The consequences of laparoscopic fascial space priority approach to lateral lymph node dissection on urinary and sexual functionality

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Videosurgery Miniinv 2023; 18 (4): 639–644
DOI: https://doi.org/10.5114/wiitm.2023.130532

Abstract

Introduction: *In this prospective observational study, we aimed to evaluate the consequences of laparoscopic fascia space priority lymph node dissection on urination and sexual function.*
Aim: *To assess the consequences of laparoscopic lateral lymph node dissection (LLND) using the fascial space priority approach on urinary and sexual function in patients with advanced middle and low rectal cancer.*
Material and methods: *Consecutive patients undergoing laparoscopic LLND using the fascial space priority approach from December 2020 to November 2022 were identified from Tianjin Union Medical Center. Clinical data including patient characteristics, surgical details, and pathology were analysed. The urinary function was assessed by international prostate symptom score (IPSS) questionnaire and residual urine volume. The sexual function was investigated using the international index of erectile function (IIEF) questionnaire.*
Results: *A total of 51 patients, mean age 60.5 ±10.9 years, were identified. The lymph nodes were positive in 70.6% (36/51) of the patients. There was no significant difference between the preoperative IPSS score and that at 6 months (5.2 ±2.1 vs. 5.6 ±1.5; p = 0.16). And there was no significant difference between the residual urine volume and that at 6 months (9.5 ±10.6 vs. 8.6 ±6.3; p = 0.61). The IIEF score before the surgery showed no significant difference from that at 6 months after the surgery (21.1 ±2.2 vs. 20.6 ±2.3; p = 0.26).*
Conclusions: *Laparoscopic LLND using a fascial space priority approach can effectively protect the autonomic nerves. The procedure reduces short-term urination and sexual function, but it has little effect on long-term function.*

Key words: *lateral lymph node dissection, rectal cancer, fascial space priority approach, urinary and sexual function.*

Introduction

Total mesorectal excision (TME) has been the gold standard for the operation of rectal cancer [1, 2]. Preservation of the autonomic nerves is of great significance for the quality of life of patients after the TME operation [3]. 14% to 30% of patients with middle or low rectal cancer already have metastasis of the lateral lymph nodes (LLN) at the time of initial diagnosis [4]. Lateral lymph node dissection (LLND) had been applied in managing LLN metastasis [5]. Increasing evidence from evidence-based medicine suggests that LLND can reduce pelvic local recurrence (LR) in rectal cancer [6]. Partial autonomic nerve preservation does not lead to satisfactory functional outcomes [7]. It is worth studying how to thoroughly dissect the LLNs and protect the autonomic nerve to obtain satisfactory postoperative sexual and urinary function. For this reason, we developed the technique of laparoscopic fascial space priority LLND. It is a very different procedure than what has

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been done in the past. The laparoscopic fascial space priority LLND adopts the new strategy that the fascial space is first separated, and then lymph node dissection is performed. Our research team has established a standardized surgical protocol for laparoscopic fascial space priority LLND in rectal cancer and has actively promoted its implementation [8]. We have conducted a multicentre retrospective study involving 12 hospitals to validate the safety and reliability of the laparoscopic fascial space priority LLND during the perioperative period. However, there is currently a lack of prospective research investigating the impact of this procedure on patients' sexual and urinary function [9]. In this study, we aimed to evaluate the consequences of laparoscopic fascia space priority lymph node dissection on urination and sexual function.

Aim

This study aimed to assess the consequences of laparoscopic LLND using the fascial space priority approach on urinary and sexual function for patients with advanced middle and low rectal cancer.

