

Mini- Laparoscopic Simple Nephrectomy Critical Assessment through A Randomized Trial

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ABSTRACT

Background: The conversion from open to laparoscopic simple nephrectomy was considered as an initial and most dramatic step toward progression, the second step is trying to miniaturization of the endoscope and instruments, in this study we aimed to evaluate miniaturization of laparoscopic simple nephrectomy looking for reduction perioperative morbidity and enhance cosmesis without significant operative disability.

Patient and Methods: We prospectively reviewed 120 patients (60 in each group) who underwent trans-peritoneal conventional laparoscopy (CL) or mini laparoscopy (ML) simple nephrectomy between April 2015 and May 2018. The CL was done using 3 to 4 ports ranged from 5 to 12 mm in diamond manner distribution. ML was done using same ports number and distribution ranged from 3- 5 mm except umbilical one was 10 mm. All operations were performed by same surgeon

Results: However, ML experienced a significant longer operative time, significant more blood loss and insignificant increased conversion rate. The Post-operative data in the interest of ML were as follows; significantly lower pain scores, lower hospital stay, earlier return to activities and significant increase of cosmesis score of patients, Lastly, port site hernia was 6.7% in CL group and none in ML group ($p = 0.042$)

Conclusion: ML trans-peritoneal simple nephrectomy is associated with lower post-operative pain, hospital stay, early return to normal activity, better cosmesis and less port site hernia. However operative time, blood loss and conversion rate are potentially more than CL.

Keywords: Laparoscopy, simple nephrectomy, conventional laparoscopy, mini-laparoscopy.

INTRODUCTION

One of the driving forces behind the development of laparoscopy has always been to decrease the morbidity of a classic open surgery. After first laparoscopic nephrectomy, which had been carried out by **Clayman *et al.***^[1]. Its beneficial outcome over laparotomy was proven via **Rozenberg *et al.***^[2]. This conversion was the initial and most dramatic step in this progression. Simple nephrectomy is the standard procedure for the removal of non-functioning benign kidney. Simple laparoscopic nephrectomy may be a challenging procedure especially during fibrous tissue dissection in post inflammatory renal condition such as recurrent renal infections, renal stone diseases and previous renal surgeries. These challenging conditions were considered as relative contraindication to laparoscopy^[3].

By the time surgeons have gotten more experience as well as rapid development of optical technology and instrument design, laparoscopy gave a good chance to miniaturization of the endoscope and instruments. Looking for reduction of perioperative morbidity and enhancement of cosmesis without significant operative disability. Mini-laparoscopy is defined as surgery with instruments that are 3-5 mm in diameter by the fact that ML allows minimal abdominal scar. Meanwhile, preserving the key principle of triangulation. Early results suggested that mini-laparoscopic procedures in the hands of experienced laparoscopic surgeons appear to be safe and effective with minimally perceptible scarring^[4]. Although promising, clear advantages in reducing

perioperative pain and morbidity have yet to be determined. During the last years, several mini-

laparoscopic urological procedures either diagnostic or intervened have been successfully performed^[5,6]. But, up to now, overall available evidence across the literature remains poor in fair assessment of mini-laparoscopic nephrectomy as compared to conventional maneuver in the presence of expert surgeon and suitable equipments.

We aimed to prove that mini-laparoscopic (ML) nephrectomy can reduce the invasiveness of standard technique, improving cosmetic outcome and recovery without significant operative and peri operative complications.

PATIENT AND METHODS

We prospectively reviewed the records of 120 patients who underwent laparoscopic simple nephrectomy for various renal conditions at our department between April 2015 and May 2018.

Ethical approval: The institutional ethics committee for research approved the study ; informed consents were obtained from all patients participating in the study. Those who signed the informed consent were included.

Exclusion criteria: Patients who had a contraindication to laparoscopic surgeries (e.g. coagulopathy, American

Society of Anesthesiologists (ASA) > grade II, patients under therapy for psychiatric problems and pregnancy).

They underwent trans-peritoneal CL or ML depending on randomization via closed envelope method. All operations were performed by the same laparoscopic surgeon. The primary outcome was post-operative cosmeses.

