritis. However, with the development of new techniques and increased experience, the laparoscopic operation is no longer contraindicated for experienced laparoscopic surgeons (Kim et al. 2000; Lee et al. 2002). In this paper, we aim to summarize recent developments in nephrectomies and compare the outcomes of laparoscopic operations with open surgery.

**Material and Methods**

**Patient population**

From May 2011 to June 2016, surgical records from patients treated by nephrectomy with unilateral nonfunctioning kidney secondary to renal tuberculosis were collected from the Department of Urology in Lanzhou University Second Hospital in this case-control study, after the approval of the Ethics Committee of Lanzhou University Second Hospital(Number: 2016A-076). Preoperative laboratory (e. g. , urine smear for acid-fast bacilli, urine polymerase chain
reaction for acid-fast bacilli) and imaging examinations (e. g., renal ultrasonography, computerized tomography, intravenous pyelogram, ) were conducted in patients suspected of renal tuberculosis, who were also conformed finally by postoperative pathological diagnosis. The patients who had abdomen operation history or underwent other surgeries simultaneously were excluded from the study.

In total, 120 consecutive patients including 51 patients underwent open nephrectomies and 69 patients underwent laparoscopic nephrectomies were enrolled in this study. Each tuberculous patient received anti-tuberculosis chemotherapy 2 weeks prior to surgery and was prescribed six to nine months of postoperative chemotherapy (5 mg/kg isoniazid orally once daily, 10 mg/kg rifampicin orally once daily, 15 mg/kg ethambutol orally once daily, with or without 10 mg/kg pyrazinamide orally twice daily). All of the surgeries were performed using the retroperitoneal approach by three senior surgeons who had performed at least 50 nephrectomies with each of the two surgical approaches. The kidneys were evaluated before surgery and confirmed to be nonfunctional by intravenous urography or radionuclide renogram. The surgical approaches (laparoscopic vs open) were selected mainly depending on patient and surgeon preference. The decision to convert to open surgery was made by the surgeons during the procedure. The basic characteristics of patients included in the study included their primary symptoms including their chief complaint, age, sex, body mass index (BMI), resected kidney location (right or left), previous history of tuberculosis, adhesion of perirenal tissue, preoperative serum creatinine level, anemia, hypertension, diabetes and their American Society of Anesthesiologists (ASA) grade.

Electronic medical records and the designated entries for “Chief complaint” and “Present illness”
were used to collect data on biographical information and medical history. The patient’s ASA grade was obtained from the anesthesiology records, and their adhesion status was gathered from descriptions by the operating surgeon. Additional information was gathered regarding the following surgical-relevant outcomes: operation time, estimated blood loss, administration of transfusion, postoperation hospital days, perioperative complications, and conversion to open surgery.

**Outcomes and Statistics**

Perioperative complications were defined as any of the following symptoms or conditions: fever, abdominal distention or ileus, abscess or infection of the incision area, and seroma volume of drainage with more than 200 ml and classified according to the Clavien-Dindo grading system (Dindo et al. 2004). Normality was measured using the Shapiro-Wilk test. Non-normal parameters were presented as median ranges (interquartile range: IQR), and the Mann-Whitney test was used to test the difference. Normal outcomes were presented as the mean ± standard deviation (SD), and independent t-test samples were used for comparison. Chi-square test was used for counting data, and MedCalc Statistical Software version 15.5 (MedCalc Software bvba, Ostend, Belgium) was used to perform statistical evaluations. A two-sided P < 0.05 was considered statistically significant.

