

Application of fast-track surgery in the perioperative period of laparoscopic partial nephrectomy for renal tumors

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Abstract

Objectives: This study aimed to examine application of fast-track surgery (FTS) in the perioperative period of laparoscopic partial nephrectomy for renal tumors, and to discuss its effects and safety.

Methods: Eighty patients who received laparoscopic partial nephrectomy in urinary surgery from January 2016 to December 2017 were selected and randomly classified as the observation group (n = 40) and control group (n = 40). Traditional treatments were performed in the control group, while FTS was applied in the observation group. The complication rate after the operation was recorded.

Results: The duration of the operation and intraoperative blood loss were not different between the groups. The duration of anesthesia and fluid transfusion volume on the day of the operation were significantly less in the observation group than in the control group. The rates of infection of the incisional wound, nausea and vomiting, and anastomotic stomal bleeding were not significantly different between the groups. However, the rates of postoperative urinary tract infection, abdominal distension, thirst, hypothermia, and pulmonary infection were significantly lower in the observation group than in the control group.

Conclusion: Application of FTS in laparoscopic partial nephrectomy contributes to postoperative recovery and reduction of postoperative complications.

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Keywords

Fast-track surgery (FTS), laparoscopic radical nephrectomy, renal cancer, complication, anesthesia, tumor

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Introduction

Renal cancer is a common malignant tumor of adults. The morbidity rate of renal cancer has been steadily rising over the years. Laparoscopic radical nephrectomy for renal cancer used to be the gold standard of a radical operation for renal cancer. With improvement of imaging diagnosis and technical progress, an increasing amount of asymptomatic renal tumors are diagnosed in the early period. For T1 renal cancer, the therapeutic scheme recommended by the European Association of Urology in 2012 is partial nephrectomy, which retains the nephron,¹ and the clinical effect is satisfying. Laparoscopic partial nephrectomy is widely applied in renal cancer treatment. This technique has features of a small operative wound, little bleeding, and fast postoperative recovery, and it effectively improves patients' quality of life and survival rate. Fast-track surgery (FTS) is a new form of surgery that has appeared in recent years.^{2,3} A Danish surgeon (Kehlet) was the first to propose the concept of FTS.⁴ In 2005, the European Committee on Clinical Nutrition and Metabolism formulated the unified scheme of Enhanced Recovery After Surgery (ERAS) for accelerated rehabilitation surgery on the basis of FTS. Both of these processes refer to a series of comprehensive measures taken during the perioperative period to maximize the patients' stress injury and promote their rehabilitation. FTS mainly emphasizes optimization of the management process before and after

the operation. ERAS plays an important role in development of minimally invasive surgery, which not only reduces the stress response and complications caused by surgery, but also shortens the hospital stay.

FTS aims to make patients suffer less stress and promotes patients' recovery by taking a series of measures in the perioperative period. Doctors often construct preoperative health education for patients and apply recovery technology in the perioperative period to reduce the operative stress response and enhance the postoperative recover treatment effect.^{5,6} Research on FTS was first carried out in cardiac surgery in Europe and America. At present, the FTS concept has been successfully applied for treating colorectal cancer, esophageal cancer, stomach cancer, and thyroid surgery.⁷ Application of FTS in partial nephrectomy of urinary surgery has not been reported. Therefore, in this study, we aimed to examine application of FTS in the perioperative period of laparoscopic partial nephrectomy for renal tumors, and to discuss its effects and safety.

Patients and methods

Ethical approval

The study was approved by the Ethics Committee of The Second Affiliated Hospital of Harbin Medical University and written informed consent was obtained from all participants.

Patients

A total of 80 patients who had a tumor diameter < 4 cm and received laparoscopic partial nephrectomy at the Second Affiliated Hospital of Harbin Medical University Hospital from January 2016 to December 2017 were included. The diseased region was on the left side in 48 cases and on the right side in 16 cases. Twenty-eight patients had angiomyolipoma of the kidney (diameter of the tumor: 2.0–4.0 cm, average: 3.2 cm) and 52 suffered from renal cancer (diameter of the tumor: 3.0–4.0 cm, average: 3.6 cm). Before the operation, B-ultrasonography, computed tomography, or magnetic resonance imaging was used to diagnose tumors according to Tumor Node Metastasis classification of T1. The patients were randomly classified into the observation group (n=40) and the control group (n=40) with the randomized control method. An imaging examination showed no deep venous cancer embolus or obvious lymphatic metastasis. The general baseline characteristics of both groups were similar (Table 1).

