Original Article

Clinicoradiological parameters predicting operative difficulty in laparoscopic partial nephrectomy for renal tumors

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ABSTRACT

Introduction: The number of renal tumors amenable to laparoscopic surgery is rising, both, due early detection by improved imaging techniques and due to progressive improvements in minimal access surgery. Conversion to open surgery, which is a significant event, can be minimized by proper case selection. We assessed the pre-operative factors that can predict the operative difficulty and can help in case selection, thus avoiding complications and reducing the chances of conversion to open.

Methods: One hundred and sixteen patients (73 males and 43 females) with the mean age of 50.78 ± 14.2 years, meeting the inclusion criteria underwent transperitoneal laparoscopic partial nephrectomy (LPN). Various clinical, anthropometric, radiological, and pathological parameters were recorded. Intraoperative difficulty was assessed and graded on a scale of 1 (easiest) to 4 (most difficult or open conversion) by an independent observer to calculate the difficulty score, which along with the other parameters of operative difficulty, was used to calculate the difficulty scale. Significant parameters on the univariate analysis, were subjected to a multivariate analysis, to find parameters that can predict the operative difficulty.

Results: The mean age was 52 ± 14.29 years, mean size was 4 ± 1.04 cm, male:female ratio was 1.6:1, most of the tumors were exophytic (60%) and anteriorly located (62%) and had a mean perinephric fat surface density (PnFSD) of 6446.026 ± 2244 surface density pixel units (SDPU). On the univariate analysis, age >60 years, Eastern Cooperative Oncology Group performance score >1, presence of perinephric fat stranding, increased PnFSD (>10,000 SDPU), large tumor size (>4 cm), hilar/posterior location, endophytic tumors and higher clinical stage were significantly associated with intraoperative difficulty. However, on the multivariate analysis, no single factor could independently predict intraoperative difficulty in LPN for Renal tumors.

Conclusion: It is difficult to predict the intra-operative difficulty during LPN. Feasibility of LPN should be based on multiple factors rather than a single factor.

INTRODUCTION

The annual incidence of renal cell carcinoma (RCC) in Indian males is 2/Lakh population and is 1/lakh population in females. The incidence in the Indian subcontinent is much lower than that in the western world due to lifestyle differences and documentation and reporting issues.[1,2] With the increased use of advanced imaging such as computed tomography (CT), the incidence of small renal masses is rising and has resulted in an increased

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utilization of laparoscopic partial nephrectomy (LPN).[3] With the rapid and progressive improvements in minimal access surgery, the other modalities of surgical treatment such as the robot-assisted laparoscopic nephrectomy are also being increasingly utilized. Conversion from laparoscopic renal surgery to open surgery is a rare but significant event. The literature regarding the preoperative risk factors which can predict the conversion to open surgery during LPN is limited. Multitude of factors have been shown to affect the operative difficulty. Researchers have tried to predict the operative difficulty of a surgical procedure based on the clinico-radiological parameters for proper case selection with an intention to reduce the intraoperative complications and the chances of conversion, without affecting the oncological outcome. The purpose of this study was to determine whether anatomic or radiologic parameters could accurately predict the operative difficulty during LPN. Preoperative determination of the operative difficulty is helpful in case selection, especially during the surgeon's early experience, when their comfort level with the procedure is low, thereby assisting in counseling the patients about the chances of complications and open conversion.

MATERIALS AND METHODS

This was a prospective observational study performed at the Department of Urology and Renal transplant, ABVIMS, and Dr. R. M. L Hospital from 2019 to 2022 over the period of 2½ years. Ethics committee approval was obtained from the Institutional Ethics Committee (No. TP [DM/MCH] [19/2019]/IEC/ABVIMS/RMLH 1868) and an informed written consent was obtained from all the patients before the enrollment. The authors confirm the availability of, and access to, all the original data reported in this study. A total of 186 patients with renal tumors were assessed, of whom 116 patients fulfilling the inclusion criteria (all renal masses with a size of ≤7 cm), were selected for LPN. Patients with tumors >7 cm or those with involvement of the renal vein, pelvicalyceal system, renal sinus, perirenal fat, or patients in whom the laparoscopic surgery as such was contraindicated were excluded from the study. All the surgeries were carried out by a single surgeon with good experience in laparoscopy (>40 cases).