**Results**

The basic characteristics of included patients are shown in Table 1. Open nephrectomy patients with a mean age of 44.57 years old were greater than laparoscopic patients with a mean age of 39.06 years old (P=0.02). Only four were over 65 years old, and the youngest was 17 years old.
The age of entire cohort ranged from 17 to 67 years old. Previous tuberculosis history was present in 20 patients. There were 59 patients with moderate to severe adhesion and 26 patients with anemia. No statistical significance was observed between open nephrectomy and laparoscopic nephrectomy by sex, BMI, surgical location, ASA grade, moderate to severe adhesion rate, anemia, hypertension, diabetes, or preoperative serum creatinine level. Additionally, data about the symptoms patients indicated as their chief complaint was collected and classified into four categories: lower urinary tract symptoms (LUTS), flank pain or accidentally discovery, urine abnormality (hematuria or cloudy urine) and fever. The rate of each symptom was demonstrated as LUTS (73/120), flank pain or accidentally discovery (66/120), urine abnormality (30/120) and fever (27/120). It is noteworthy that 23 of the 120 patients only complaint of flank pain or fatigue and seven cases were accidentally discovered. Renal tuberculosis is often asymptomatic and is difficult to diagnose.

Table 2 lists the surgical outcomes of the two treatment options. Seven laparoscopic cases were converted to open nephrectomy. The median operation time was 135 minutes (IQR: 120-165 minutes) for open surgery and 180 minutes (IQR: 150-225 minutes) for laparoscopic nephrectomy (P<0.01). All postoperative complications were grade 1 according to Clavien-Dindo classification. There was no significant difference between open nephrectomy and laparoscopic nephrectomy in estimated blood loss, transfusion rate, postoperative hospital days and perioperative complication rates (Table 2).

**Discussion**

The 2015 global tuberculosis report showed that there were an estimated 9.6 million new TB
cases and China accounted for 10% of the world’s TB cases ranking second in the world (Organization). According to the National Health and Family Planning Commission of PRC, there were 95,924 new TB cases in August (PRC 2016) and 1,918 new cases in Gansu province citing the Health and Family Planning Commission of Gansu (Gansu 2016). As the data show, the people in Gansu have a high incidence of tuberculosis, and furthermore seek medical advice with relative delay. The manifestation of tuberculosis is increasingly atypical. Unfortunately, the prevalence of drug-resistant strains of the tuberculosis bacterium is increasing (Lee et al. 2015). Latent tuberculosis presents great challenges in terms of diagnosis and treatment (Getahun et al. 2015). Renal tuberculosis is a severe organ-destroying disease. The majority of symptomatic outpatients has progressed to the end stages and has a nonfunctional kidney. According to the 2005 EU guideline, the drug treatment is the first line therapy for renal tuberculosis (Cek et al. 2005). However, patients in Gansu usually present end stage and the surgical excision of non-functioning kidneys or highly destructive lesion is unavoidable.

As our results describe, 23 of 120 patients only presented with flank pain or fatigue, symptoms they had previously ignored, and seven patients were discovered accidently. Huang et al surveyed 239 cases of renal tuberculosis. In their study, 94 of the 239 renal tuberculosis cases were atypical. The main symptoms experienced by the typical group were lower urinary tract symptoms, flank pain, hematuria and fever, etc. In addition, flank pain was regarded as the major complaint in the atypical group (Huang et al. 2013). Wang et al also confirmed these findings (Wang et al. 2016). A previous history of tuberculosis was observed in twenty patients in our cohort. Huang et al reported that nearly 50% (125/239) of renal tuberculosis patients had a
tuberculosis history or extrarenal findings in radiological images (Huang et al. 2013). Therefore, we can conclude that tuberculosis history is a good clue for the diagnosis of renal tuberculosis (Cek et al. 2005).