Inclusion and exclusion criteria

Inclusion criteria included patients with a clear mind, normal thinking, normal orientation, good language listening competence, and a signed informed consent form.

Exclusion criteria included mental disorders, diabetes, hypertension, severe audio-visual obstacles, a lack of cooperation, and patients who were unable to participate in the study.

Surgery

Both groups received retroperitoneal laparoscopic partial nephrectomy under general anesthesia, and the same group of doctors conducted the operation. Traditional measures in the perioperative period were performed in the control group, while FTS was applied in the observation group (Table 2).

Observation indices

The following indices were observed and recorded. Operational indices included the duration of the operation, duration of anesthesia, intraoperative blood loss, and fluid transfusion volume on the day of the operation. Postoperative indices were the degree of postoperative pain, and durations of the first time away from the bed after the operation, of first feeding time after the operation, of first evacuation time after the operation, of indwelling drainage time, of indwelling urethral catheter time, and of hospital stay. Postoperative pain was determined by the Visual Analogue Scale (VAS) as follows: 0, no

Table 1. Comparison of the patients' general information

Group	Age (years)	Sex		Side		Diameter of the tumor (cm)	Disease category	
		Male (n)	Female (n)	Left (n)	Right (n)		Renal cancer (n)	Angiomyolipoma of the kidney (n)
Observation group (n = 40)	53.2	22	18	26	14	3.44 ± 0.56	28	12
Control group (n = 40)	49.6	24	16	22	18	3.23 ± 0.67	24	16
t (χ^2) value	t = 0.885	$\chi^2 = 1.102$		$\chi^2 = 0.417$		t = 1.176	$\chi^2 = 2.285$	$\chi^2 = 0.439$
P value	0.382	0.749		0.519		0.247	0.374	0.507

Values are mean ± standard deviation or number

Table 2. Treatment measures for both groups in the perioperative period

Item	Observation group	Control group
Hospitalization	Except for general health education, explain FTS-related contents, expected results, possible circumstances, and solutions to reduce patients' anxiety	General health education: introduce the treatment situation and successful cases, inform patients of preoperation and postoperation instructions, and instruct them to abstain from tobacco and drinking
Preoperative diet	Preoperative fasting for 6 hours, prohibition of drinking water for 2 hours; intravenous drip of 500 mL 10% glucose or oral administration of 250 mL 5% glucose 2 to 3 hours before the operation; apply antibiotics before the operation	Preoperative fasting for 24 hours; prohibition of drinking water for 8 hours to prevent aspiration syndrome
Bowel preparation	Oral administration of compound polyethylene electrolyte powder 1 day before the operation; no administration of antibiotics; no conventional mechanical clysis	Cleansing and clysis with 800 to 1000 mL warm suds preoperatively in the evening
Anesthesia	General anesthesia + continuous epidural anesthesia; try to take morphine as little as possible	General anesthesia
Insulation measures	Increase the room temperature to 22°C to 26°C; increase the temperature before transfusion and blood transfusion; cover the non-surgical field with bedding; maintain bed temperature at 40°C to 45°C with an electric blanket	No warming, no special insulation measures
Diet management	No nausea, vomiting, or abdominal distension after becoming entirely awake; a little clean water can be drunk; bowel sounds can be heard; a little water in which rice has been cooked can be eaten; if there is no discomfort after 24 to 48 hours, a small liquid diet and semiliquid diet can be eaten; usual food can then be gradually eaten; chew gum to prevent postoperative abdominal distension	After the patient's anal exhaust a small liquid diet and semiliquid diet can be eaten; usual food can then be gradually eaten
Postoperative analgesia	Apply a self-controlled analgesia pump to ease pain; take non-steroidal anti-inflammatory drugs orally to ease pain; attempt to reduce use of opioids	Apply a self-controlled analgesia pump to ease pain; adopt quick-acting morphine to ease pain
Transfusion	Controllable transfusion; attempt to reduce the transfusion volume; attempt to apply a peripheral intravenous transfusion	No limit of transfusion

(continued)

Table 2. Continued.