Clinical, anthropometric, and radiological parameters of interest were recorded. Radiological parameters of interest were assessed by Contrast enhanced CT (CECT) scan of the abdomen, pelvis and chest. CT angiography was performed in all the patients for the assessment of vascular anatomy. Tumors located on the ventral surface were designated as "anteriorly,", those on the dorsal surface as "posteriorly" and those at hilum as "hilar tumors".

Perinephric fat surface density

Perinephric fat surface density (PnFSD) was measured on the CECT image, at the level of the ipsilateral renal hilum [Figure 1a]. The CT slice of interest in the Digital Imaging and Communications in Medicine format was loaded onto the ImageJ software version 1.47 f. After manually outlining the area of perinephric fat, which is delineated by the Gerota's fascia, both the area and the surface density measurements were automatically determined by the ImageJ software, based on a previously published institutional study of visceral adipose tissue using the predefined Hounsfield unit thresholds of –190 to –30. In the area of interest, we counted the total amount of pixels that had a threshold value of –190 to –30. The total pixel value was divided by the percentage area covered by the pixels with a value of –190 to –30. The result was a calculated surface density unit, which we referred to as a "surface density pixel unit (SDPU).[4]

RENAL nephrometry score

This score is based on 5 anatomical features of solid renal masses. Of the 5 components, 4 are scored on a 1, 2, or 3-point scale and the 5th indicates the anterior or posterior location of the mass, relative to the coronal plane of the kidney. It categorizes renal masses into low, intermediate and high complexity.

Perirenal fat thickness

Anterior: Distance from the anterior renal capsule to the closest overlying bowel or the posterior peritoneum at the level of renal hilum [Figure 1b].

Posterior: Distance from the posterior renal capsule to the anterior layer of the lumbodorsal fascia over the psoas or quadratus lumborum muscle at the level of the renal hilum [Figure 1b].

Lateral: Distance from the renal capsule laterally to the inner surface of the abdominal wall at the level of the renal hilum [Figure 1b].

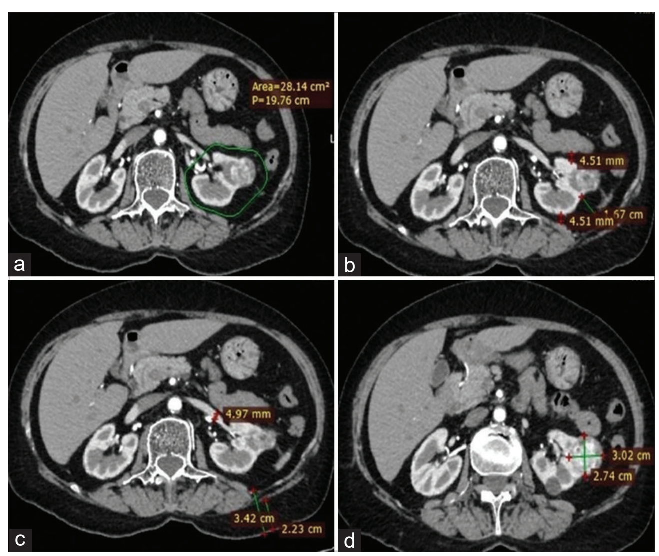

Figure 1: (a) Area of interest for assessment of PnFSD, (b) Various parameters of perirenal fat thickness, (c) Abdominal wall, hilar thickness, (d) Assessment of tumor size. PnFSD = Perinephric fat surface density

Renal hilum thickness: Thickness of the renal hilum, 2 cm proximal to the level of the entry of vessels into the kidney [Figure 1c].

Total abdominal thickness: Thickness at the lateral border of erector spinae muscle at the level of the hilum (shown in Figure 1c).

Size of tumor: Size was measured at two maximum dimensions in small renal masses [Figure 1d].

Operative difficulty

All the partial nephrectomies were divided into two phases:

- Phase I: Colonic mobilization to clamping of the renal pedicle
- Phase II: Tumor excision, renal reconstruction till the retrieval of the specimen.

A single surgeon performed all the laparoscopic partial nephrectomies. An independent observer, well versed with the operative procedure and blinded to the clinical history, examination, and CT findings, graded the operative difficulty of each phase (difficulty graded on a scale of 1–4 (1 – very easy, 2 – easy, 3 – -difficult, and 4 – very difficult)). If any procedure was converted to open surgery, a score of four was given for each phase after the conversion. After adding the difficulty grades of each phase, the difficulty score was calculated. Difficulty score (2–8) = Difficulty grade (Phase I [1–4] + Phase II [1–4].

