Original Research Article

Prospective Evaluation of Preoperative factors to Predict Intraoperative Difficulty during Transperitoneal Laparoscopic Simple Nephrectomy for Non-functioning Kidney Secondary to Urolithiasis

ABSTRACT

Background: Laparoscopic simple nephrectomy (LSN) for non-functioning kidney (NFK) due to urolithiasis is considered difficult with higher conversions to open surgery and complication rates than radical nephrectomy. Preoperative assessment of operative difficulty would be useful for better preoperative planning, to select patients with less difficulty in early phases of learning and to counsel patients. There is a paucity of the prospective studies assessing intraoperative difficulty during LSN for stone related NFK.

Objectives: To evaluate preoperative clinical and radiological characteristics that could predict difficulty during transperitoneal LSN for NFK due to urolithiasis.

Methods: A prospective study was done in National Academy of Medical Sciences, Bir Hospital, Kathmandu, Nepal from September 2021 to August 2022 among patients undergoing transperitoneal LSN for NFK secondary to urolithiasis. Demographic and clinico-radiological parameters were documented preoperatively. The single experienced surgeon provided the difficulty score for major steps of surgery in a Likert scale of 1(easy) to 4 (most difficult). Final difficulty scale was calculated adding blood loss and operative duration as surrogate markers of difficulty and patients were divided into two groups, Easy group, and Difficult group. Preoperative, intraoperative, and postoperative characteristics were compared. Univariate and multivariate analysis were done to identify factors that could predict intraoperative difficulty.

Results: There were 88 patients included in the final analysis. Presence of pyonephrosis ($p<0.001$) and

preoperative percutaneous nephrostomy (p=0.04) showed significant correlation with intraoperative difficulty in univariate analysis. However, pyonephrosis was only significantly associated with difficulty during multivariate analysis (OR 3.87, 95% CI 1.00-14.96). Patients with pyonephrosis had higher conversion rates to open surgery and higher complication rates.

Conclusions: Pyonephrosis in NFK secondary to urolithiasis predicted higher intraoperative difficulty during LSN. Patients with pyonephrosis experienced higher conversions to open surgery and higher complications rate.

Keywords: Urolithiasis, difficulty, laparoscopic nephrectomy, non-functioning kidney, pyonephrosis

1. INTRODUCTION

Despite the availability of various treatment modalities for urolithiasis, a portion of patients with urolithiasis still land up with non-functioning kidney secondary to urolithiasis. In developing countries urolithiasis related non-functioning kidney accounts more than half (57.1-65%) of nephrectomies which in contrast to developed countries where majority of the nephrectomies are done for malignancy [1,2].

Laparoscopic simple nephrectomy (LSN) is considered the standard procedure for non-functioning kidney with the benefits of reduced postoperative pain, better cosmesis, shorter hospital stays and earlier convalescence with equivalent outcomes to open surgery [3]. Transperitoneal approach is the most preferred technique for benign disease as it provides familiar anatomic landmarks and wider surgical field with better manipulation area.

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Despite the word simple in simple nephrectomy, LSN due to stone disease is considered a challenging procedure as higher conversion rate and complications rate have been documented than in radical nephrectomies [4]. The inflammatory response induced by urolithiasis and accompanying infection leads to dense perirenal and adjacent organ adhesions that make visualization of the anatomic planes and individualization of the renal pedicle difficult thus adding to the complexity of the procedure [5].

LSN is one of the first laparoscopic procedure performed during urology residency training, and like every surgical procedure LSN has a learning curve [6]. Preoperative assessment of operative difficulty would be useful for better preoperative planning, to select patients in whom surgery can be performed with less difficulty in early phases of learning curve and to counsel patients about the risks of open conversions and morbidities.