Item	Observation group	Control group
Drainage tube, urethral catheter Movement	Remove the urethral catheter 1 to 2 days after the operation; remove the drainage tube 2 to 3 days after the operation Encourage patients to turn over as early as possible; assist patients in getting out of bed and walking about on the first day after the operation, and lengthen the time of being out of bed day by day	Keep the drainage unblocked and well fixed; mark the drainage tube well Encourage patients to turn over and walk about as early as possible according to their recovery condition

FTS: fast-track surgery

pain; < 3, mild pain that is bearable; 4–6, pain that affects sleep, but it is still bearable; and 7–10, pain gradually becomes intense, unbearable, and affects appetite and sleep. Postoperative recent complications were recorded.

Statistical analysis

Measurement data are expressed as mean \pm standard deviation. Inter-group comparisons were conducted with the t test. Enumeration data are expressed as number and percentage, and the chi-squared test was used for inter-group comparison, with an inspection level of $\alpha = 0.05$. IBM SPSS Statistics for Windows, Version 19.0 (IBM, Armonk, NY, USA) was used for data analysis. $P < 0.05$ indicates statistical significance.

Results

Operational indices

The mean age of the patients was 54.5 ± 17.5 years (35–75 years). There were 46 men and 34 women. The duration of the operation and intraoperative blood loss were not significantly different between the two groups. However, the duration of anesthesia and fluid transfusion volume on the day of operation were significantly less in the observation group than in the control group (both $P < 0.05$) (Table 3).

Postoperative recovery

The degree of postoperative pain was significantly less in the observation group than in the control group ($P < 0.05$). Furthermore, the durations of the first time away from the bed after the operation, of the first feeding time after the operation, of the first evacuation time after the operation, of indwelling drainage time, of indwelling urethral catheter time, and of

Table 3. Comparison of operation indices

Group	Number	Duration of the operation (hours)	Duration of anesthesia (days)	Intraoperative blood loss (mL)	Fluid transfusion volume on the day of the operation (mL)
Observation group	40	171.42 ± 24.47	173.63 ± 19.22	101.12 ± 21.37	1227.42 ± 139.67
Control group	40	169.19 ± 21.67	191.75 ± 23.46	98.23 ± 24.31	2327.65 ± 267.84
t value		0.334	2.927	0.437	17.844
P		> 0.05	< 0.01	> 0.05	< 0.001

Values are mean ± standard deviation or number

hospital stay were significantly shorter in the observation group than in the control group (all $P < 0.05$) (Table 4).

Complications

On the basis of the observation of patients during the hospital stay, postoperative recent complications included infection of the incisional wound, abdominal distension, nausea, emesis, thirst, hypothermia, anastomotic stomal bleeding, and pulmonary infection. The occurrence rates of infection of the incisional wound, nausea and vomiting, and anastomotic stomal bleeding were not significantly different between the two groups. However, the rates of postoperative urinary tract infection, abdominal distension, thirst, hypothermia, and pulmonary infection were significantly lower in the observation group than in the control group (all $P < 0.05$) (Table 5).

Discussion

Tension, fear, hunger, thirst, hypoglycemia, clysis, anesthesia, wound pain, transfusion, an indwelling drainage tube, and other factors can stimulate patients' stress response in the perioperative period, thus affecting patients' treatment and recovery. Minimally invasive surgery and damage control only relieve the patient's trauma and stress response from the perspective of