Patients were objectively categorized into easy and difficult by the "Difficulty scale" based on four parameters, i.e., difficulty score, ToT, WIT and EBL. Each parameter was given points from 1 to 3 depending on the percentile, i.e., <25th percentile of the parameter – 1 point, 25th to 75th percentile – 2 points, and >75th percentile – 3 points [Table 1].

Difficulty scale (4–12) = Difficulty score (1–3) + ToT (1–3) + WIT (1–3) + EBL (1–3).

Out of a total of 12 points on the difficulty scale, the cases with a total of 7 points or less were included in the Group I (easy), and patients with 8–12 total points were included in the Group II (difficult).

Operating time (in minutes)

Phase-wise operative time was calculated and the meantime was taken as the standard. In the case of conversion from laparoscopy to open, ToT was taken as the operative time.

Table 1: Parameters for evaluating operative difficulty

Difficulty Parameter	Difficulty points		
	1	2	3
Difficulty score	2–4	5–6	7–8
Total operative time	150–170	171–240	>240
Warm ischemia time	20–30	31–45	>45
Blood loss	200–340	341–1000	>1000

Warm ischemia time

The WIT was measured between the clamping and unclamping of the renal artery.

Estimated blood loss

Was calculated from blood in the suction unit (total output – Saline used for irrigation).

Postoperative complications

All complications till the discharge of the patient or any other significant complication within 30 days from the date of surgery.

Analysis

The categorical variables were presented as numbers and percentages (%) while the quantitative data was presented as the mean ± standard deviation and median with 25th and 75th percentiles (interquartile range). The normality of the data was assessed by Kolmogorov–Smirnov test and for the non-normal data nonparametric tests were used. The statistical tests applied for the results were:

- Mann–Whitney *U* Test (for two groups) and Kruskal–Wallis test (for more than two groups) for the comparison of the variables which were quantitative and not normally distributed
- Chi-Square test for variables which were qualitative in nature. If any cell had an expected value of <5 then Fisher's exact test was used
- Spearman rank correlation coefficient was used to correlate the difficulty score, ToT, warm ischemia time, EBL, complications with each other
- Multivariate logistic regression was used to find out independent risk factors for difficult LPN.

The data entered on a Microsoft EXCEL spreadsheet and Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, Illinois, USA, version 21.0. was used for the final statistical analysis. $P < 0.05$ was considered statistically significant.

The general outline of the study is presented in Figure 2.

RESULTS

The mean ToT (minutes), warm ischemia time (minutes), EBL (ml) and difficulty score in the easy and the difficult groups were 166.4 ± 17.61 min, 24.8 ± 5.93 min, 284.21 ± 65.71 mL, 3.87 ± 1.24 and 226.25 ± 30.52 min, 26.25 ± 24.12 min, 993.75 ± 134.01 mL, 8 ± 0, respectively Table 2]. The proportion of patients with advanced age (>60 years) and Eastern Cooperative Oncology Group (ECOG) status >1 were significantly lower in the easy laparoscopic group compared to the difficult group.