The use of the laparoscopic technique has become very popular among surgeons for dealing with renal diseases. However, renal tuberculosis challenges this application because of its severe adhesion and perinephritis. Both of these obstacles could contribute to the need to convert to open surgery during the laparoscopic procedure. All surgery was performed by retroperitoneal laparoscopic approach. Compared with transperitoneal laparoscopic nephrectomy, retroperitoneal laparoscopic nephrectomy has several advantages, particularly for patients with normal anatomy (Fan et al. 2013; Garg et al. 2014; Zhang et al. 2013). Although one study reported 10 laparoscopic nephrectomies using the transperitoneal approach and 21 using the retroperitoneal approach, the comparison between the two approaches was not conducted in the results (Lee et al. 2002). Hence, the advantages and disadvantages between the two laparoscopic approaches could not be identified from previous researches. In 2000, Hemal et al compared nine retroperitoneoscopic nephrectomies with nine open nephrectomies for a nonfunctional tuberculous kidney, and their work showed no significant differences between operative times, blood loss and complications. Retroperitoneal nephrectomy is associated with significantly shorter hospital days and recovery time, and less analgesic is required than in open surgery (Hemal et al. 2000; Hemal et al. 2007; Zhang et al. 2005b). Unfortunately, our study could not calculate the difference in the levels of analgesics used for postoperative pain therapy because patient-controlled intravenous analgesia was used in some postoperative patients. In addition, our
results show a longer operation time in laparoscopic group (median 180min) than open group (median 135 min) that is consistent with the result of Hemal's study to a certain extent (Hemal et al. 2000). However, compared with existing reports in which surgical time of laparoscopic approach ranged from mean 92 min to mean 244 min (Lee et al. 2002; Tian et al. 2015; Zhang et al. 2005b), the median time of our operations was 180 min and this difference may be due to the selection of patients or the surgical experience.

In 1998, among 5 patients with renal tuberculosis treated by laparoscopic nephrectomy, four patients (80%) suffered the conversion to open surgery because of difficult dissection of the severe adhesions (Rassweiler et al. 1998). Then Zhang et al reported 12 successful retroperitoneoscopic nephrectomies without conversion to open operation for an infective nonfunctioning kidney with dense perinephric adhesions (Zhang et al. 2005a). Additionally, they also confirmed the operability and advantages of retroperitoneal laparoscopic nephrectomy for renal tuberculosis by comparing 22 successful laparoscopic with 22 open nephrectomies (Zhang et al. 2005b). Recently Tian et al reported 51 consecutive patients with tuberculous nonfunctioning kidney treated by laparoscopic nephrectomy and there was only one case required conversion to open surgery due to non-progression of dissection (Tian et al. 2015). The present research presented nearly 10 percent of conversion to open surgery and the good news is all these surgical conversion resulted from uncompleted dissection of the severe adhesions without any vascular injury or visceral injury. Thus, perinephric adhesions should not be considered an absolute contraindication to laparoscopic nephrectomy and the comprehensive preoperative evaluation, the delicate surgical technique and the accumulation of surgical
experiences are very important to complete laparoscopic nephrectomy for tuberculous nonfunctioning kidneys successfully. There were some discrepancies within our study, and the results could thus be attributed to sample size and a more recent time period. We have noted that this study was a retrospective. Selection bias was unavoidable. Randomized controlled trials with a larger sample size are needed to confirm these results.

**Conclusion**

Laparoscopic nephrectomy is as an effective treatment as open nephrectomy for a nonfunctional tuberculous kidney. Although the laparoscopic procedure takes longer than the open surgery, no significant differences in other surgical outcomes were observed.
References

Cek M, Lenk S, Naber KG, Bishop MC, Johansen TE, Botto H, Grabe M, Lobel B, Redorta JP, and Tenke P. 2005. EAU guidelines for the management of genitourinary tuberculosis. *Eur Urol* 48:353-362. 10.1016/j.eururo.2005.03.008

Dindo D, Demartines N, and Clavien PA. 2004. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg* 240:205-213.

Fader T, Parks J, Khan NU, Manning R, Stokes S, and Nasir NA. 2010. Extrapulmonary tuberculosis in Kabul, Afghanistan: a hospital-based retrospective review. *International Journal of Infectious Diseases* 14:e102-110. 10.1016/j.ijid.2009.03.023

Fan X, Xu K, Lin T, Liu H, Yin Z, Dong W, Huang H, and Huang J. 2013. Comparison of transperitoneal and retroperitoneal laparoscopic nephrectomy for renal cell carcinoma: a systematic review and meta-analysis. *BJU Int* 111:611-621. 10.1111/j.1464-410X.2012.11598.x

Gansu HaFPCo. 2016. August 2016 Gansu tuberculosis report. Available at [http://www.gsws.gov.cn/html//2016/09-09/6dc48ed0-0082-48fc-a09f-28e11c18a3bf.html](http://www.gsws.gov.cn/html//2016/09-09/6dc48ed0-0082-48fc-a09f-28e11c18a3bf.html) (accessed September 2016). September 2016).