a surgical operation. FTS is based on the patients' pathological and physiological changes in the perioperative period, as well as evidence-based medicine. FTS integrates some new ideas, such as minimally invasive surgery and damage control. Specifically, FTS includes three aspects as follows. First, FTS involves preoperative preparation, such as preoperative education, gastrointestinal preparation, and oral administration of glucose liquid. Second, with FTS, there is rational anesthesia, fluid infusion, and a surgical operation, with a reduction in the operative stress response as far as possible. Third, there is enhancement of postoperative recovery treatment, such as forcing patients to get out of bed and walk about, and scientific enteral nutrition.⁸ The application time is FTS is not long, and there are many contradictions between the FTS concept and traditional ideas. Experts in various fields are unsure about the safety of comprehensive execution of FTS. Many medical institutions are not enthusiastic about applying FTS. Some subversive ideas of FTS are also resisted by some people. An example of this situation is that anesthetists consider that water should not be drunk before the operation and thus refuse to allow drinking of water. FTS, including gynecological and urinary surgery, is still in the observational stage, and it is not entirely accepted subjectively.⁹

Table 4. Comparison of postoperative recovery between the groups

Group	Number	Postoperative pain score	Feeding time (days)	Evacuation time (days)	Duration of first time leaving the bed and walking about (hours)	Indwelling drainage time (hours)	Indwelling urethral catheter time (hours)	Hospital stay (days)
Observation group	40	3.12 ± 0.27	0.51 ± 0.21	0.41 ± 0.70	6.81 ± 0.50	40.2 ± 18.5	20.4 ± 4.50	6.80 ± 0.51
Control group	40	5.34 ± 0.52	1.30 ± 0.90	1.41 ± 0.81	7.20 ± 0.41	83.4 ± 39.6	34.1 ± 5.71	7.21 ± 0.40
t value		18.56	10.25	5.342	2.92	4.420	7.36	2.92
P		< 0.01	< 0.01	< 0.05	< 0.05	< 0.05	< 0.01	< 0.05

Values are mean ± standard deviation or number

Table 5. Comparison of postoperative complications between the groups

Group	Number	Infection of the incisional wound	Urinary tract infection	Abdominal distension	Nausea and vomiting	Thirst	Hypothermia	Anastomotic stomal bleeding	Pulmonary infection
Observation group	40	0 (0)	2 (5)	2 (5)	2 (5)	2 (5)	2 (5)	1 (2.5)	2 (5)
Control group	40	2 (5)	8 (20)	10 (25)	5 (12.5)	10 (25)	8 (20)	1 (2.5)	8 (20)
χ^2		2.05	4.11	6.27	1.41	6.27	4.11	1	4.11
P		> 0.05	< 0.05	< 0.05	> 0.05	< 0.05	< 0.05	> 0.05	< 0.05

Values are number (%)

In this study, FTS was applied for patients who received laparoscopic partial nephrectomy. The differences between FTS and traditional surgery in the perioperative treatment period are as follows. (1) One of these differences is health education. Because patients lack cognition of the operation and relevant knowledge of the disease, they have doubts about the operation's safety and results, and their feeling of tension increases. Therefore, there are some specific physiological responses, such as a rise in blood pressure, sweaty palms, and acceleration of heart rate. The main measures for implementing FTS are to enhance individualized education and maintain favorable communication between doctors and patients.¹⁰ (2) Diet and bowel preparation are different between FTS and traditional surgery. The purpose of preoperative fasting is to avoid aspiration in the anesthesia and operation process. Preoperative fasting guidelines in the revised edition of the American Society of Anesthesiologists state that preoperative fasting for 6 hours and a preoperative intravenous drip of 500 mL 10% glucose liquid can avoid aggravation of the stress response (caused by adverse effects, such as hunger, thirst, dehydration, agitation, or hypoglycemia due to long-term fasting and prohibition of drinking water), without an increase in anesthesia aspiration and risk of asphyxia.¹¹ FTS does not advocate preoperative fasting for a long time and prohibition of drinking water, as well as bowel preparation for mechanical clysis. Under the condition of normal gastrointestinal function, solid food in the stomach can be evacuated within 6 hours, and the liquid can be evacuated within 2 hours. Oral administration of a proper amount of carbohydrates 2 hours before the operation is safe and effective, and can shorten the preoperative fasting time and reduce occurrence of insulin resistance, without an increase in the