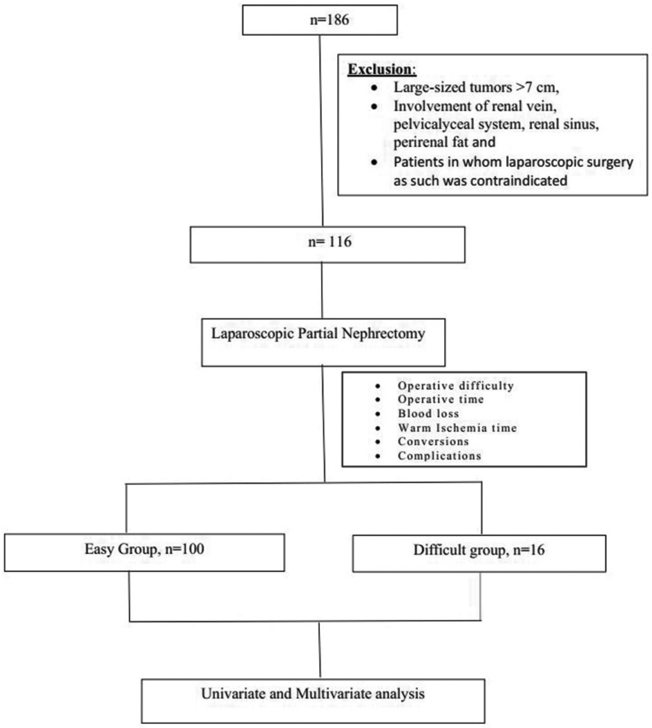

Figure 2: Study design

Thirty seven percent of the cases in the difficult group were chronic smokers compared to 20% in the easy group, which was not statistically significant [Table 3]. No significant association was seen in the anthropometric profile between the two groups [Table 3]. The mean size (cm) of the tumor in the difficult laparoscopic group was 6 cm compared to 3.7 cm in the easy laparoscopy group (P < 0.0001). The mean perinephric fat surface density (PnFSD) in SDPU in the difficult laparoscopic group was 11654 compared to 5444 in the easy group (P < 0.0001) [Table 3]. Complications were noted in 24% of the patients (bleeding 10%, atelectasis 4.3%, ileus 3.4%, and urinary leak 2.5%). Bleeding was the most common complication and was responsible for 50% of the conversions in the difficult group. On the multivariate logistic regression, none of the factors was found to be an independent predictor of difficulty during.

DISCUSSION

In the present study, various preoperative factors were assessed for their ability to predict the operative difficulty during the LPN. The aim was to generate data based on which the ease of performing LPN could be assessed preoperatively, so as to help in appropriate patient selection and counselling and to minimize the intraoperative complications and conversion to open surgery. After analysis of the data, a difficulty scale based on four parameters (difficulty score, ToT, warm ischemia time, and blood loss) was created. Each parameter had a score from 1 to 3 depending on the percentile, <25th percentile of parameter - 1 point, 25th to 75th percentile –2 points and >75th percentile –3 points. A patient with a score of ≤7 was included in the easy group whereas those with 8–12 points were classified in the difficult group. This type of scale allows for the assessment of operative difficulty prospectively in contrast to the retrospective studies.[5,6]

Table 2: Distribution of markers of operative difficulty in the two groups

Parameter	Easy group	Difficult group	*P*
Conversion to open	0 (0%)	10 (62.50%)	<0.0001
Difficulty score (Mean±SD)	3.87±1.24	8±0	<0.0001
Warm ischemia time (min) (Mean±SD)	24.8±5.9	26.25±24.1	<0.0001
Total operative time (min) (Mean±SD)	166.4±17.6	226.25±30.5	<0.0001
Estimated blood loss (mL) (Mean±SD)	284±65.7	993.75±134.0	<0.0001

SD=Standard deviation

Patients with advanced age (>60 year) and poor performance status (ECOG >1) had higher intraoperative difficulty whereas no such association was found with smoking. Matin *et al.*[7], in their retrospective study, did not find any significant correlation between poor performance score and the operative difficulty. Contrary to the their findings, Rais-Bahrami *et al.*[8] observed a 3.8-fold higher rate of conversion in patients aged ≥70 years. Low threshold for conversion to open surgery, because of hemodynamic instability, could have been the reason of our observation. Smoking, theoretically can increase the operative difficulty as nicotine induces fibrosis around the tissues,[9] but the intraoperative difficulty was not found to be higher among the smokers in our study.

The intra-operative difficulty amongst males and females was similar in our study. Sammon *et al.*[10] also did not find a difference in the intraoperative difficulty during laparoscopic nephrectomy in respect to the gender of the patient.

Also, obesity was not found to increase the intraoperative difficulty in our study. However, Anast *et al.*[11] reported a longer operative time and higher blood loss in obese patients compared with the nonobese patients but the complications, conversion rates, analgesia requirements, and the length of the hospital stay were similar. The limited number of obese patients in our study could have resulted in this insignificant difference in the intra-operative difficulty. The incidence of obesity is rising and a higher number of RCCs are being diagnosed in obese patients. Its impact on complications and outcomes remain unclear and more studies with larger sample size are required to draw firm conclusions.

