Modified Mini-laparoscopic Surgery Optimized the Laparoscopic Decortication of Renal Cyst

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Purpose: This study was to introduce the modified mini-laparoscopic surgery for renal cyst and investigate its advantages on operative time, cosmetic effect and pain reduction by comparison with laparo-endoscopic single site surgery (LESS) and conventional laparoscopic surgery.

Methods and patients: Between May 2015 and October 2018, 140 consecutive patients with benign renal cyst underwent laparoscopic decortication of renal cyst. Of which, 48 cases were in mini-laparoscopic surgery group (M group), 56 cases in LESS group and 36 cases in conventional laparoscopic surgery group (C group). The operative time, blood loss, visual analog scale (VAS) and Scar Cosmesis Assessment and Rating (SCAR) Scale was recorded.

Results: The mean operative time in M group (26.08±7.70 min) and C group (28.56 ± 7.99 min). was significantly less than that in LESS group (47.32 ±10.53 min) ($P < 0.01$). Mean blood loss did not differ between the 3 groups ($P > 0.05$). Mean VAS pain scores in M group were significantly lower than that of LESS group and C group on postoperative day (POD) 1 and 3 ($P < 0.01$). The SCAR scale of POD 30 in C group (6.25 ± 1.0) was significantly higher than that in M group (0.77 ± 0.59) and LESS group (0.98 ± 0.70). The postoperative course was uneventful with no morbidity within 1to 6 months of follow-up.

Conclusion: Modified mini-laparoscopic decortication of renal cyst have more comprehensive advantages comparing with LESS and conventional laparoscopic surgery. It is convenient and offered significant cosmetic benefit and reduced incisional pain.

Keywords: laparo-endoscopic single site surgery; decortication of renal cyst; mini-laparoscopic surgery; laparoscopic surgery; renal cyst; cosmesis

INTRODUCTION

Renal cysts prevalence varies in the adult population between 20% and 50%, the vast majority of them being asymptomatic and undergoing regular surveillance [1]. Treatment of simple renal cysts is recommended when they are associated with flank pain, infection, obstruction of the pyelocaliceal system and hydronephrosis. The surgical decortication was the recommended strategy[2]. Conventional laparoscopic decortication with three-port incisions tend to make three permanent scars. To resolve this problem, some doctors perform decortication of renal cyst with LESS. The introduction of LESS has offered cosmetic benefit to patients. It is a scar-free procedure with reduced surgical wound complications[3-6]. But in the same time, Surgeons must manipulate multiple instruments through one small incision. It is time consuming and difficult for the operators[7,8].

It is an important question how to quickly and easily perform a scar-free operation. Here, we describe modified mini-laparoscopic decortication for renal cyst. This technique is a modification of mini-laparoscopic surgery in order to overcome the disadvantages of the LESS and previous mini-laparoscopic surgery.

PATIENTS AND METHODS

To simplify the scar free operation for renal cyst, we describe modified mini-laparoscopic decortication for renal cyst. This technique can conveniently perform decortication by using 2 very fine (3-mm) mini-laparoscopic instruments through abdominal wall and a 5 mm ultrasonic dissector through umbilicus. It was expected to promote the cutting speed and hemostatic effect and simplify the extraction of specimen without any visible scar. In the study, we demonstrated the advantages of the modified mini-laparoscopic decortication on operative time, cosmetic satisfaction and the postoperative pain reduction by comparing the surgical results of mini-laparoscopic decortication with those of LESS and conventional laparoscopic decortication. We performed a retrospective analysis of data from consecutive patients who underwent decortication of renal cyst with modified mini-laparoscopic surgery, LESS or conventional laparoscopic surgery in Zhongshan Hospital, Fudan University, between May 2015 and August 2018. The patients underwent a contrast-enhanced abdominal and pelvic computer tomography (CT) to diagnose sim-

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Table 1. Patient demographics.

	Needlescopic decortication	LESS decortication	Conventional laparoscopic decortication
Age(years)	49.2 ± 15.7	43.6 ± 12.6	52.3 ± 17.2
Sex(male/female)	21/27	31/25	19/17
Cyst location(left/right)	19/29	34/22	15/21
Cyst location (upper pole)	11	13	8
Cyst location (middle)	21	20	18
Cyst location(lower pole)	16	23	10
Cyst diameter (mm)	65.6 ± 12.0	61± 16.4	67.7± 8.7
BMI	23.2 ± 4.2	24.5± 3.7	22.0± 5.5