Material and methods

Case selection

Fifty-one consecutive patients undergoing laparoscopic LLND were enrolled in this study from December 2020 to November 2022 in Tianjin Union Medical Center. The medical records of these patients were documented. The methodology established in our previous work was followed [9]. Inclusion criteria for participant selection were defined as follows: (i) A confirmed diagnosis of advanced middle or low rectal adenocarcinoma, characterized by the presence of the tumour's inferior border located below the peritoneal reflection, as ascertained through the utilization of colonoscopy in conjunction with biopsy. (ii) For patients who underwent preoperative chemoradiotherapy (CRT), the short-axis diameters of the LLNs were found to exceed 7 mm on MRI prior to neoadjuvant CRT (nCRT) initiation and remained greater than 5 mm on the subsequent preoperative MRI. (iii) In the case of patients who did not receive preoperative CRT, the short-axis diameters of the LLNs were required to measure at least 7 mm on the MRI conducted during the preoperative staging phase. Conversely, the exclusion criteria were defined as follows: (i) The presence of unresectable distant metastasis, and (ii) The identification of tumour invasion necessitating the concurrent resection of visceral organs.

Based on our recommendations, nCRT was deemed appropriate when the short diameter of the largest lymph node measured at least 7 mm on the pre-treatment staging MRI and the radial resection margin was determined to be positive. In cases where, following 5 weeks of nCRT, the short diameter of the largest lymph node measured at least 5 mm on the preoperative MRI, a combined procedure consisting of TME and LLND was performed within a timeframe of 6 to 8 weeks after the completion of nCRT. However, if the short diameter of the largest lymph node measured less than 5 mm on the preoperative MRI, TME alone was performed, with subsequent follow-up observation being strongly recommended. Furthermore, TME + LLND was also performed in patients who did not undergo nCRT but displayed a negative radial resection margin.

Surgical procedure

LLND was performed in a unilateral or bilateral manner based on the presence of suspected LLN metastasis, subsequent to TME. The dissection primarily focused on the internal iliac lymph nodes and the obturator lymph nodes, which were identified as the primary areas of surgical exploration. All surgical procedures were conducted utilizing the fascial space priority approach, as demonstrated in our previously published video [10].

Generally, the sequence of lateral dissection, with a fascial space priority approach, is to give priority to the separation of 3 non-vascular anatomical spaces of the lateral pelvis: the first one is the space between the lateral side of the ureterohypogastric nerve fascia and the medial side of the vesicohypogastric fascia; the second one is the space between the lateral of vesicohypogastric fascia and the obturator lymph nodes; and the third one is the space between the obturator and the obturator lymph nodes. After full dissection of the aforementioned 3 spaces, the borders of the LLNs could be defined, including the medial bordar, the lateral bordar, and the dorsal border. Then, the LLNs could be removed *en bloc*. With uni-LLND, all the vascular branches from the internal iliac artery to the pelvic organs could be removed together; for bi-LLND, the superior vesicle arteries would be reserved to maintain blood flow to the bladder. From the final surgical field, the ureterohypogastric nerve fascia could be found integrated, and the included pelvic autonomic nerves were well protected as an intact fascia.

Assessment of urinary function and sexual function

The international prostate symptom score (IPSS) [11–14] questionnaire was conducted on all patients at pre-operation and 10 days, 1 month, and 6 months after the laparoscopic fascial space priority LLND procedure. Residual urine volume by ultrasonography was also measured as an important indicator at pre-operation and 10 days, 1 month, 6 months after the procedure. Sexual function was assessed by means of the international index of erectile function (IIEF) [15–17] questionnaire in male patients.

Clinical parameters and patient follow-up

An electronic data collection sheet was completed, and patient profiles, surgical data, pathological data, and short-term prognosis were collected and analysed. Patients had follow-up visits at pre-operation and 10 days, 1 month, and 6 months after the procedure.

Statistical analysis

The collected data were subjected to analysis using SPSS Statistics software (Version 25.0). Normally distributed numerical variables were presented as mean ± standard deviation (SD). The significance of differences between groups was assessed using Student's *t*-test. Non-normally distributed numerical variables were expressed as median (range), and the significance of differences was evaluated using the Mann-Whitney *U* test. Categorical variables were reported as frequencies and percentages, and the χ^2 test was employed for comparisons. A *p*-value less than 0.05 was considered statistically significant.

Results

Patient characteristics

The characteristics of all 51 patients are summarised in Table I. There were 37 men and 14 women. The mean age was 60.5 ±10.9 years, and the mean body mass index (BMI) was 24.4 ±2.8 kg/m^2. The mean distance from the distal edge of the tumour to the anal verge was 4 (range: 0 to 10.0) cm. The lymph nodes were positive in 70.6% (36/51) of the patients.