Various measurements relating to the body habitus were recorded at the induction of anesthesia at the time of surgery with the patient in the supine position. Unfortunately, none

Table 3: Association of clinal, anthropometric and radiological parameters with difficult laparoscopy

Clinical, Anthropometric, and Radiological parameters	Easy (*n*=100), *n* (%)	Difficult (*n*=16), *n* (%)	Total, *n* (%)	*P*
Age ≤60 years	95 (95)	6 (37.5)	101 (87.06)	0.0002*
Male	60 (60)	13 (81.25)	73 (62.93)	0.162*
ECOG >1	0	5 (31.25)	5 (4.31)	<0.0001*
Past surgery	5 (5)	3 (18.75)	8 (6.90)	0.079*
Smokers	20 (20)	6 (37.50)	26 (22.41)	0.119†
BMI ≤25, *n* (%)	95 (95)	14 (87.50)	109 (93.97)	0.248*
Umbilicus to xiphoid process (cm)	17 (16–18)	17 (17–18)	17 (16–18)	0.278‡
Umbilicus to the tip of the eleventh rib (cm)	15 (14–16)	16 (16–17)	15 (14–16)	0.26‡
Umbilicus to anterior superior iliac spine (cm)	14 (13–15)	16 (15–16)	14 (13–16)	0.41‡
Umbilicus to pubis (cm)	34 (32.75–34)	33 (33–34)	34 (33–34)	0.421‡
Abdominal girth at the umbilicus (cm)	97 (95–98)	98 (97–100)	97 (95–98)	0.51‡
Location				
Lateral	5 (5)	0	5 (4.31)	<0.0001*
Anterior	70 (70)	0	70 (60.34)	
Posterior	25 (25)	8 (50)	33 (28.45)	
Hilar	0	8 (50)	8 (6.90)	
Laterality (L:R)	40:60	4:12	44:72	0.284*
Growth pattern				
Exophytic	70 (70)	10 (62.50)	80 (68.97)	0.045*
Endophytic	15 (15)	6 (37.50)	21 (18.10)	
Completely endophytic	15 (15)	0	15 (12.93)	
Positive Lymph nodes	5 (5)	3 (18.75)	8 (6.90)	0.079*
Abnormal Vessel	5 (5)	3 (18.75)	8 (6.90)	0.079*
cT-stage				
T1a	80 (80)	0	80 (68.34)	<0.0001*
T1b	20 (20)	16 (100)	36 (31.03)	
Peri renal fat stranding present	0	5 (31.25)	5 (4.31)	<0.0001*
Size (cm)	3.7 (3.275–4.05)	6 (5.875–6.25)	3.8 (3.3–5)	<0.0001‡
PnFSD in SDPU	5444 (5146.75–6156.75)	11,654 (10,808.75–12,328)	5478 (5200–6780)	<0.0001‡
Perirenal fat thickness posterior (mm)	17.5 (8–20)	12 (11–13)	16.5 (8–20)	0.095‡
Perirenal fat thickness lateral (mm)	9 (7.75–12)	9.1 (8–10)	9 (8–12)	0.84‡
Perirenal fat thickness anterior (mm)	7 (5.75–8.25)	8 (7.25–11)	7 (5.75–9)	0.106‡
Renal hilum thickness (mm)	11 (9.75–12.25)	11 (11–13)	11 (10–13)	0.466‡
Total abdominal wall thickness (mm)	34 (32.75–36.5)	37.5 (36–40)	35 (33–38)	0.26‡
Subcutaneous fat thickness (mm)	21 (20–22)	25 (23–26)	22 (20–23)	<0.31‡

*Fisher's exact test. †Chi square test. ‡Mann Whitney test. ECOG=Eastern Cooperative Oncology Group. BMI=Body mass index. SDPU=Surface density pixel unit, , PnFSD=Perinephric fat surface density, cT=Clinical T stage

of these were found to correlate with the operative difficulty. Similar parameters were examined by Ratner *et al.*[12] and they found that the technical difficulty of laparoscopic nephrectomy could be predicted based on the parameters related to the body habitus. Operative difficulty is also dependent on factors such as the amount of laparoscopic working space, quality of tissue planes, and retractability of the colon and mesocolon; factors that, to date, are not quantifiable.

The size of the the tumor was significantly associated with intraoperative difficulty and higher conversion rates. These results were similar to those reported by Patard *et al.*[13] who found a significantly higher mean operative time ($P=0.002$), mean blood loss ($P=0.01$), blood transfusion rate ($P=0.001$), and urinary fistula rate ($P=0.01$) in patients with tumors >4 cm undergoing LPN.

PnFSD was found to positively correlate with the intraoperative difficulty during LPN in our study. Zheng *et al.*[4] also found that the PnFSD positively correlated with the total surgical duration and the operative difficulty (Pearson's correlation coefficient 0.314, $P=0.04$). PnFSD is an independent prognostic factor for determining the difficulty of perinephric fat dissection due to the presence of "sticky" fat. Increased PnFSD makes the dissection around the kidney difficult, which is required to delineate the tumor properly during the partial nephrectomy and thus these cases also tend to have higher blood loss.