As an initial steps preoperatively, all patients underwent history taking, physical examination and routine laboratory investigations were carried out. In addition, before simple nephrectomy non-contrast computerized tomography (NCCT) and radioisotope renography and renal functions were evaluated by dimercaptosuccinic acid (DMSA) scintigraphy and the kidneys that had < 10 % total renal uptake were defined as non-functioning.

Trans-peritoneal simple conventional laparoscopic (CL) nephrectomy technique^[7-10].

The procedure was performed under general anaesthesia with the patient in full lateral flank position; three to four ports (from 5 to 12 mm), which were distributed as a diamond-shaped distribution. The kidney was extracted through an iliac crest port site after sufficient wound extension.

Trans-peritoneal simple (ML) nephrectomy technique^[11]

In ML using same ports number and distribution ranged from 3- 5 mm except umbilical one was 10 mm. At the time of renal pedicle control interchange of instruments Hem-o-lok–stapler used through umbilical port. While a smaller endoscope (5 mm) was temporary shifted to the other working ports. Finally, umbilicus port site was extended enough through zigzag like incision and peritoneal cavity was exposed by splitting incision of rectus muscle to retrieve the specimen through it. Wound was drained and ports sites were closed .

Estimated blood loss (EBL), intraoperative complications, (bleeding, bowel or solid organ injury, anesthetic adverses) postoperative complications measured by modified Clavien-Dindo classification^[12], postoperative assessment and early pain and analgesic requirements 3 days post-surgery according to visual analogue scale (VAS)^[13], HB deficit, needing of blood transfusion, hospital stay and time to return to normal activities. After at least 3 months: port site hernia and cosmeses results were assessed by two physicians about skin scar development. At the same time, all patients evaluated themselves about their skin scar formation with patient scale and observer scale (POSAS)^[14].

Statistical analysis

All data were computed using a commercial program "SPSS" (version 20). Categorical variables were compared using Chi-Square test or fisher exact test.

Continuous variables were compared using t-test for parametric data and Mann-Whitney-u test for non-parametric data. P value ≤ 0.05 was the cut off for significance of the differences between the two groups.

RESULTS

120 patients were subjected to laparoscopic simple nephrectomy of non-function kidneys. Base line demographic properties of study were comparable. As regards clinical presentation, the most common symptomatology was pain. CT imaging revealed pyelonephritis was predominant picture (Table 1). By checking of preoperative data, operation time was significant decreased in CL when compared to ML group (78.68 ± 12.20 vs 116.10 ± 18.84 minutes respectively). As regards blood loss and hemoglobin deficit in CL and ML, there was significant increase of hemoglobin deficit (0.61 ± 0.38 vs 0.34 ± 0.60 g/dl respectively) and increased blood loss (149.58 ± 33.57 vs 164.50 ± 15.93 ml, respectively) in ML group when compared to conventional. There was one case (1.7%) in conventional versus three cases (5.0%) in ML that needed blood transfusion, which was insignificant in both group (P=0.31) (Table2).

As regards conversion to open; in conventional, there was one case (1.7%) that was converted to open due to anesthetic problem. On the other side in mini, there were three cases (5%) that were convert to open. Two cases (3.3%) due to failure of progression and one case due to intractable bleeding but the difference was not significant.

As regards post-operative data, the postoperative pain was significantly increased in conventional group, the majority of pain category in conventional was moderate type 50 cases (83.3%) and nine cases needed narcotics (sever pain), but in ML group, 38 cases (66.7%) were mild pain and no one need narcotics.

Regarding hospital stay and time to retain normal activities, they ranged from 2-3 days for CL vs 1-3 days for ML and 9-15 days for CL vs 8-12 days for ML. There was statistically significant increase in conventional when compared to ML group [(2.76 ± 0.43 vs 1.72 ± 0.55 respectively for hospital stay) and (13.73 ± 1.55 vs 9.59 ± 1.10 respectively for time to retain normal activities)].

There was statistically significant increase of cosmeses score of patients, observer 1 and observer 2 in conventional when compared to ML group (4.55 ± 0.95 , 3.36 ± 0.66 and 3.05 ± 0.68 vs 1.79 ± 0.73 , 1.37 ± 0.56 and 1.30 ± 0.50 successively) and the different three opinions were nearby in both groups (table 2).