Assessment of IPSS and residual urine volume

There was no significant difference between the preoperative IPSS score and that at 6 months (5.2 ±2.1 vs. 5.6 ±1.5; $p = 0.16$). The IPSS score was significantly increased at 10 days and at 1 month after surgery (11.2 ±4.9 and 8.4 ±3.8, respectively) compared with that before the surgery (5.2 ±2.1), and the difference was statistically significant ($p < 0.01$) (Table II).

There was no significant difference between the residual urine volume and that at 6 months (9.5 ±10.6 vs. 8.6 ±6.3; $p = 0.61$). The residual urine volume was significantly increased at 10 days and at 1 month after surgery (7.95 ±5.61 and 11.40 ±6.62, respectively) compared with that before the surgery (7.95 ±5.61), and the difference was statistically significant ($p < 0.01$) (Table III).

Table I. Patients' characteristics ($n = 51$)

Variable	Value
Age [years] $\bar{x} \pm s$	60.5 ±10.9
Sex, *n* (%):	
Male	37 (72.5)
Female	14 (27.5)
BMI [kg/m^2] $\bar{x} \pm s$	24.4 ±2.8
Mean distance to tumour from AV [cm] (range)	4 (0–10.0)
History of abdominal operation, *n* (%)	6 (11.8)
nCRT, *n* (%)	13 (25.5)
Operation time [min] $\bar{x} \pm s$	420.3 ±110.7
Mean blood loss [ml] (range)	100 (10–700)
Median post-operative hospital stay [days] (range)	13 (4–34)
Lateral lymph node dissection, *n* (%):	
Unilateral	41 (80.4)
Bilateral	10 (19.6)
Conversion, *n* (%)	0 (0)
Number of patients with positive lateral lymph nodes, *n* (%)	36 (70.6)
TNM stage, *n* (%):	
0	4 (3.6)
I	7 (6.2)
II	35 (31.3)
III	66 (58.9)
Number of lymph nodes per side	6 (1–41)
Number of patients with positive lateral Lymph nodes, *n* (%)	36 (70.6)
Timing of catheter removal [days] (range)	8 (2–10)

BMI – body mass index, AV – anal verge, nCRT – neoadjuvant chemoradiotherapy.

Table II. Assessment of urinary function

Variable	Preoperative	10 days after the surgery	1 month after surgery	6 months after surgery	*P*-value
IPSS	5.2 ±2.1	11.2 ±4.9	8.4 ±3.8	5.6 ±1.5	< 0.001
Residual urine volume $\bar{x} \pm s$	9.5 ±10.6	33.5 ±72.1	18.5 ±10.4	10.5 ±8.6	< 0.001

IPSS – international prostate symptom score.

Table III. Assessment of 6-month urinary function

Variable	Preoperative	6 months after surgery	*P*-value
IPSS	5.2 ±2.1	5.6 ±1.5	0.161
Residual urine volume $\bar{x} \pm s$	9.5 ±10.6	10.5 ±8.6	0.61

IPSS – international prostate symptom score.

Table IV. Assessment of sexual function

Variable	Preoperative	1 month after surgery	6 months after surgery	*P*-value
IIEF	21.1 ±2.2	18.4 ±2.0	20.6 ±2.3	0.00
P-value		< 0.001	0.258	

IIEF – international index of erectile function.

Assessment of IIEF score

The changes of IIEF score in male patients are shown as Table II. The IIEF score increased significantly at 1 month after the surgery (18.4 ±2.0) compared with the score before the LLND procedure (21.1 ±2.2), and the difference was statistically significant ($p < 0.01$), but there was no significant difference between the IIEF score before the surgery and that at 6 months after the surgery (21.1 ±2.2 vs. 20.6 ±2.3; $p = 0.26$) (Table IV).

Post-operative pathology

The pathology findings are summarised in Table IV. Patients with pathological stage III tumours constituted the largest group ($n = 66$ patients; 58.9%). The lymph nodes were positive in 70.6% (36/51) of the patients.