We also assessed various perirenal parameters and abdominal wall parameters but none was found to contribute significantly with the operative difficulty. Similar parameters were also assessed by Gahlawat *et al.*[5] and none was found to significantly predict the opertative difficulty. These parameters were assessed based on the clinical experience at our institute, where it was previously noticed that an increase in the lateral wall thickness may increase the distance from the tip of the instrument to the body surface. Accordingly, the distance from the handle of the instrument to the body surface decreases, potentially leading to a contact between the handle and the abdominal wall. The resultant awkward hand positioning may result in increased operative time and difficulty. Perirenal parameters were presumed to help in predicting the amount of laparoscopic working space, however, it appears that working space is influenced by many other factors rather than the peri-renal parameters alone.

RENAL Nephrometery score was used to predict the intraoperative difficulty, complications, and conversion to open surgery during the LPN in our study. We found that the higher the score was, the greater was the operative difficulty. Okhunov *et al*.[14] studied the reliability of various radiological scoring systems (SS) and their predictive capacity for intraoperative difficulty during the nephron-sparing surgery (NSS). They did not find a significant association between any of the three SS and the complications, Operative time (OT), or EBL and hence the operative difficulty. This could be due to the larger size of the tumors and a higher number of hilar/posteriorly located tumors in the difficult group in their study. The value of SS in predicting the perioperative outcomes still remains controversial.[15,16] In fact, with the advancement in minimal access surgery, NSS is being offered to patients with larger tumors and those with highly complex tumors.[17,18]

Perinephric fat stranding was assessed preoperatively in all the patients on the CT scan and correlated significantly with the intraoperative difficulty ($P < 0.0001$). Perinephric fat stranding, described on the CT scan, is a sign of chronic inflammation,[19,20] and in our study, the surgeon's score was found to be higher in patients with perinephric fat stranding.

Renal vascular anomalies were not associated with an increase in the difficulty of LPN. Similar findings were noted with regard to the laterality of the tumor, also. Akaihata *et al*.[21] also did not find any relation between the involved side and the intraoperative difficulty, mean operative time and EBL.

We found that the T1b tumors had higher intra-operative difficulty as compared to the T1a. Similar results were reported by Pierorazio *et al*.[22] The higer operative difficulty in T1b tumors could be ascribed to the reduced working space and the distorted anatomy.

On the univariate analysis, advanced age, poor performance status, fat stranding, PnFSD, tumor size, posterior, hilar location of tumor, and higher tumor stage were the pre-operative factors that could predict the intra-operative difficulty. However none of these factors were found to be significant on the multivariate analysis. This could be due to the co-linearity between the various preoperative parameters.

Limitations

In our study, laparoscopic surgery was performed by a single surgeon and all the cases were operated by the transperitoneal route. Thus, the experience of the surgeon was not taken into the consideration while deciding the operative difficulty. Three dimensional reconstruction, which provides superior anatomic images, was not used in our study, as the required software was not available. Also, only the effect of smoking on the operative difficulty was assessed and not that of tobacco chewing, which is more common in our population.

CONCLUSION

Intraoperative difficulty cannot be predicted based on the clinical, anthropometric, and radiological data. Even though the tumor size, PnFSD, fat stranding, posterior/hilar location, and clinical stage can predict the intraoperative difficulty, they are so much interrelated to each other, that it is difficult to single out one parameter that can predict the intraoperative difficulty.

Ethical approval

Ethical approval is taken from the institutional ethical committee.

