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Transperitoneal Laparoscopic Nephrectomy for Non-Functional Kidneys: A Report of 25 Cases

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Abstract

Background and Aim: Ever since the first-ever laparoscopic nephrectomy performed in 1991 by Clayman, laparoscopy has become the technique of choice for benign renal pathologies and also for cancerous lesions. In this paper, we present and evaluate the results of laparoscopic nephrectomy carried out on patients with non-functional kidneys at the *Centre medico-chirugical d'urologie* in Douala, Cameroon. **Materials and Methods:** This was a retrospective study carried out from 2016 to 2020. We included 25 patients with non-functional kidneys who underwent transperitoneal laparoscopic nephrectomy. **Results:** We included 25 patients (15 males and 10 females) with a mean age of 32.80 ± 9.76 years. Twenty (80%) patients presented with low back pain, four (16%) presented with acute pyelonephritis, and one (4%) presented with both low back pain and hematuria. The right kidney was damaged in 10 (40%) patients and the left kidney in 15 (60%) patients. The kidney failure requiring nephrectomy was due to stones in 16 (64%) patients and upper pyeloureteric junction obstruction in nine (36%) patients. The mean surgery duration was 111.08 ± 31.95 minutes. The median perioperative blood loss was 100 [70 - 120] ml. Percutaneous drainage was required in 13 (52%) patients. Only two (8%) patients developed postoperative complications. The mean follow-up duration was 64 ± 24.48 days. All patients survived the surgical intervention. **Conclusion:** Laparoscopic nephrectomy is a mini-invasive technique that is suitable for the surgical removal of non-functional kidneys due to either ureteropelvic junction obstruction or massive kidney stones.

Keywords

Pelvic Calculi, Laparoscopy, Nephrectomy, Pyeloureteric Junction Obstruction

1. Introduction

The indications for nephrectomy, which is the surgical removal of the kidney, include both benign and malignant conditions. Some of the common indications include renal stones, chronic pyelonephritis, neglected ureteropelvic junction obstruction (UPJO), renal tuberculosis, and renal cell carcinoma [1]. The first-ever programmed nephrectomy was performed by Gustav Simon in 1869 and since then, the procedure has been carried out all over the world and there have been improvements in the technique over time [2]. This surgical procedure, like many others, can also be performed using laparoscopic techniques [3]. Hiller *et al.* carried out a comparative study on live nephrectomy donors and found out that laparoscopic nephrectomy donors experienced significantly shorter hospitalizations, less pain, felt able to return to work and normal routines sooner, and needed significantly less assistance during the recuperation period than did open nephrectomy donors. Laparoscopic nephrectomy has also been proven to be preferable to open nephrectomy in patients with high body mass indexes [4]. Another advantage of this procedure is that it is associated with a better cosmetic outcome. It has been reported to conceal visible scars above underwear, improving cosmetical outcomes [5]. However, despite all the advantages of the laparoscopic procedure, it still faces many barriers in resource-limited settings such as ours. Choy *et al.* identified the organizational structure for funding laparoscopic procedures, the hierarchical nature of the local surgical culture, and the expertise and skills associated with a change in practice as the main barriers facing the practice of laparoscopic surgery in low-income and middle-income countries [6]. The members of the population are also skeptical about laparoscopic techniques as they doubt if they can be as effective as open surgical procedures. This skepticism constitutes one of the major barriers that experts have been combatting for many years [7]. The general population and policymakers need more evidence to convince them of the merits of laparoscopic surgery, including laparoscopic nephrectomy. Also, there is a paucity of reports on the results of laparoscopic nephrectomy in sub-Saharan Africa. Therefore, we carried out this study to evaluate the results of laparoscopic nephrectomy carried out on patients with non-functional kidneys at the *Centre medico-chirugical d'urologie* in Douala, Cameroon.