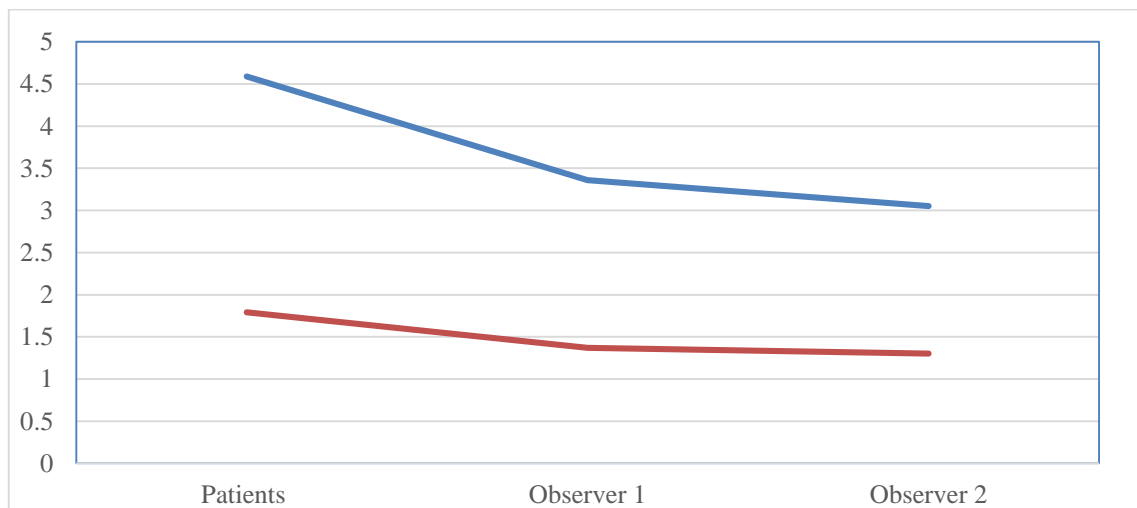
Lastly, port site hernia was reported in 4 patients in conventional group (6.7%) and none in ML group. There was marginal significant increase of port site hernia in conventional when compared to ML group (p=0.042) (table 2).

Table (1): patient demographics, ASA class, symptoms among studied population

Mean(S.D.) /No%		Conventional	mini-laparoscopy	P
Sex	Male	32 (53.3%)	27 (45.0%)	0.36
	Female	28 (46.7%)	33 (55.0%)	
Age		51.48 ± 11.22	47.63 ± 15.77	0.126
BMI		20.04 ± 1.05	20.06 ± 1.15	0.901
ASA	I	48 (80.0%)	47 (78.3%)	0.82
	II	12 (20.0%)	13 (21.7%)	
Symptoms	Fever	30 (50.0%)	30 (50.0%)	1.00
	Pyria	30 (50.0%)	30 (50.0%)	1.00
	Pain	44 (73.3%)	50 (83.3%)	0.18
CT	Hydronephrosis	19 (31.7%)	20 (33.3%)	0.96
	Pyelonephritis	30 (50.0%)	30 (50.0%)	
	Small sized kidney	11 (18.3%)	10 (16.7%)	

Table (2): Outcome among studied populations

Mean (S.D.) /No%		Conventional	Mini-laparotomy	P
Blood loss (ml)		149.58 ± 33.57	164.50 ± 15.93	0.002*
Operative time (minutes)		78.68 ± 12.20	116.10 ± 18.84	<0.001*
Conversion to open		1 (1.7%)	3 (5.0%)	0.30
PO Hospital stay (days)		2.76 ± 0.43	1.72±0.55	<0.004
Cosmoses	Patients	4.59 ± 0.85	1.79 ± 0.73	<0.001
	Observer 1	3.36 ± 0.66	1.37 ± 0.56	<0.001*
	Observer 2	3.05 ± 0.68	1.30±0.50;	<0.001*
Time to return normal activity		13.73 ± 1.55	9.59 ± 1.10	<0.001
Recent complications	None	59 (98.3%)	57 (95.0%)	0.36
	Failure of progression	0 (0.0%)	2 (3.3%)	
PO pain	Mild	1 (1.7%)	38 (66.7%)	<0.001*
	Moderate	50 (83.3%)	19 (33.3%)	
	Severe	9 (15.0%)	0 (0.0%)	
Need to transfusion		1 (1.7%)	3 (5.0%)	0.31
Port site hernia		4 (6.7%)	0(0.0%)	0.042*



Blue line: CL Red line: ML
 Figure (1): Cosmoses score among studied populations of patients, observer1 and observer2

DISCUSSION

In this study we considered that sometimes laparoscopic simple nephrectomy surgery can be more difficult than radical one specially in recurrent and post inflammatory cases.