Patient characteristics in the three groups were comparable at baseline
Abbreviations: BMI, Body Mass Index

ple cyst and exclude the parapelvic cysts, calyceal diverticula and bilateral or multiple cyst. All of the case were diagnosed with Bosniak category I large renal cyst with backache. The difference between the mini-laparoscopic surgery, LESS and conventional laparoscopic surgery were clearly explained to all the patients. All the decision of surgery type was made by patients and operations were performed by same surgeon group. The Ethics Committee approved the study. A total 140 consecutive cases of decortication were performed during the study period. 48 cases were in mini-laparoscopic surgery group (M group), 56 cases in LESS group and 36 cases in conventional laparoscopic decortication group (C group). Demographic and operative data in the three groups were assessed (**Table 1 and Table 2**). The anesthesiologist recorded the operative time. It was the time frame between the skin incision and the entirely closure of the last incision. On POD 1, 3 and 5, the visual analog scale (VAS) was used to evaluate incisional pain objectively. The Scar Cosmesis Assessment and Rating (SCAR) Scale [9,10] was used to evaluate incisional cosmesis on POD 30.

Surgical technique

All of the cases were successfully treated through transperitoneal approach without conversion to open surgery.

After the induction of general anesthesia, the patient was rotated in 75o lateral decubitus, without the surgical table angle. The video cart was placed in back of the patient.

In M group, a small transverse skin incision at the umbilicus was first made for a 5mm trocar. Through a needle hole that made by a 14G syringe needle, a 3-mm trocar (Storz, Germany) for the mini-laparoscope (camera) (Storz, Germany)on the affected side of the abdomen were placed at the level of umbilicus on the midclavicular line (**Figure 1.A**). Another 3-mm trocar for mini-laparoscopic grasper (Storz, Germany) were placed on the abdomen near the surface projections of renal cyst (**Figure 1.B**). The mini-laparoscopic grasper in left hand lifted up the posterior peritoneum and Gerota fascia. An ultrasonic dissector in right hand was then placed into the 5-mm trocar at the umbilicus to incise the posterior peritoneum and Gerota fascia. So, the surrounding tissue could be dissected and the cyst was easily incised (**Figure 1.C**). For the cysts on the very top of right kidney, the operative area may be covered by liver margin. The fourth 3 mm trocar near the surface projections of renal cyst would be necessary. We inserted another mini-laparoscopic grasper through the fourth trocar to hold the Gerota fascia on surface of the cyst and then the liver margin and Gerota fascia can be lifted. Specimen was extracted through 5-mm trocar and no drainage was placed. The small incision and the two needle holes require no stitch.

In the LESS group, 20 mm of the skin incision at the umbilicus was also first made. Single-port-access device (Tri-port, Olympus, Japan) was placed through the umbilicus. A 5-mm flexible laparoscope (Olympus, Japan), a grasper and an ultrasonically activated scalpel were then positioned in this single-port-access device (**Figure 1.D**). The remaining procedure was the same as that of the M group. But, the incision should be closed after the specimen extraction.

In C group, a 10 mm trocar for laparoscope on the affected side of the abdomen were placed at the level of umbilicus on the midclavicular line. A 5-mm trocar for grasper was placed under rib arch on the midclavicular line. Another 5-mm trocar for ultrasonic dissector was placed near Mc Burney's point on the right side and the mirror position on the left side. The other procedure was the same as M group. The three incision should also be closed after the specimen extraction. For the cysts at the very top of the kidney, another 5 mm trocar

Table 2. postoperative outcome of 3 groups.

	Mini-laparoscopic	LESS	Conventional laparoscopic	*P* value
Mean operative time (min)	26.08 ± 7.70	47.32 ± 10.53*	28.56±7.99	.000
Mean estimated blood loss (ml)	4.06 ± 3.49	5.45 ± 3.72	5.67 ± 4.40	.099
Mean VAS scores				
POD 1	1.79 ± 0.82*	2.41 ± 0.80*	3.03 ± 1.06*	.000
POD 3	1.02 ± 0.51*	2.1 ± 0.86	2.17 ± 0.81	.000
POD 5	0.56 ± 0.50	0.71 ± 0.6	0.78 ± 0.54	.188
SCAR scores				
POD 30	0.77 ± 0.59	0.98 ± 0.70	6.25 ± 1*	.000

The number that labeled with " * " means the parameter in the group was significantly different with that in other 2 groups.
Abbreviations: POD, Postoperative Day