2. Materials and Methods

2.1. Study Design and Data Collection

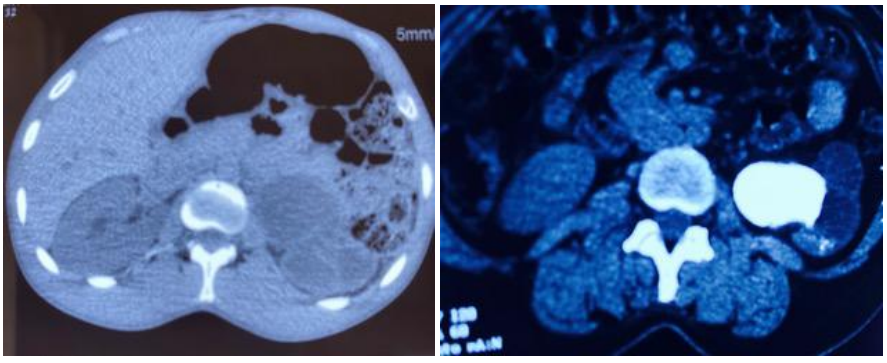
This is a retrospective study carried out at the *Centre medico-chirugical d'urologie* in Douala, Cameroon. In this study, we included patients who underwent transperitoneal laparoscopic nephrectomy for non-cancerous, non-functional kidneys. We included all patients who underwent nephrectomy at our center from 2016 to 2020 and excluded patients who underwent surgery for malignant renal lesions and patients whose clinical records were missing relevant information. We consulted each participant's clinical records and collected information including

age, sex, clinical presentation, laterality of the nephrectomy, creatinine level, imaging method used, renal function of the normal kidney, the presence, sizes, and locations of kidney stones in patients whose end-stage renal disease (ESRD) was caused by stones, the presence or absence of crossing vessels in patients whose ESRD was caused by UPJO, surgery duration, estimated blood loss during surgery, post-surgical drainage, duration of postoperative hospitalization, postoperative pain intensity, postoperative complications, and follow-up duration. The estimated blood loss was determined by reading off the volume of blood in the suction bottle used during surgery and counting the number of surgical gauzes that were soaked with blood during the operation, as a dry 10 cm × 10 cm surgical gauze reportedly absorbs up to 12 ml of blood [8]. The pain intensity was determined using the visual analog scale (VAS), which is a subjective linear scale that is graduated from 0 to 10, with zero representing no pain and 10 representing the worst possible pain. In our study, there were two main causes of ESRD. The first was the prolonged presence of kidney and ureteral stones while the second was UPJO which, in turn, was due to the presence of crossing vessels in some cases.

Computed tomography (CT) images of patients with UPJO and kidney stones are presented in **Figure 1**.

2.2. Surgical Procedure

This procedure was carried out under general anesthesia in all patients. The patient is placed in the complete right lateral decubitus position when going for the left kidney and the partial left lateral decubitus position when going for the right kidney. The first 10 - 12-mm long trocar at the external border of the latissimus dorsi muscle, after which the peritoneal cavity was insufflated with carbon dioxide to obtain a pneumoperitoneum with a pressure of 12 - 15 mmHg. Thereafter, the other trocars are placed and their positions are verified visually while respecting the proper triangulation of the instruments. When operating on the left kidney, the left colon and spleen are moved out of the visual field together.



(a) (b)

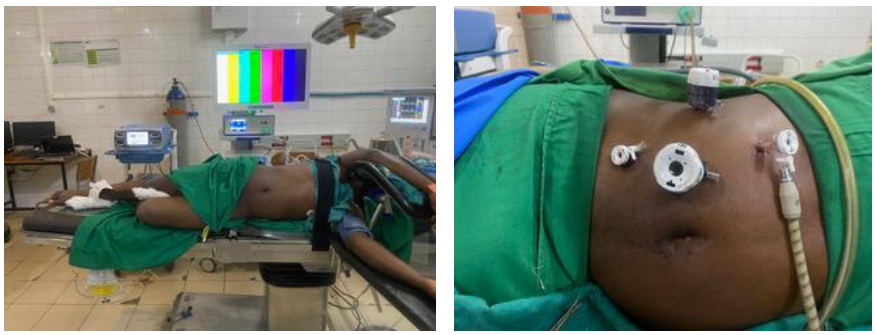
Figure 1. CT images of the two main causes of ESRD among our patients; (a) Non-functional left kidney with ureteric pelvic junction obstruction; (b) Non-functional left kidney with a giant kidney stone.