Various studies have tried to analyze preoperative factors to identify association with intraoperative difficulty during LSN. However, most of the studies being retrospective in nature could not assess the difficulty faced intraoperatively and used surrogate markers such as amount of blood loss, duration of surgery, conversions, and complications as surrogate markers of difficulty [6]. Also, surgeon's assessment of difficulty during LSN have been considered only in few studies [7,8]. There is a paucity of the prospective studies that analyze intra-operative difficulty during LSN for stone related non-functioning kidney as studies evaluating difficulty are predominantly from laparoscopic donor nephrectomy or benign nephrectomy overall, which are considered different from nephrectomy due to urolithiasis as higher complications rate have been demonstrated in those with urolithiasis.

The purpose of this study was to attempt to identify preoperative clinical and radiologic parameters that could predict the intraoperative technical difficulty of transperitoneal LSN for non-functioning kidney due to urinary stone disease.

2. MATERIAL AND METHODS

This prospective observational study was conducted in the Department of Urology, Bir Hospital, National Academy of Medical Sciences, Kathmandu, Nepal from September 2021 to August 2022. Ethical approval was obtained from Institutional Review Board of National Academy of Medical Sciences, Kathmandu (Ref.no. 529/77) and written informed consent was obtained from all patients. Patients undergoing transperitoneal LSN for non- functioning kidney due to urinary stone disease were included in the study. Patients with co-existent malignancies and genitourinary tuberculosis later found in histopathology after surgery were excluded.

Pre-operatively history and physical examination were documented together with investigations including complete blood count, serum chemistries, coagulation panel, urinalysis, and urine culture. Computed tomography (CT) scan was obtained to assess anatomy and the relationship of the kidney to adjacent structures. Diethylenetriamine pentaacetate (DTPA) diuretic renogram scintigraphy was obtained to assess the differential renal function. In patients with pyonephrosis (suggested by clinical, laboratory, and radiologic parameters), percutaneous nephrostomy tube was placed and DTPA diuretic renogram was performed following 6 weeks of drainage. Kidneys with split function less than 15% on renogram were considered non-functional.

2.1 Surgical Technique

All surgeries were done by a single experienced surgeon (PMS). Prophylactic antibiotic Ceftriaxone 1 gm was given intravenously at the time of induction of general anesthesia. After insertion of Foley catheter and orogastric tube, the patient was positioned in a lateral flank position with the operative side facing upwards and the patient's abdomen lying at the edge of the table. Pneumoperitoneum was created using 14-gauge Veress needle with insufflation of Carbon dioxide. Two 12 mm ports and one 5 mm ports were placed with additional ports placed as required.

The ascending and descending colon were reflected off from the anterior surface of the kidney by incising the line of Toldt from hepatic and splenic flexure on the right and left side respectively to the iliac vessels at the pelvic brim. Colon was reflected medially, and psoas muscle was exposed to approach gonadal vessels, and ureter. Blunt dissection through the retroperitoneal fat was done to identify the ureter which was traced to the hilum of the kidney. Upper pole of the kidney was mobilized and freed from the adrenal gland. The hilar dissection was done with the renal artery and vein circumferentially dissected. The vessels were divided after applying hemoclips (Weck Hem o Lok, Global Medi Innovations, India) with two clips on the patient side and one towards the specimen side.

Kidney was mobilized from all sides. Finally, the ureter was divided as distally as feasible with the placement of hemoclips distally. The kidney was placed intact in a locally modified Nadiad bag and was retrieved by extending 10 mm port [9]. Drain was placed in the surgical space as per the surgeon's discretion.

Postoperatively, patients were allowed sips after 6 hours of surgery and diet as tolerated was allowed on the first postoperative day. Patients were usually discharged on the third post-operative day. Those with drain were discharged after removal of drain when the drain output was less than 50 ml over 24 hours.

2.2 Assessment of difficulty

The evaluation of operative difficulty was adapted from the studies done by Gahlawat et al. [6] Ratner et al. [7]. At the completion of surgery, surgeon scored the difficulty during the surgery in the range from 1 (easiest) to 4 (most difficult) for the four major steps of the surgery (Table 1). The maximum score of four to each step were given for those requiring conversion to open surgery. This was designated as the surgeon's score to each step and the sum of the scores for the four steps was designated as "Difficulty score".