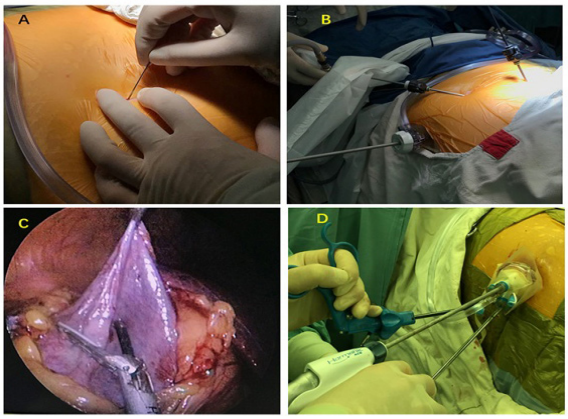

Figure 1. The Surgical technique of minilaparoscopic surgery and LESS. **(A)** Through a needle hole that made by a 14G syringe needle, a 3-mm trocar for the mini-laparoscope on the affected side of the abdomen were placed at the level of umbilicus on the midclavicular line. **(B)** Another 3-mm trocar for mini-laparoscopic grasper were placed on the abdomen near the surface projections of renal cyst. **(C)** With the help by 3mm grasper in left hand, an ultrasonic scalpel in right hand was then placed into the 5-mm trocar at the umbilicus to incise the posterior peritoneum and Gerota fascia. **(D)** In LESS, a single-port-access device was placed through the umbilicus. A 5-mm flexible laparoscope, a grasper and an ultrasonic scalpel were then positioned in this single-port-access device.

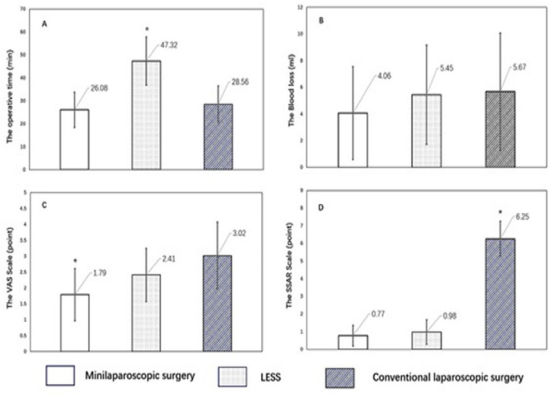

Figure 2. Postoperative outcome in M group, LESS group and C group. **(A, top left)** The results shown that the mini-laparoscopic procedure and conventional surgery required significantly less operating time than the LESS. **(B, top right)** The blood lost was similar in the 3 groups. **(C, bottom left)** On POD 1, the VAS pain score in M group was significantly lower than that in LESS group and C group. **(D, bottom right)** The SCAR scale in M group and LESS group was significantly better than that of C group on POD 30. There was no significant difference between M group and LESS group in SCAR scale.

was used to lift the liver.

Statistical Analysis

SPSS 19.0 for Windows was used for statistical analysis. Comparisons between the 3 operative approaches were performed with the one way Analysis of Variance□ANOVA) and Post hoc Analysis (S-N-K). All statistical tests were 2-sided, with $P < 0.05$ indicating statistical significance.

RESULTS

Patient characteristics in the three groups were comparable at baseline (**Table 1**).

There were no intraoperative complications or technique conversions at the time of surgery. All of the cases were successfully treated through transperitoneal approach without conversion to open surgery. For 2 cases in C group and 3 cases in M group a 4th trocar was used to lift the liver because of the very top location on upper pole of right kidneys.

The postoperative outcomes of the 3 groups were indicated in **Table 2**. The results show that the mini-laparoscopic procedure and conventional laparoscopic surgery required significantly less operating time than the LESS (26.08 ± 7.70 min vs. 28.56 ± 7.99 min vs.47.32 ±10.53 min, $P < 0$ .01).

The blood lost was similar in the 3 groups (M group :4.06 ± 3.49 ml, LESS group: 5.45 ± 3.72 ml, C group 5.67 ± 4.40 ml, $P > 0.05$) (**Figure 2.B**). The VAS pain score in M group (1.79 ± 0.82) was significantly lower than that in LESS group (2.41 ± 0.80) and C group (3.03±1.06) on POD 1 ($P < 0.01$) (**Figure 2.C**). On POD 3, the difference was still significant (1.02±0.51 vs. 2.1 ± 0.86 vs. 2.17 ± 0.81, $P < 0.01$). On POD 5, the VAS pain score have no difference in the 3 groups (0.56 ± 0.50 vs. 0.71 ± 0.6 vs. 0.78 ± 0.54, $P > 0.05$). Five patients in C group used analgesics for one time. The SCAR scale in M group (0.77 ± 0.59) and LESS group (0.98 ± 0.70) was significantly better than that of C group (6.25 ± 1.0, $P < 0.01$) on POD 30 (**Figure 2.D**). Both of the two groups got satisfactory cosmetic results. But the SCAR scale in C group was still higher than M group and LESS group on that time. Immediately after operation, only minimal wounds appeared on the patients' skin in M group and the small wounds in umbilicus was hidden. (**Figure 3.A**). But the wounds were obvious in LESS group (Figure 3.B) and C group (**Figure 3.C**). The postoperative course was uneventful