Then, the gonadal vein, which leads to the renal vessels, is identified. When going for the right kidney, the right colic angle is moved out of the visual field, after which the duodenum is dissected (Kocher's maneuver), and the inferior vena cava is dissected, followed by the renal vein. After that, Hem-o-lock clips are placed on the renal artery and then on the renal vein. Thereafter, the ureter is clamped and sectioned, after which the kidney is put in a plastic bag, then extracted from the body by enlarging the incision at the 12-mm trocar on the lower abdomen by 5 - 6 cm. After this, the trocars are removed, marking the end of the procedure. The positions of the patient and ports during a right nephrectomy can be seen in Figure 2.

All surgical procedures and follow-up were carried out by the same surgical team. The patients were also followed up by the same team that carried out the procedure. A non-functional kidney and a giant kidney stone removed via laparoscopy can be seen in Figure 3.

2.3. Data Management

The data collected from patients' clinical records were entered into Microsoft Excel 2016 and then exported to Epi info 7 for statistical analysis. Quantitative



(a) (b)

Figure 2. (a) Position of the patient during a right laparoscopic nephrectomy. (b) Positions of the ports during a right laparoscopic nephrectomy

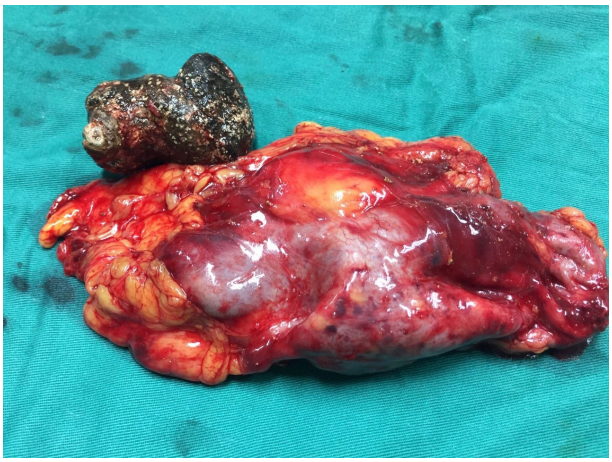


Figure 3. Non-functional kidney and a giant kidney stone removed via laparoscopy.

variables were presented as mean values and standard deviations for normally distributed data and as median values with interquartile ranges for data with skewed distributions. The independent samples t-test was used to compare normally distributed continuous variables while the Mann-Whitney U test was used to compare continuous variables with skewed data distributions. The chi-square test and the Fisher exact test were used to compare categorical variables. Values of $P < 0.05$ were considered statistically significant.

2.4. Ethical Approval

This study was approved by the institutional review board of the Faculty of Medicine and Pharmaceutical Sciences (FMPS) of the University of Douala and by the ethical committee of the *Centre medico-chirugicale d'urologie* in Douala, Cameroon. The requirement for patients' informed consent was waived due to the retrospective nature of the study.

3. Results

We included a total of 25 patients (15 males and 10 females) aged 17 years to 50 years with a mean age of 32.80 ± 9.76 years. Twenty (80%) of our study participants presented with low back pain, four (16%) presented with acute pyelonephritis, and one (4%) presented with low back pain and hematuria. Ten (40%) of the damaged kidneys to be removed were on the right side of the body while 15 (60%) were on the left side. All twenty-five patients in our study underwent CT scanning and were found to have hydronephrosis. The cause of ESRD was kidney stones in 16 (64%) cases and UPJO in 9 (36%) cases. Of the nine patients with UPJO, four (44.44%) had crossing vessels while five (55.56%) did not have crossing vessels. Sixteen of our patients had ESKD due to kidney stones. The stone sizes in these patients ranged from 15 mm to 45 mm with a median value of 19.5 [16.5 - 29] mm. These stones were located in the lumbar urethra in 6 (37.5%) and in the renal pelvis in 10 (62.5%) patients. The preoperative characteristics of the study participants can be found in Table 1.