Table 1. Score assigned by surgeon at the completion of procedure

Phases of operation	**Assigned score**			
Mobilization of colon	1	2	3	4
Dissecting vessels at the hilum, clipping and dividing them	1	2	3	4
Freeing the kidney all around	1	2	3	4
Identification of ureter	1	2	3	4
Sum				

(1-very easy, 2-easy, 3-difficult, and 4-very difficult)

Total operative time and the estimated blood loss amount were documented and incorporated to calculate the final difficulty score. Each parameter was given points from 1 to 3 depending on the percentile as shown in Table 2.

Table 2. Difficulty scale

	Difficulty points			
Variables	**1 (<25th percentile)**	**2 (25-75th percentile)**	**3 (>75th percentile)**	**Score**
Difficulty score	3-5	6-9	10-16	
Total operative time (min)	<45 min	45-80 min	>80 min	
Estimated blood loss (ml)	<100 ml	100-200 ml	>200 ml	
Sum				

Difficulty scale was calculated as:

Difficulty scale (3–9) = Difficulty score (1–3) + Total operative time (1–3) + Estimated blood loss (1–3).

"**Difficulty scale**" was used to objectively categorize the patients in two groups of difficulty. Those with less than 6 were considered as **"Easy Group"** and those with 6 or more were considered as **"Difficult Group"**.

2.3 Statistical Analysis

The categorical variables and numerical variables were presented as number (%) and mean ± standard deviation, respectively. For categorical variables Chi-square/ Fisher's exact test, and Student t test /Mann-Whitney U test for continuous data was used. Patient demographic and clinical characteristics were compared among groups. Univariate analysis was performed between individual parameter and difficulty scale using t-test or Chi-square test. Logistic multivariate regression was done to identify the predictors for difficulty during surgery only taking those parameters with *P* value less than 0.1 in univariate analysis. Statistical analyses were done using Statistical Packages for Social Sciences (SPSS) version 23.0 (IBM Corp., Armonk, NY, USA). A *P*-value less than 0.05 was considered statistically significant.

3. RESULTS

Ninety-two patients underwent LSN due to urolithiasis during the study period. Four patients were excluded from the final analysis, malignancy (n=2) and genitourinary tuberculosis (n=2) detected in histopathological examination and, 88 patients were included in the final analysis.

The preoperative characteristics of the patients are outlined in Table 3. Out of 88 patients, 48 (54.5%) and 40 (45.5%) patients were designated to Easy and Difficult groups respectively.The gender distribution was similar in both the groups (*P*=0.41). The mean age of the patients was 46.68 years (range 18-78 years). Majority of the nephrectomies were done on right side (60.2 %). More than a third of patients (n=31, 35.2%) had undergone surgery prior to nephrectomy and predominantly surgeries were done for renal stones, open (n=14) and endourologic (n=13) approach.

Table 3. Pre-operative patient's characteristics

Variables	**Overall (n=88)**	**Easy group (n=48)**	**Difficult group (n=40)**	***P* value**
Sex				0.41
Male, n (%)	42 (47.7)	21 (43.75)	21 (52.5)	
Female, n (%)	46 (52.3)	27 (56.25)	19 (47.5)	
Age (mean ± SD) (years)	46.68 ± 14.91	46.77 ± 13.78	46.58 ± 16.34	0.95
BMI (mean ± SD) (kg/m^2)	23.94 ± 3.63	23.82 ± 3.43	24.08 ± 3.89	0.73
Laterality				0.08
Right, n (%)	53 (60.2)	33 (68.75)	20 (50)	
Left, n (%)	35 (39.8)	15 (31.25)	20 (50)	
ASA grade*				0.27
I, n (%)	57 (64.8)	34(70.8)	23(57.5)	
II, n (%)	30(34)	14(29.2)	16(40)	
III, n (%)	1(1.1)	0.0	1(2.5)	
Prior intervention				0.67
Ureteroscopy, n (%)	8(25.8)	4(26.6)	4(25.0)	
Open renal Surgery, n (%)	14(45.1)	7(46.6)	7(43.7)	
Percutaneous nephrolithotomy, n (%)	9(29.1)	4(26.6)	5(31.2)	
Percutaneous nephrostomy prior, n (%)	16 (18.2)	5(10.41)	11(27.5)	0.03
Duration of nephrostomy (weeks)	8.88 ± 4.96	8 ± 5.52	9.27 ± 4.92	0.04