Mostly due to hilar and perihilar tissue fibrosis, which make the renal pedicle identification and control “as the corner stone step” in this procedure are challenging points in laparoscopic simple nephrectomy either in conventional or mini approach. So, we followed two rules to overcome this situation; the first one we operated within Gerots fascia away from peri nephric adhesions and the second one during hilar dissection the starting point was an identification of aorta or venacava according to surgical side and then continue pedicle dissection in ante grade manner with initial renal artery control. Similar technique was used by some authors before **Hemal et al.** [15], **Hemal and Mishra** [16], **Duarte et al.** [6] and **Kapoor et al.** [17]. We found this technique could convert a problematic case to an easier, faster and less complicated act (bleeding, bowel or solid organ injury and anesthetic adverses) especially in ML. However, following previously mentioned rules, the significant difference was the quality of laparoscopic vision provided by the 5 mm scope that used during clipping of the vessels that was inferior in terms of image resolution, clarity, light transmitting capacity and its position in one of the working ports instead of initial camera port in comparison to a 10 mm laparoscope in camera port (umbilical). To improve vision the camera zoom must set to maximum and this can impair the definition of the image. Moreover, the image is adequate when the operative field is clean, however in case of bleeding the illumination-induced light absorption causes a substantial decrease in image quality. All these technical data leads to significant decrease of operative time in conventional when compared to mini-laparoscopy group (78.68 ± 12.20 vs 116.10 ± 18.84 minutes, respectively). On the other hand, with a deeper look in mini laparoscopy group the significant decrement in operative time comes harmonious with **Dunn et al.** [18] study when they compared the operative time of first ten and last ten cases who subjected to laparoscopic radical nephrectomy the time had been dropped to the half in last ten patients.

In this study the median estimated blood loss (EBL) in cases of conventional laparoscopy (110 to 230 ml) was comparable to the average estimated blood loss (100–300 ml) that was reported in study of **Eskicorapci et al.** [19]. And our mean blood loss (168.40) was comparable to mean blood loss (260.3 ml) that was

reported in study of **Porpiglia et al.** [20]. In ML, the published data by **Soble and Gill** [21], showed that the mean EBL was 30 ml in their large series of ML nephrectomy that wasn't comparable to our study (mean EBL 150.00ml) as it represents our initial experience. In addition to this fact, most kidneys were pyelonephretic 60 cases (50% of study population) and 50% of these sample done via ML approach. Our results were not far from other studies as **Simforoosh et al.** [11] who had no blood transfusion in there study that involved 100 cases (as regard CL) and **Liao et al.** [22] study that reported only 1 case (0.9%) (regarding ML) considering our initial experience as regarding ML.

In 1998 **Keeley and Tolley** [23] recorded high rate of perioperative complications that was 18 % (15 % minor and 3 % major). Rate of conversion was estimated by 5% of cases . The trial which done in this era by **Janetschek** [24], **Barrett** [25], **Rassweiler** [26] and **Dunn** [18] had comparable results.

Although the rate of complications increased with difficult dissectible kidneys as recurrent and pyelonephretic cases, using of advanced equipment, such as the harmonic, ligature and bipolar diathermy enhance results. In this study, intra-operative the only recorded complication was conversion to open technique with insignificant value for both convention and mini ($p= 0.30$) as in conventional there was one case (1.7%) converted to open due to anesthetic problem. On the other side in mini, there were three cases (5%) converted to open. Two cases (3.3%) due to failure of progression and one case due to intractable bleeding.

Regarding complications of ML, **Liao et al.** [22] reported only 1 case (0.9%) that required blood transfusion, and no patients in ML group required conversion. The study of **Abdel-Karim et al.** [27] is not so far from our results in this regard.

One of the main advantages of laparoscopic surgery over open approaches is decreased postoperative pain, but the impact of further reduction in port size is still not yet well established in urologic procedures. The postoperative pain was significantly increased in conventional group, that was of moderate type in 50 cases (83.3%) and nine cases needed narcotics (sever pain). In mini group, 38 cases (66.7%) suffered mild pain and no one needed narcotics because in ML extraction of specimen was done in umbilical area where there was no muscles to be dissected or cut.