The surgery duration ranged from 65 minutes to 170 minutes with a mean duration of 111.08 ± 31.95 minutes. The estimated blood loss ranged from 50 ml to 280 ml with a median value of 100 [70 - 120] ml. Percutaneous drainage was performed in 13 (52%) patients and not performed in 12 (48%) patients. The duration of postoperative hospitalization ranged from 2 days to 6 days with a mean duration of 2.36 ± 0.86 days. Eleven (44%) patients had a pain intensity of 2/10 as measured using the VAS score, nine (36%) had a score of 3/10, and five (20%) had a score of 4/10. The follow-up duration ranged from 23 days to 125 days, with a mean duration of 64 ± 24.48 days. Only two (8%) participants had postoperative complications, with one of them having a renal pelvis hematoma and the other having an incisional hernia. The incisional hernia occurred one month after the intervention and was managed by placing a synthetic prosthesis. The patient with the renal fossa hematoma underwent another laparoscopic surgical

Table 1. Preoperative characteristics of the study participants.

Variable	Frequency (%)
Age	
0 - 20	4 (16)
21 - 40	16 (64)
41 - 60	5 (20)
Sex	
Male	15 (60)
Female	10 (40)
Clinical presentation	
Low back pain	20 (80)
Acute pyelonephritis	4 (16)
Low back pain/hematuria	1 (4)
Laterality of nephrectomy	
Left	15 (60)
Right	10 (40)
Cause of ESRD	
Kidney stones	16 (64)
Neglected UPJO	9 (36)
Presence of crossing vessels (UPJO only)	
Yes	4 (44.44)
No	5 (55.56)
Location of stones	
Lumbar ureter	6 (37.5)
Renal pelvis	10 (62.5)
Size of stone	
≤20 mm	9 (36)
>20 mm	16 (64)

operation on postoperative day 3 during which clips were placed on the collateral vessels. The complications were successfully managed in both cases. All 25 patients survived the intervention. The operative and postoperative details of the study participants are presented in Table 2.

4. Discussion

In this study, we aimed to present and evaluate the results of laparoscopic nephrectomy carried out on patients with non-functional kidneys at the *Centre medico-chirugical d'urologie* in Douala, Cameroon. We included 25 patients (15

Table 2. Intraoperative and postoperative characteristics of the study participants.

Variable	Frequency (%)
Surgery duration (minutes)	
60 - 120	16 (64)
121 - 180	9 (36)
Estimated blood loss (ml)	
≤100	13 (52)
101 - 200	10 (40)
>200	2 (8)
Duration of hospitalization (days)	
2	19 (76)
3	5 (20)
6	1 (4)
Percutaneous drainage	
Yes	13 (52)
No	12 (48)
Pain score (VAS)	
2	11 (44)
3	9 (36)
4	5 (20)
Postoperative complications	
Yes	2 (8)
No	23 (92)
Postoperative follow-up duration (days)	
≤50	8 (32)
51 - 100	15 (60)
>100	2 (8)

males and 10 females) with a mean age of 32.80 ± 9.76 years, which is lower than the 61 years reported by Cadeddu *et al.* [9]. The difference can be accounted for by the fact that Cadeddu *et al.* carried out their study on patients with renal cell cancer, who are usually elderly people. The mean age of our study participants was this low because we excluded patients with renal cell cancer, who are usually elderly people. In our study, ESRD due to stones was the most common indication for nephrectomy. This is in line with the findings of Zaidi *et al.* in 2007, who also reported stones as the most common indication for nephrectomy in their study [10]. In our study, a left nephrectomy was performed in 15 (60%) patients while a right nephrectomy was performed in 10 (40%) patients. Vaz *et al.* re-