** ASA, American Society of Anesthesiologists*

The mean size of the non-functioning kidney was 9.82 cm (range 3.2 - 21 cm). Majority of the patients had gross hydronephrosis (62%) and 8% (n=7) of the patients had atrophied kidney (Table 4). Approximately 1 in 5 patients (19.3%)

had pyonephrosis. Majority of the calculus leading to non-functioning kidney were located in the kidney (65%) followed by ureter (35%).

Table 4. Comparison of the radiologic findings between the groups

Variables	Overall (n= 88)	Easy group (n=48)	Difficult group (n=40)	*P* value
Size of kidney (cm)	9.82 ± 3.64	9.36 ± 3.23	10.36 ± 4.05	0.20
Location of stone				0.76
Staghorn	19(21.6)	8(16.6)	11(27.5)	
Pelvis	38(43.2)	21(43.7)	12(30)	
Ureter	31(35.2)	19(39.5)	17(42.5)	
Gross hydronephrosis, n (%)	53 (60.22)	31(64.5)	22(55)	0.64
Pyonephrosis, n (%)	17 (19.3)	4 (83.33)	13 (32.5)	0.006

Data presented as mean ± SD

The mean duration of the surgery was 64.89 minutes (range 20-130 minutes) and mean estimated blood loss was 165 ml (range 50-600ml) (Table 5). Conversion to open surgery was required in four patients in the difficulty group only due to dense perinephric adhesions and all of them had pyonephrosis. Overall complication rate was 37.5% (n=33) in the study. Majority of the complications were Clavien grade I and II while major complication (Clavien > II) occurred in 1 patient (1/88, 1.1%) . The mean hemoglobin change and need of transfusion was higher in Difficult group, however they were not statistically significant, *P*=0.17.

Table 5. Comparison of Intraoperative and postoperative characteristics between the groups

Variables	Overall n= 88	Easy group (n= 48)	Difficult group (n= 40)	*P* value

Duration of surgery (mins)	64.89 ± 26.44	48.6 ± 15.30	84.43 ± 23.67	<0.001
Estimated blood loss (ml)	165 ± 114.26	110.20 ± 50.29	230.75 ± 133.98	<0.001
Need of conversion, n (%)	4 (4.5)	0 (0)	4 (10)	0.03
Drain placement, n (%)	30 (34.1)	7 (14.5)	23 (57.5)	<0.001
Complication Clavien Grade				<0.001
I, n (%)	9(27.2)	3(33.3)	6(25.0)	
II, n (%)	23(69.7)	5(55.5)	18(75.0)	
III, n (%)	1(3.0)	1(11.1)	0(0.0)	
Hemoglobin change (g/dl)	1.80 ± 0.80	1.7 ± 1.40	2.06 ± 1.07	0.18
Requirement of transfusion, n (%)	5(5.6)	1 (2)	4 (10)	0.17
Duration of drain (days)	2.7 ± 0.70	2.14 ± 0.377	2.86 ± 0.69	<0.001
Duration of hospital stay (days)	4.11 ± 1.26	3.68 ± 0.94	4.62 ± 1.40	<0.001

Data presented as mean ± SD

In univariate analysis age, sex, ASA classification, BMI, presence of comorbidity and prior surgical intervention history were not significantly associated with the difficulty scores (Table 6). Similarly, laterality, location of stone and size of the kidney were not significantly associated with the final difficulty scale. Presence of pyonephrosis (p<0.000) and the percutaneous nephrostomy preoperatively (p=0.04) were the only variables significantly associated with the final difficulty scale.

