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

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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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 optimal preoperative planning, to select patients with less difficulty in early phases of learning and to

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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. A 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. Patients were divided into two groups, Easy group, and Difficult group based on difficulty scale. Preoperative, intraoperative, and postoperative characteristics were compared between the groups. Univariate and multivariate analysis was 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 benefits in terms of postoperative pain, cosmesis, hospital stay compared to open surgery [3]. Transperitoneal approach is the preferred technique due to familiar anatomic landmarks and availability of wider surgical field for manipulation. Despite the word simple in 'Simple Nephrectomy', LSN due to stone disease is considered a challenging procedure as comparable or even higher conversion and complications rates have been reported than in radical nephrectomies [4,5]. The dense perirenal and perihilar adhesions due to urolithiasis and accompanying infection make visualization of the anatomic planes and dissection of the renal pedicle difficult [6-8].

LSN is one of the first laparoscopic procedure performed during urology residency training, and like every surgical procedure LSN has a learning curve [9]. Preoperative assessment of operative difficulty would be useful for better preoperative planning, to select patients with minimal difficulty in phases of learning and to counsel patients about the risks of open conversions and morbidities. There is a paucity of the prospective studies evaluating intra-operative difficulty during LSN for stone related non-functioning kidney, as most studies evaluating difficulty are from donor nephrectomy or benign nephrectomy overall. The retrospective studies could not include intraoperative surgeon's assessment and, the parameters such as amount of blood loss, duration of surgery, conversion rate, and complication rate were considered as surrogate markers of difficulty [9-11].

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. MATERIALS 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 taken 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. 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 done to assess anatomy and the relationship of the kidney to adjacent structures. The differential renal function was assessed using Diethylenetriamine pentaacetate (DTPA) diuretic renogram. In patients with pyonephrosis (suggested by clinical, laboratory, and radiologic parameters), DTPA diuretic renogram was performed following 6 weeks of percutaneous nephrostomy drainage. Kidneys with split function less than 15% on renogram were considered non-functional.

2.1 Surgical Technique

A single experienced surgeon (PMS) performed all surgeries. Prophylactic antibiotic Ceftriaxone 1 gm was administered 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 and it 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 performed, and the renal artery and vein were 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. The specimen was retrieved by extending 10 mm port after placement in a locally modified Nadiad bag [12]. Drain was placed as per the surgeon's discretion.

Postoperatively, patients were kept nil per oral for six hours of surgery and diet as tolerated was allowed on the first postoperative day. Patients were discharged on the third post-operative day and, those with drains were discharged after removal of drain when the 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 was 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".

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

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

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

Table 2. Difficulty scale

Variables	Difficulty points			
	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	

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. Eighty-eight patients were analyzed after exclusion of four patients, malignancy (n=2) and genitourinary tuberculosis (n=2).

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 had nephrectomies for right side NFK (60.2%). Thirty-one patients (35.2%) had history of intervention for urolithiasis prior to nephrectomy.

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). Seventeen (19.3%) patients had pyonephrosis. Majority of the calculus leading to NFK were located in the kidney (65%) followed by ureter (35%).

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 minor (Clavien grade I and II) while major complication (Clavien > II) occurred in 1 patient (1/88, 1.1%). The mean hemoglobin drop and need of transfusion was higher in Difficult group, however it was not statistically significant (Table 5).

In univariate analysis, age, sex, ASA classification, BMI, presence of comorbidity and history of prior intervention 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*<0.001) and the percutaneous nephrostomy preoperatively (p=0.04) were the only variables significantly associated with the final difficulty scale.

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 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*

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

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

Table 6. Univariate analysis of factors to predict difficult nephrectomy

Variable	Easy vs Difficult		
	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*

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

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

Parameters	Pyonephrosis Presence (n=17)	Pyonephrosis Absence (n=71)	*P* value
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

Patients with pyonephrosis had longer duration of surgery (*P*<0.001) and higher blood loss with greater need of blood transfusion (*P*=0.01) (Table 8). In the study all the four patients who required conversion to open surgery had pyonephrosis. Patients with pyonephrosis had higher complication rates and longer duration of hospital stay (*P*<0.001).

4. DISCUSSION

Urolithiasis remains as one of the major causes of non-functioning kidneys and accounts for the majority of the nephrectomies in the developing countries [1]. Laparoscopic nephrectomy in non-functioning kidneys due to stone disease is considered difficult with higher complication rates than radical nephrectomies for malignancies [4,5]. Various studies had assessed clinico-radiologic parameters to predict the intraoperative difficulty, however the result varies are not consistent. In the present study, pyonephrosis was the only factor associated with the increased difficulty during the laparoscopic nephrectomy for NFK due to urolithiasis.