Discussion

TME has become the standard operation for radical resection of rectal cancer, which can significantly reduce the LR [2, 18–21]. Significant discrepancies exist between Eastern and Western countries regarding LLND for middle and low rectal cancer. As early as the 1970s, Japan adopted LLND as a standard procedure and widely implemented it for middle and low rectal cancer. The Japanese guidelines for colorectal cancer treatment recommend routine LLND for locally advanced T3-4 lower rectal cancer located below the peritoneal reflection [22]. In contrast, Western scholars consider LLN metastasis as distant metastasis. LLND does not achieve curative outcomes and is associated with significant urological and reproductive system complications [23]. The disparities in reporting between Eastern and Western countries may be attributed to factors such as the extent and indications of lymph node dissection, patient obesity levels, surgical complexity, neoadjuvant chemoradiotherapy, and whether *en bloc* resection is performed. Several previous studies have reported an increased incidence of postoperative urinary and male sexual dysfunction associated with LLND [24–26]. Therefore, further research is warranted to explore strategies for enhancing the safety of LLND.

Because the autonomic nerve is adjacent to the TME surgical level, damage to the autonomic nerves occurs from time to time. Postoperative urinary dysfunction and sexual dysfunction are due to autonomic nerve injury during TME [27, 28]. A study has shown that autonomic nerve preservation does not reduce the effect of radical surgery [29]. TME combined with LLND has a larger resection area compared with TME [30]. So how can we reduce the damage of autonomic nerve with thoroughly radical lymph node dissection so as to reduce the incidence of postoperative urinary and sexual dysfunction? We have developed a laparoscopic fascial space priority LLND, which can protect the au-

tonomic nerve better by prioritising dissection of the fascial space [10].

In our study, all the patients had their urinary tubes removed before discharge. The short-term (10 days and 1 month after the surgery) residual urine volume increased significantly compared with the preoperative level. The postoperative residual urine was more than 50 ml in 2 cases, but it was less than 50 ml in all patients at 1 month after the procedure. The residual urine volume at 6 months after the surgery was no difference from that before the procedure. The IPSS score showed similar results. The IPSS score increased remarkably within a month after surgery and came close to the preoperative value. The result suggests that the TME plus laparoscopic fascial space priority LLND procedure had no long-term effect on residual urine volume. Although it caused an increase in residual urine in the short term, it did not lead to permanent catheterisation.

Sexual function was assessed by the IIEF score in all the male patients. Three cases had no sexual life before operation because of old age, so they were excluded from this study. Postoperative erectile dysfunction occurred in 2 cases. The IIEF score before the TME plus LLND was obviously higher than the IIEF score at 10 days and at 1 month after the procedure. However, there was no statistical difference between the IIEF at 6 months after surgery and that before surgery. Postoperative local tissue inflammation and oedema in the patient may have contributed to this short-term decline in sexual function, which gradually improved over time to near the preoperative level.

Our study showed that the fascial space priority approach LLND can better preserve the pelvic autonomic nerve. By prioritizing identification and separation of fascial space, intraoperative bleeding and tissue exudation are reduced, and better autonomic nerve recognition and protection can be achieved.

However, several limitations should be acknowledged in this research. Firstly, it should be noted that this study adopted a prospective observational design. To provide further comprehensive insight into the topic, future investigations should include large-scale randomized controlled trials. Secondly, the limited number of cases included in this study is attributed to the rarity of therapeutic LLND. Consequently, additional studies with larger sample sizes are warranted to enhance the statistical power and generalizability of the findings. Lastly, it is important to recognize that the relatively short follow-up duration may limit the ability to assess long-term outcomes accurately.

Conclusions

Laparoscopic LLND using a fascial space priority approach can effectively protect the autonomic nerves. The procedure reduces short-term urination and sexual function, but it has little effect on long-term function.

Acknowledgments

This study was sponsored by Tianjin Health Research Project (ZC20081).

Conflict of interest

The authors declare no conflict of interest.

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Received: 9.06.2023, **accepted:** 31.07.2023.