Table 6. Univariate analysis of factors to predict difficult nephrectomy

	Easy vs Difficult		
Variable	**OR**	**95% CI**	**p value**
Sex (Male)	1.42	0.61-3.30	0.41
Age	0.99	0.97-1.02	0.95
ASA Score*	1.87	0.80-4.36	0.14
Laterality (Right)	0.45	0.19-1.08	0.07
BMI	1.02	0.90-1.14	0.73
History of prior surgery (Yes)	1.63	0.68-3.88	0.26
Type of surgery (vs none)			

Open	1.37	0.47-3.98	0.67
Endoscopic	1.60	0.47-5.38	0.44
Nephrostomy preoperatively	3.26	1.02-10.37	0.04
Pyonephrosis	5.29	1.56-17.91	< 0.001
Duration of nephrostomy	1.12	0.99-1.27	0.06
Size of kidney	1.08	0.95-1.21	0.20
Location of stone (vs ureter)	1.86	0.79-4.36	0.15
Gross hydronephrosis (vs none)	0.53	0.10-2.61	0.43

** ASA, American Society of Anesthesiologists*

On the multivariate logistic regression done with those factors with *P*<0.1 in univariate analysis, only the presence of pyonephrosis correlated with the final difficulty scale (OR 3.87, 95% CI 1.00 -14.96) (*P*=0.04). Laterality, presence of percutaneous nephrostomy and the duration of PCN were not associated with difficulty during laparoscopic simple nephrectomy in multivariate analysis (Table 7).

Table 7. Multivariate analysis to predict factors with intraoperative difficulty

Variables		**95% C.I. for Exp(B)**		
	Exp(B)	**Lower**	**Upper**	**Sig.**
Side (Right)	0.522	0.204	1.334	0.17
Nephrostomy (Presence)	2.535	0.245	26.198	0.43
Duration of nephrostomy	0.964	0.753	1.234	0.77
Pyonephrosis (Yes)	3.870	1.001	14.961	0.04

Patients with pyonephrosis had longer duration of surgery and higher blood loss with greater need of blood transfusion, *P*=0.00 (Table 8). In the study four patients required conversion to open surgery and all of them had pyonephrosis and none of the patients without pyonephrosis required conversion to open surgery. The postoperative complications were higher, and duration of hospital stay were longer in patients with pyonephrosis.

Table 8. Correlation of pyonephrosis with preoperative, intraoperative and postoperative variables

Parameters	**Pyonephrosis Presence**	**Pyonephrosis Absence**	***P* value**

	(n=17)	(n=71)	
Duration of surgery (min)	91.76 ± 31.22	58.45 ± 20.71	<0.001
Estimated blood loss (ml)	252.94 ± 165.33	143.94 ± 87.48	0.01
Conversion, n (%)	4 (23.5%)	0 (0%)	<0.001
Hemoglobin change (g/dl)	1.90±1.26	1.85 ±1.27	0.47
Need of transfusions, n (%)	3 (17.6%)	2 (2.8%)	0.01
Postop complications, n (%)	13 (76.4%)	20 (28.1%)	<0.001
Duration of hospital stay (days)	5.35 ±1.53	3.81 ±0.99	<0.001

Data presented as mean ± SD

4. DISCUSSION

Urolithiasis remains as one of the major causes of non-functioning kidneys and accounts for the majority of the nephrectomies performed in the developing countries [1]. Laparoscopic nephrectomy in non-functioning kidneys due to stone disease had been considered difficult with more complication rate than radical nephrectomies done for malignancy [4]. Various studies had assessed clinico-radiologic parameters to predict the intraoperative difficulty, however the results were not consistent across the studies. In the present study, pyonephrosis was the only factor associated with the increased difficulty during the laparoscopic nephrectomy for non-functioning kidney due to urolithiasis.

Demographic characteristics had been assessed in studies to predict difficulty such as age and gender. Aging has been associated with increased prevalence of comorbidities, however better preoperative preparation, improved intraoperative and postoperative care have contributed to the comparable outcome. Similarly, as in other studies age was not found to be associated with increased difficulty in our study [8]. In our study gender was also not associated with the intraoperative difficulty as documented in other studies [6,8]. However, higher rate of blood transfusions with similar complications rate was reported in females by Sammon et al. [10] and Hsiao and colleagues [11].