Non-urologic prospective randomized studies demonstrated that using smaller incisions significantly reduces postoperative pain scores and analgesic requirements. By comparing conventional and ML,

general surgical procedures showed better pain scores in ML group (3.9 versus 4.9, $P=0.04$)^[28].

Conventional laparoscopic results in our study were comparable to results of **Alan et al.**^[29]. Moreover, in ML the mean visual analogue pain scale was comparable with **Abdel-Karim et al.**^[27].

Shorter hospital stay and time to retain normal activities is also another advantage of ML {(2-3 days for CL vs 1-3 days for ML) and (9-15days for CL vs 8-12 days for ML) respectively}. There was statistically significant increase in conventional when compared to ML group (2.76 ± 0.43 vs 1.72 ± 0.55 respectively for hospital stay) and (13.73 ± 1.55 vs 9.59 ± 1.10 respectively for time to retain normal activities).

Concerning hospital stay, in conventional laparoscopy our study had mean hospital stay 2.76 ± 0.43 that is comparable to the study of **Gill et al.**^[30], with mean hospital stay 1.5 ± 0.8 days and **Abbou et al.**^[31], with mean hospital stay 2.1 ± 0.8 days that generally shows significant advantage of laparoscopy. While in ML, our results are comparable to **Abdel-Karim et al.**^[27] that ranged from 1.9 to 2.2 days. This can be explained by that our study discussed only ablative kidney surgery while their study discussed both ablative and reconstructive surgery that need relatively less time.

As regards time to return to normal activities in conventional laparoscopy, it is comparable with the study of **Hemal et al.**^[32] that had 1.6 weeks to return to normal activity. While in ML our study is not comparable with the study of **Abdel-Karim et al.**^[27] as return to normal activity was 7.4 day that may be due to patient's attitude and not due to surgical difference.

Most of the surgeons dealing with laparoscopic surgeries can agree that majority of patients care about cosmetic results as well as management of main pathology. Using of patient and observer scar assessment scale (POSAS) as an adequate tool designed to evaluate various types of scar subjectively. That put reliability and validity results that cover most scar evaluation quality points as well as the observers' and the patient's insights and compare between results^[14, 33]. One of the advantages in our series was that scars resulting from both techniques (CL and ML) aimed for better appearance of the scar by patients in ML group ($p < 0.001$). There was statistically significant increase of cosmeses score of patients, observer 1 and observer 2 in conventional group when compared to ML group (4.55 ± 0.95 , 3.36 ± 0.66 and 3.05 ± 0.68 vs 1.79 ± 0.73 , 1.37 ± 0.56 and 1.30 ± 0.50 successively). The different three opinions (observer 1, observer 2 and patient) were nearby in both groups. This could be explained by the fact that incision of specimen extraction in conventional

laparoscopy was done in apparent area with muscle cutting and dissection while in ML specimen extraction was done in umbilicus that is considered confusing area and scars in it not annoying to the patient. Our results were in agreement with the published data of PSAQ in several trials as **Abdel-Karim et al.**^[27] with total score of 51. And comparable with **Fiori et al.**^[4] trials comparing standard and ML in urologic procedures. They concluded that ML has better cosmetic outcomes in comparison to standard laparoscopy.

By using smaller trocar sizes, the other advantage of mini-laparoscopy is reduction of the risk of postoperative hernia formation. It has shown that 86.3% of all trocar hernias occurred with 12 mm or bigger trocar. Conversely, only 2.7% of all trocar hernias occurred with 5 mm trocars^[28].

In the present study, port site hernia was reported in 4 patients in CL group (6.7%) and none in ML group. There was marginal significant increase of port site hernia in conventional when compared to mini-lab group ($p=0.042$).

Finally our series from early publications about ML, some study limitations should be acknowledged such as that this study depended on one surgeon and one center experience and with no control group. Thus, further broad multi centric randomized controlled studies are necessary in this field.

CONCLUSION

ML transperitoneal simple nephrectomy is associated with lower post-operative pain, short time of post-operative hospital stay, early return to normal activity, better cosmeses and less port site hernia. However, in this series ML operative time, blood loss, conversion to open are potentially more than CL, which might be improved by time.

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