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REFERENCES

1. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2018;68:394-424.
2. Jemal A, Siegel R, Ward E, Murray T, Xu J, Thun MJ. Cancer statistics, 2007. CA Cancer J Clin 2007;57:43-66.
3. Chow WH, Devesa SS, Warren JL, Fraumeni JF Jr. Rising incidence of renal cell cancer in the United States. JAMA 1999;281:1628-31.
4. Zheng Y, Espiritu P, Hakky T, Jutras K, Spiess PE. Predicting ease of perinephric fat dissection at time of open partial nephrectomy using preoperative fat density characteristics. BJU Int 2014;114:872-80.
5. Gahlawat S, Sood R, Sharma U, Khattar N, Akhtar A, Pandey PK, *et al.* Can preoperative clinicoradiological parameters predict the difficulty during laparoscopic retroperitoneal simple nephrectomy? – A prospective study. Urol Ann 2018;10:191-7.
6. Shah P, Ganpule A, Mishra S, Sabnis R, Desai MR. Prospective study of preoperative factors predicting intraoperative difficulty during laparoscopic transperitoneal simple nephrectomy. Urol Ann 2015;7:448-53.
7. Matin SF, Abreu S, Ramani A, Steinberg AP, Desai M, Strzempkowski B, *et al.* Evaluation of age and comorbidity as risk factors after laparoscopic urological surgery. J Urol 2003;170:1115-20.
8. Rais-Bahrami S, Lima GC, Varkarakis IM, Romero FR, Trock B, Jarrett TW, *et al.* Intraoperative conversion of laparoscopic partial nephrectomy. J Endourol 2006;20:205-8.
9. Jensen K, Nizamutdinov D, Guerrier M, Afroze S, Dostal D, Glaser S. General mechanisms of nicotine-induced fibrogenesis. FASEB J 2012;26:4778-87.

10. Sammon J, Trinh QD, Sun M, Bianchi M, Schmitges J, Shariat SF, *et al.* The effect of gender on nephrectomy perioperative outcomes: A national survey. Can J Urol 2012;19:6337-44.
11. Anast JW, Stoller ML, Meng MV, Master VA, Mitchell JA, Bassett WW, *et al.* Differences in complications and outcomes for obese patients undergoing laparoscopic radical, partial or simple nephrectomy. J Urol 2004;172:2287-91.
12. Ratner LE, Smith P, Montgomery RA, Mandal AK, Fabrizio M, Kavoussi LR. Laparoscopic live donor nephrectomy: Pre-operative assessment of technical difficulty. Clin Transplant 2000;14:427-32.
13. Patard JJ, Pantuck AJ, Crepel M, Lam JS, Bellec L, Albouy B, *et al.* Morbidity and clinical outcome of nephron-sparing surgery in relation to tumour size and indication. Eur Urol 2007;52:148-54.
14. Okhunov Z, Rais-Bahrami S, George AK, Waingankar N, Duty B, Montag S, *et al.* The comparison of three renal tumor scoring systems: C-Index, P.A.D.U.A., and R.E.N.A.L. Nephrometry scores. J Endourol 2011;25:1921-4.
15. Yeon JS, Son SJ, Lee YJ, Cha WH, Choi WS, Chung JW, *et al.* The nephrometry score: Is it effective for predicting perioperative outcome during robot-assisted partial nephrectomy? Korean J Urol 2014;55:254-9.
16. Acar Ö, Işık EÖ, Mut T, Sağlıcan Y, Onay A, Vural M, *et al.* Comparison of the trifecta outcomes of robotic and open nephron-sparing surgeries performed in the robotic era of a single institution. Springerplus 2015;4:472.
17. Masson-Lecomte A, Yates DR, Bensalah K, Vaessen C, de la Taille A, Roumiguié M, *et al.* Robot-assisted laparoscopic nephron sparing surgery for tumors over 4 cm: Operative results and preliminary oncologic outcomes from a multicentre French study. Eur J Surg Oncol 2013;39:799-803.
18. Kopp RP, Liss MA, Mehrazin R, Wang S, Lee HJ, Jabaji R, *et al.* Analysis of renal functional outcomes after radical or partial nephrectomy for renal masses ≥7 cm using the RENAL score. Urology 2015;86:312-9.
19. Thornton E, Mendiratta-Lala M, Siewert B, Eisenberg RL. Patterns of fat stranding. AJR Am J Roentgenol 2011;197:W1-14.
20. Bylund JR, Qiong H, Crispen PL, Venkatesh R, Strup SE. Association of clinical and radiographic features with perinephric "sticky" fat. J Endourol 2013;27:370-3.
21. Akaihata H, Haga N, Yanagida T, Aikawa K, Ishibashi K, Takahashi N, *et al.* Does body habitus of patients affect operative difficulty during retroperitoneal laparoscopic radical nephrectomy? J Endourol 2013;27:208-13.
22. Pierorazio PM, Hyams ES, Lin BM, Mullins JK, Allaf ME. Laparoscopic radical nephrectomy for large renal masses: Critical assessment of perioperative and oncologic outcomes of stage T2a and T2b tumors. Urology 2012;79:570-5.

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