No significant correlation was found between the ASA grade and intraoperative difficulty in the present study. Similarly, Matin et al. [12] and Naya et al. [13] did not find significant difference in intraoperative or postoperative complications with ASA score. In contrast Permopongkosol et al. [14] and Danilovic et al. [15] reported higher complication rate in patients with higher ASA score. Although less likely to make the surgery difficult , higher prevalence of comorbidities such as cardiovascular and pulmonary could make patient less tolerant of surgical blood loss or complications from anesthesia [12].

Studies analyzing the impact of Body Mass Index (BMI) on complications after laparoscopic nephrectomy had been contradictory. In the present study, the mean BMI did not correlate with difficulty (p=0.07) and similar findings were observed by Gahlawat et al.[6]. In a study by Shah et al. [8], BMI less than 25 kg/m^2 was a significant predictor of intraoperative difficulty and opined to be due to increased difficulty during dissection of correct planes in thin patients. In contrast, other studies had observed longer duration of surgery and increased chance of conversion in patients with higher BMI [16]. It may partly may be due to the difficult initial access and difficult dissection owing to the increased amount of perinephric fat in patients with higher BMI and also due to the higher risk of comorbidities such as diabetes, hypertension, dyslipidemia and breathing disorders in this group [17].

Right side had been considered difficult due to the liver covering the hilum and upper pole, close proximity of the inferior venacava and duodenum which necessasitates extra care. Increased difficulty with higher conversion rate had been reported in various studies [11,18] . In our study laterality did not affect the difficulty scale and complication rate. Higher risk of complications and longer hospital stay in patients undergoing right laparoscopic nephrectomy after open cholecystectomy due to adhesions had been reported [19] .

Studies regarding the history of prior surgery and intraoperative difficulty had been contradictory. History of previous surgery and type of surgery, either open or endoscopic, were not found to predict intraoperative difficulty in the present study. Other studies had also observed similar perioperative outcomes in those with or without prior surgery albeit with prolonged operative duration [4,20,21]. In contrast higher rate of conversion to open surgery, higher complication rate, higher transfusion rate and increased intraoperative difficulty had been reported in patients with history of previous open or endoscopic renal surgery [20,22,23]. In patients with previous surgery, prolonged operative duration and higher complication may be related to the altered anatomy, longer duration required for adhesiolysis in the hilar area and mobilization of kidney from the scar tissue together with high likelihood of access-related complications and vital organ injury. Although, percutaneous nephrolithotomy is expected to cause less adhesion formation than open renal surgery, leakage of the irrigation fluid and urine into the retroperitoneum as well as perinephric hematoma during or after percutaneous renal stone surgery can result in scarring [24].

Laparoscopic surgery in the patients with large hydronephrotic kidney can be challenging due to the difficulty in port placement, limited manipulating space in the abdomen, and difficulty in approaching the renal hilum [25].We did not find association of kidney size with the intraoperative difficulty.We adopted similar technique of puncturing and draining the kidney early in the dissection for grossly enlarged hydronephrotic kidneys as described by Challocombe and colleagues

[26]. Shah et al.[8] also failed to find association of kidney size with intraoperative difficulty in multivariate analysis although it was significant in univariate analysis. However, kidney size more than 10 cm had been documented as risk factor for complication and also associated with higher intraoperative difficulty [15,27]. This findings might be related to perirenal adhesions due to repeated urinary infections associated with obstructive etiologies. Contrary to these findings, increased difficulty, higher conversion rate, increased need of transfusion and higher complication rate had been reported in atrophic kidneys than hydronephrotic kidneys [6,28]. Laparoscopic nephrectomy for atrophic kidney may be difficult because of dense perinephric adhesions and difficulty in identifying the kidney itself.