ported that 81.7% of their patients underwent left nephrectomy [11]. Although they had more left nephrectomy cases as well, their proportion of left-sided nephrectomies was much higher than ours because they carried out their study on cases of hand-assisted donor nephrectomy. It has been reported that there is a tendency to prefer the left kidney during donor nephrectomy due to anatomical differences between the right and left kidney [12], which explains why Vaz *et al.* had up to 81.7% of left-sided nephrectomy cases. The mean surgery duration in our study was 111.08 ± 31.95 minutes. This is less than the 140 ± 51.1 minutes reported by Zaidi *et al.* in 2007 [10]. This shorter surgery duration can be explained by the fact that while we used the transperitoneal route in all our patients, Zaidi *et al.* used the retroperitoneal route in 50 of their 60 patients. They also had concomitant interventions such as ureteric reimplant and augmentation ureterocystoplasty to carry out in some patients, which made some of their interventions longer. In our study, we carried out only nephrectomies in all our patients, which explains why the mean duration of our interventions was less than that of the interventions performed by Zaidi *et al.* The median estimated blood loss in our study was 100 [70 - 120], which is higher than the mean estimated blood loss of 85.6 ml reported among patients who underwent laparoscopic nephrectomy by Yu *et al.* in 2021 [13]. This difference in the estimated blood loss during surgery is probably due to the fact that Yu *et al.* carried out a comparative study between partial laparoscopic nephrectomy and partial open nephrectomy in which the surgeons who carried out the laparoscopic procedure were more experienced and better equipped than our surgeons were at the time, which is a plausible explanation for our patients losing more blood during surgery. The postoperative pain intensity (according to the VAS) in our study was 2 in 11 (44%) patients, 3 in nine (36%) patients, and 4 in five (20%) patients. This is in line with previous studies according to which the postoperative pain intensity is significantly less with laparoscopic nephrectomy than with open nephrectomy [14] [15]. The lower postoperative pain intensity can be explained by the fact that laparoscopic nephrectomy is associated with less muscle dissection, peritoneal irritation, and diaphragmatic trauma than the open procedure. Our patients received only acetaminophen, a level 1 non-opioid analgesic drug [16]. Also, during their postoperative hospitalization period, percutaneous drainage was performed in 52% of our study participants. This is in line with the findings of the study by Godoy *et al.* in 2011, who stated that the decision to place a drain after nephrectomy must be made intraoperatively and tailored to each case. In 2020, Celasin *et al.* published a study reporting that there were no significant differences between the groups of patients with and without drains in terms of length of hospital stay, complication rates, and postoperative creatinine levels [17]. This further supports the fact that the decision to place a drain after laparoscopic nephrectomy should be subjective and not systematic.

The mean hospital stay of our study participants was 2.36 ± 0.86 days, which was shorter than the 3.1 days reported by Zaidi *et al.* [10]. This was because a

number of the participants in their study required additional procedures, as the mean hospitalization duration for those who underwent only laparoscopic nephrectomy in the same study was 2.2 days. This goes to confirm the fact that laparoscopic nephrectomy, like many other laparoscopic procedures, has the advantage of being associated with a shorter hospital stay. The complication rate in our study was 8%, which is similar to the 5.64% reported by Castillo *et al.* in 2006. This highlights the fact that laparoscopic nephrectomy is a procedure that is associated with minimal postoperative complications.

In spite of the interesting findings of our study, it had a few limitations. First, the retrospective study design we used comes with recall bias. Second, our study sample was small. More studies with different study designs and larger study samples should be conducted in the future to further investigate our findings.

5. Conclusion

Laparoscopic surgery is a safe and effective technique for nephrectomy. It is associated with a low rate of complications, mild postoperative pain, and shorter postoperative hospitalization periods. The use of laparoscopic techniques for this surgical procedure should be encouraged in resource-limited settings such as sub-Saharan Africa.

Acknowledgments

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Availability of Data and Materials

The data analyzed in this study are available from the corresponding author upon reasonable request.

Ethics Statement

Ethical approval was obtained from the institutional review board of the Faculty of Medicine and Pharmaceutical Sciences and the ethics committee of the *Centre medico-chirugicale d'urologie* in Douala, Cameroon. The requirement for informed consent was waived due to the retrospective nature of the study.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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