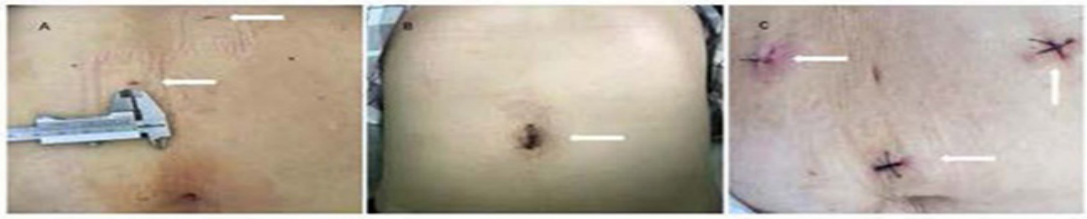

Figure 3. Immediately after operation, wounds (arrow mark) appeared on the patients' skin in the 3 groups. **(A, left)** Minimal wounds on the patients' skin in M group. The small wounds in umbilicus was hidden. **(B, middle)** Wound on the patients' skin in LESS group. **(C, right)** Obvious wounds on the patients' skin in C group.

with no morbidity within 1to 6 months of follow-up.

DISCUSSION

Renal cyst is a common and frequently-occurring disease in adult. The percutaneous approach for renal cyst has shown lower success rates in comparison with the laparoscopic approach and currently it is not widely used. Laparoscopic decortication of renal cyst has been considered the gold standard for the treatment of renal cyst. Though it is easy to operate, conventional laparoscopic decortication always leads to scars.

Compared with conventional laparoscopic surgery, both of LESS and mini-laparoscopic surgery can perform the scar-less operations and each of them has its own advantages and disadvantages.

LESS uses only single incision in the umbilicus that promotes cosmetic satisfaction. After operation, the incision hides in umbilicus without observed scar.[11]

But, LESS surgery has both the cosmetic advantage and the technically disadvantage. Through a small single incision, the incomplete triangulation and interference of the multiple instruments make LESS surgery very difficult and challenging[12].

To date, LESS technique is still not widespreadly used. The insufficient instrument triangulation is one of the main causes. Mini-laparoscopic surgery resolved the limitation[13,14]. It was used in the same way as the conventional laparoscopic surgery. But in the past reports[15,16], mini-laparoscopic decortication of renal cyst also had some problems. The low efficiency of dissection and hemostasis with the fine instruments made the operation difficult and time consuming. After operation, the specimens have to be dissected into pieces and then extracted. So, it is necessary to promote the operating efficiency by modification of mini-laparoscopic decortication.

In this study, we used 2 fine trocars (3 mm) for mini-laparoscope (camera) and mini-grasper. It only required 2 needle holes for insertion without any incision. After operation, puncture site heals without any scar. To facilitate hemostasis, dissection and specimen extraction, we modified the mini-laparoscopic decortication by addition of 5 mm trocar in umbilicus. Through this trocar, the ultrasonic scalpel and Hem-O-lok clip applier can be used. The addition of the 5 mm trocar in umbilicus simplified the procedures and it didn't affect the cosmetic outcome. The small incision and puncture points did not need to be stitched.

The results show that the operating time was similar between the mini-laparoscopic group and conventional laparoscopic group. Compared with the other two groups, LESS was relatively time-consuming.

The modified mini-laparoscopic surgery has only a very small incision in umbilicus and two puncture point. So the pain was very slight. According to the results, The VAS pain score was significantly lower in mini-laparoscopic surgery group compared with LESS and conventional laparoscopic surgery on POD 1 and POD 3.

The cosmetic results are visible on POD 30. Both of the mini-laparoscopic group and LESS group got very satisfactory cosmetic results without obvious scar. But in conventional laparoscopic surgery group, the incisions leave three conspicuous scars.

The only drawback to this approach is the small view field because of the very fine laparoscope (camera). However, renal cysts tend to poke out of the surface of kidney and are very easy to be focused. The drawback does not affect the results of operation.

The limitations of this study was the small sample size. Only 140 cases in the 3 groups were included. However, the operations were performed by a same surgeon group. All the data was collected prospectively although the study was a retrospective analysis. The possible bias may be minimized.

CONCLUSIONS

Modified mini-laparoscopic decortication of renal cyst is an easy and safe technique for decortication of benign renal cyst. It has both the convenience of conventional laparoscopic surgery and the cosmetic benefit of LESS surgery. In addition, it caused just a little pain that was significantly better than conventional laparoscopic surgery and LESS surgery.

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CONFLICT OF INTEREST

None of the authors has any commercial associations that might be a conflict of interest in relation to this article.

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