Garg M, Singh V, Sinha RJ, and Sharma P. 2014. Prospective randomized comparison of transperitoneal vs retroperitoneal laparoscopic simple nephrectomy. *Urology* 84:335-339. 10.1016/j.urology.2014.04.038

Getahun H, Matteelli A, Chaisson RE, and Raviglione M. 2015. Latent Mycobacterium tuberculosis infection. *N Engl J Med* 372:2127-2135. 10.1056/NEJMra1405427

Hemal AK, Gupta NP, and Kumar R. 2000. Comparison of retroperitoneoscopic nephrectomy with open surgery for tuberculous nonfunctioning kidneys. *J Urol* 164:32-35.

Hemal AK, Kumar A, Kumar R, Wadhwa P, Seth A, and Gupta NP. 2007. Laparoscopic versus open radical nephrectomy for large renal tumors: a long-term prospective comparison. *J Urol* 177:862-866. 10.1016/j.juro.2006.10.053

Huang HC, Li X, and Jin J. 2013. [Epidemiology and clinical features of renal tuberculosis: 239 cases report]. *Beijing Da Xue Xue Bao* 45:600-604.

Kim HH, Lee KS, Park K, and Ahn H. 2000. Laparoscopic nephrectomy for nonfunctioning tuberculous kidney. *J Endourol* 14:433-437. 10.1089/end.2000.14.433

Lee HY, Lee J, Lee YS, Kim MY, Lee HK, Lee YM, Shin JH, and Ko Y. 2015. Drug-resistance pattern of Mycobacterium tuberculosis strains from patients with pulmonary and extrapulmonary tuberculosis during 2006 to 2013 in a Korean tertiary medical center. *Korean J Intern Med* 30:325-334. 10.3904/kjim.2015.30.3.325

Lee KS, Kim HH, Byun SS, Kwak C, Park K, and Ahn H. 2002. Laparoscopic nephrectomy for tuberculous nonfunctioning kidney: comparison with laparoscopic simple nephrectomy for other diseases. *Urology* 60:411-414.

Organization WH. Global tuberculosis report 2015. Available at [http://apps.who.int/iris/bitstream/10665/191102/1/9789241565059_eng.pdf?ua=1](http://apps.who.int/iris/bitstream/10665/191102/1/9789241565059_eng.pdf?ua=1) (accessed October 2015).

PRC NHaFPCo. 2016. August 2016 national tuberculosis report. Available at [http://www.nhfpc.gov.cn/jkj/s3578/201609/6dc46a3f8d874da7941beb56e5378fd7.shtml](http://www.nhfpc.gov.cn/jkj/s3578/201609/6dc46a3f8d874da7941beb56e5378fd7.shtml) (accessed
September 2016).

Rassweiler J, Fornara P, Weber M, Janetschek G, Fahlenkamp D, Henkel T, Beer M, Stackl W, Boeckmann W, Recker F, Lampel A, Fischer C, Humke U, and Miller K. 1998. Laparoscopic nephrectomy: the experience of the laparoscopy working group of the German Urologic Association. *J Urol* 160:18-21.

Tian X, Wang M, Niu Y, Zhang J, Song L, and Xing N. 2015. Retroperitoneal Laparoscopic Nephroureterectomy for Tuberculous Nonfunctioning Kidneys: a single-center experience. *Int Braz J Urol* 41:296-303. 10.1590/s1677-5538.ibju.2015.02.16

Wang J, Fan S, Xiao J, and Liang CZ. 2016. Renal tuberculosis tends to be low symptoms: how to improve the diagnosis and treatment of renal tuberculosis. *Asian J Androl* 18:145-146. 10.4103/1008-682x.150839

Zhang X, Ma X, Li HZ, Chen Z, Li LC, and Ye ZQ. 2005a. Retroperitoneoscopic subcapsular nephrectomy for infective nonfunctioning kidney with dense perinephric adhesions. *BJU Int* 94:1329-1331.