Demographic characteristics such as age and gender were assessed in studies to predict difficulty. Although aging is associated with increased prevalence of comorbidities, improved preoperative, intraoperative and postoperative care have contributed to the comparable

outcome. Similar to the findings by Shah et al. [11], we did not find association of age with increased difficulty. In our study, gender was also not associated with difficulty as reported in other studies [9,11]. However, higher rate of blood transfusions with similar complications rates in females were observed by Sammon et al.[13] and Hsiao and colleagues [14].

No significant correlation was found between the ASA grade and intraoperative difficulty in the present study. Similarly, Matin et al.[15] and Naya et al. [16] did not find significant difference in intraoperative or postoperative complications with ASA score. In contrast Permopongkosol et al. [17] and Danilovic et al. [18] 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 [15].

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. [9]. In a study by Shah et al. [11], BMI less than 25 kg/m^2 was a significant predictor of intraoperative difficulty and attributed it to increased difficulty during dissection of correct planes in thin patients. In contrast, longer duration of surgery and increased conversion to open surgery was observed in patients with higher BMI [19]. The longer duration of sugery in patients with higher BMI may be explained by difficult initial access and difficult dissection of perinephric fat. These patients also has higher risk of comorbidities such as diabetes, hypertension, dyslipidemia and breathing disorders thus increased risk of complications [20].

Right side is considered difficult due to the liver covering the hilum and upper pole, close proximity of the inferior venacava and duodenum. Increased difficulty with higher conversion rates for right side had been reported in studies [14,21]. In our study laterality did not affect the difficulty scale and complication rates. Higher complication rate and longer hospital stay had been reported in patients undergoing right laparoscopic nephrectomy after open cholecystectomy due to adhesions [22].

Studies assessing association of prior intervention with intraoperative difficulty have yielded conflicting results. We did not find association of increased intraoperative difficulty with history of prior intervention and the type of intervention, open or endoscopic. Other studies had also observed similar perioperative outcomes in those with or without prior surgery although prolonged operative duration was noted in those with prior intervention [4,23,24]. In contrast, higher rate of conversion to open surgery, higher complication rate, higher transfusion rate and increased intraoperative difficulty was reported in patients with previous intervention [23,25,26]. 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, 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 during or after percutaneous renal stone surgery can result in scarring [27].

Laparoscopic surgery in the patients with large hydronephrotic kidney can be challenging due to the difficulty in port placement, limited manipulating space, and difficulty in approaching the renal hilum [8,28]. We did not find association of kidney size with the intraoperative difficulty. We routinely puncture and drain the grossly enlarged hydronephrotic kidneys early in the dissection as described by Challocombe and colleagues [29]. Shah et al. [11] also did not 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 was found to be associated with higher complication rate and increased intraoperative difficulty [18,30]. This increased difficulty might be related to perirenal adhesions caused by repeated urinary infections associated with obstruction. 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 [9,31]. Laparoscopic nephrectomy for atrophic kidney may be difficult because of dense perinephric adhesions and difficulty in identifying the kidney itself [11].

In the present study, presence of percutaneous nephrostomy significantly correlated with the difficulty scale in univariate analysis and not on multivariate analysis. Similarly, Shah et al. [11] did not find increased intraoperative difficulty in the presence of nephrostomy. In contrast, Gahlawat et al. [9] and Adiga et al. [32] 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. In transperitoneal approach, the PCN related adhesions affects the lateral aspect of the kidney which is dissected at the end thus posing lesser difficulty unlike in retroperitoneal approach where nephrostomy related adhesions limits the initial working space. The need of nephrostomy for conditions such as pyonephrosis conditions might also contribute to the difficulty.

Pyonephrosis leads to 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 requiring conversion to open surgery had pyonephrosis. Patients with pyonephrosis experienced higher blood loss, transfusion rates, complication rates with prolongeed operative duration and hospital stay. Similar higher intraoperative difficulty in those with pyonephrosis was documented in other studies [11,18].

Majority of the stones leading to NFK were located in the kidney followed by ureter in the present study. Staghorn stones was 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 could may contribute to the difficult hilar dissection.

Xanthogranulomatous pyelonephritis due to long standing obstruction due to renal stones is considered the most challenging for laparoscopic nephrectomy with higher rate of conversion to open surgery and complications [33,34]. 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 with inability to objectively quantify every aspect. Being 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 factors such as instruments, supporting personnel etc. The surgeons' subjective evaluation may also 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 we had a single patient with that condition. Also, the association of difficulty with multiple renal vessels, location of kidney and nature of fat was not evaluated in this study.

6. CONCLUSION

Pyonephrosis was associated with significant increase in intraoperative difficulty during laparoscopic nephrectomy for nonfunctioning kidney due to urolithiasis. Laparoscopic nephrectomy due to urolithiasis in the presence of pyonephrosis was 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 further adds to the complexity of the surgery. Hence, surgeons in initial phase of the learning curve should be careful when selecting patients with pyonephrosis for laparoscopic nephrectomy.

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).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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