In the present study presence of percutaneous nephrostomy significantly correlated with the difficulty scale in the univariate analysis, however it failed to show significance on multivariate analysis. Similarly, Shah et al. [8] in their prospective study of 77 patients to predict difficulty during transperitoneal nephrectomy did not find increased intraoperative difficulty with the presence of nephrostomy. In contrast, Gahlawat et al. [6] and Adiga et al. [29] reported higher difficulty scores, longer operative duration, prolonged hospital stay, higher need for ICU and transfusion requirements in those with nephrostomy tube during retroperitoneal nephrectomy. Placement of the PCN leads to adhesions around the PCN site and can make the perirenal dissection difficult. The presence of nephrostomy may pose difficulty during retroperitoneal laparoscopic nephrectomy as the tract being posteriorly limits the development of initial working space, whereas in transperitoneal approach, the perirenal adhesion laterally is dissected toward the end of the procedure. The need of nephrostomy for conditions such as pyonephrosis conditions might also contribute to the difficulty.

Pyonephrosis is the one of the dreaded complications of the obstructed system and the infection is associated with surrounding inflammation which leads to the dense adhesions in the perihilar and perirenal area. Pyonephrosis was significantly associated with increased difficulty in both univariate and multivariate analysis in our study. In our study all the patients needing conversion to open had pyonephrosis. Patients with pyonephrosis had higher blood loss, longer duration of surgery, higher need of transfusion, higher postoperative complications and longer duration of hospital stay. Similar higher intraoperative difficulty in those with pyonephrosis was noted in other studies [8,15].

Majority of the stones were located in the kidney followed by ureteral stones. Staghorn stones were found in 21.5 % (19/88) of patients. In the present study location of stones location did not affect the intraoperative difficulty score. The association of stone location with the intraoperative difficulty had not been commented in previous studies. Stones located in the pelvis and pelvi-ureteric junction can lead to significant adhesions in the renal pelvis and hilum and thus making the dissection of the hilar structures difficult.

Xanthogranulomatous pyelonephritis due to long standing obstruction due to renal stones is considered the most challenging for laparoscopic nephrectomy with several studies documenting higher rate of conversion to open surgery and complications. In our study xanthogranulomatous pyelonephritis was present in a patient and she required conversion to open nephrectomy.

5. LIMITATIONS

The evaluation of difficulty during surgery is subjective and influenced by multiple factors and ability to objectively quantify every aspect is not feasible. The best parameter to predict difficulty remains elusive. As this was a single-center study, the result might not be generalizable at a large scale. The surgery was performed by a single experienced surgeon; hence the difficulty assessment may not be applicable to those in the initial learning curve. The surrogate markers such as blood loss, conversion, duration of surgery together with the surgeons' subjective assessment were taken into consideration to assess difficulty in the study. These factors may be influenced by instruments, supporting personnel and the surgeons' subjective evaluation may differ with circumstances such as time of the day, exhaustion or mood which could not be factored during the evaluation. The association of xanthogranulomatous pyelonephritis with difficulty could not be assessed as only a single patient in our study had this condition. Also, the association of difficulty with multiple renal vessels, location of kidney, nature of fat were not evaluated in this study.

6. CONCLUSION

Pyonephrosis was associated with significant intraoperative difficulty during laparoscopic nephrectomy for nonfunctioning kidney due to urolithiasis. Laparoscopic nephrectomy due to urolithiasis in the presence of pyonephrosis was also associated with significantly higher complication rates, conversion to open surgery and need of transfusion. Stone related laparoscopic nephrectomy itself is considered a challenging operation and the addition of pyonephrosis adds to the difficulty of the surgery. Hence, surgeons in initial phase of the learning curve should be careful when selecting patients for benign laparoscopic nephrectomy with pyonephrosis.

CONSENT

The authors declared that the written informed consent was obtained from all patients for participation in the study.

ETHICAL APPROVAL

The study protocol was reviewed and ethical clearance was obtained from the Institutional Review Board of National Academy of Medical Sciences, Bir Hospital, Kathmandu, Nepal (Ref letter number 529/077).

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