Zhang X, Zheng T, Ma X, Li HZ, Li LC, Wang SG, Wu ZQ, Pan TJ, and Ye ZQ. 2005b. Comparison of retroperitoneoscopic nephrectomy versus open approaches to nonfunctioning tuberculous kidneys: a report of 44 cases. *J Urol* 173:1586-1589.

Zhang ZL, Li YH, Luo JH, Liu ZW, Yao K, Dong P, Han H, Qin ZK, Chen W, and Zhou FJ. 2013. Complications of radical nephrectomy for renal cell carcinoma: a retrospective study comparing transperitoneal and retroperitoneal approaches using a standardized reporting methodology in two Chinese centers. *Chin J Cancer* 32:461-468. 10.5732/cjc.012.10185
Table 1 (on next page)

Characteristics and comparative results of open versus laparoscopic surgery for renal tuberculosis

Annotation: The interval in the parenthesis is interquartile range and the number before parenthesis is the median value; Scr- serum creatinine;

* Chi-square test;
** Fisher’s exact test;
※ Independent samples t-test;
& Mann-Whitney test.
Table 1. Characteristics and comparative results of open versus laparoscopic surgery for renal tuberculosis.

|                          | Total | Open nephrectomy | Laparoscopic nephrectomy | P value |
|--------------------------|-------|------------------|--------------------------|---------|
| No. of pts               | 120   | 51               | 69                       | -       |
| Age (years)              | 41.40±12.55 | 44.57±13.0       | 39.06±11.74              | 0.02 ★  |
| Sex (female/male)        | 55/65 | 27/24            | 28/41                    | 0.18*   |
| BMI                      | 22.6 ± 3.35 | 22.39±2.95       | 22.76±3.63               | 0.55★   |
| Location (left/right)    | 63/57 | 27/24            | 36/33                    | 0.93★   |
| Previous tuberculous history (yes/no) | 20/100 | 9/42            | 11/58                    | 0.80★   |
| ASA grade                |       |                  |                          |         |
| I                        | 8     | 5                | 3                        | 0.21★   |
| II                       | 106   | 42               | 64                       |         |
| III                      | 6     | 4                | 2                        |         |
| Moderate-to-severe adhesion (yes/no) | 59/61 | 28/23            | 31/38                    | 0.28★   |
| Anemia (yes/no)          | 26/94 | 12/39            | 14/55                    | 0.67★   |
| Hypertension (yes/no)    | 11/109| 3/48             | 8/61                     | 0.35★★  |
| Diabetes                 | 5/115 | 2/49             | 3/66                     | >0.99★★ |
| Preoperative Scr         | 83.65 (70-95.55) | 82 (67-91)       | 85 (73-100.5)            | 0.12&   |

Annotation: The interval in the parenthesis is interquartile range and the number before parenthesis is the median value; Scr- serum creatinine;

* Chi-square test;
** Fisher’s exact test;

Independent samples t-test;

& Mann-Whitney test.
Table 2 (on next page)

Surgical outcomes of the different operation methods.

* Chi-square test;
** Fisher’s exact test;
& Mann-Whitney test.
Table 2. Surgical outcomes of the different operation methods.

|                                | Total | Open nephrectomy | Laparoscopic nephrectomy | P value |
|--------------------------------|-------|------------------|--------------------------|---------|
| No. of pts                     | 120   | 51               | 69                       | -       |
| Operation time (minutes)       | 160 (132-198.75) | 135 (120-165)   | 180 (150-225)            | <0.01** |
| Estimated blood loss (ml)      | 100 (50-200) | 100 (50-150)    | 100 (50-200)             | 0.69**  |
| Transfusion (yes/no)           | 9/111 | 1/50             | 8/61                     | 0.08**  |
| Postop hospital days           | 8 (7-10.75) | 9 (7-11)        | 8 (7-10)                 | 0.11**  |
| Perioperative complication rate| 37/120 | 14/51           | 23/69                    | 0.49*   |
| Conversion to open surgery     | -     | -                | 7/69                     | -       |

* Chi-square test;
** Fisher’s exact test;
& Mann-Whitney test.