occurrence rate of postoperative complications.¹² Traditional retroperitoneal laparoscopic surgery requires preoperative bowel preparation. This involves applying warm soap suds for cleaning and clysis before the operation to prevent intraoperative surgery field pollution and promote recovery of postoperative gastrointestinal function. Mechanical clysis is a type of stress for patients, and this not only increases discomfort and pain, but can also lead to water-electrolyte and acid-base disturbance. This can even cause intestinal ectopic bacteria and increase postoperative abdominal infection.¹³ Avoiding unnecessary bowel preparation before the operation and supporting prevention of antibiotic use can reduce the infection rate of the operation.¹⁴ (3) Thermal insulation and fluid infusion are different between FTS and traditional surgery. Hypothermia may easily occur in the operation because of the patient's body exposure and effect of medicine. Hypothermia stimulates the body to release catecholamines, intensify oxygen dissipation, inhibit enzyme activity, and affect coagulation function. Application of an electric blanket in the inpatient ward not only makes patients feel comfortable, but can also reduce energy consumption.¹⁵ A low temperature in the operation can increase the occurrence rate of intraoperative bleeding and cardiovascular complications.¹⁶ FTS adopts insulation measures in the operation and limits fluid infusion. Therefore, intraoperative bleeding and cardiopulmonary complications can be effectively decreased.¹⁷ Sufficient intraoperative transfusion can lead to a high blood volume, which is adverse to postoperative recovery and increases the occurrence rate of complications. (4) Diet and activity are also different between FTS and traditional surgery. The concept of FTS advocates eating food after the operation as early as possible because fasting for a long time can easily lead to dehydration, a decrease in

blood volume, and can cause hypoglycemia. Nutrients are supplemented orally. Contact between food and the oral cavity and chewing with teeth can stimulate patients' parasympathetic nerves, increase salivary secretion, reflectively cause gastric juice and pancreatic secretion, and shorten recovery of gastrointestinal function. Patients can also compensate for lost energy and water and body metabolism deficiency, have enhanced pathogenic factor resistance, and gain time for a fast recovery. In FTS, patients are encouraged to walk about as early as possible. Taking food orally after the operation as early as possible can facilitate peristalsis, maintain intestinal mucosal barrier function, increase splanchnic blood flow, enhance patients' anti-infection ability, and promote wound healing. Lying in bed for a long time after the operation can cause a reduction in muscular strength and damage lung function, which leads to venous congestion and thrombosis and reduces pulmonary infection.^{11,18,19} (5) Finally, pain and tube management are different between FTS and traditional surgery. The degree of pain is evaluated every day after the operation with FTS. Relieving pain fully according to the degree of pain is an important method to reduce operative stress. If possible, the drainage tube and ureter should be removed according to the doctor's advice to shorten the tube indwelling time, reduce patients' discomfort, avoid wound and urinary tract infection, and contribute to patients' concentration on activity.

This study has a limitation of sample size. We only selected 80 patients to study. Therefore, the sample size was too small, which may have increased the probability of type II errors and reduced the statistical power. This could have affected the power of statistical analysis, and finally affected the conclusions of the study. Because of the small heterogeneity of the research population, this study had sufficient test

efficacy in strict accordance with the inclusion and exclusion criteria. Therefore, in future research, we should strictly select the sample size to reduce its effect on the statistical results.

Our study showed that, for laparoscopic partial nephrectomy guided by FTS, the duration of anesthesia was shorter and fluid transfusion volume on the day of the operation was lower compared with controls. Additionally, the degree of postoperative pain was less, and the durations of the first time away from the bed after the operation, of first feeding time after the operation, of first evacuation time after the operation, of indwelling drainage time, of indwelling urethral catheter time, and of hospital stay were significantly shorter in the observation group than in the control group. These findings indicate that, compared with traditional postoperative recovery, FTS has obvious advantages. Furthermore, the rates of postoperative complications, such as urinary tract infection, abdominal distension, thirst, hypothermia, and pulmonary infection, were significantly lower in the observation group than in the control group.

In conclusion, effective measures that are used in the perioperative period, such as better preoperative education, the anesthesia method, pain relief, and the surgical operation, can reduce operative stress, relieve pain, accelerate organ function recovery,^{20,21} and reduce the occurrence rate of complications.²² FTS is a safe and effect method for laparoscopic partial nephrectomy. FTS can shorten the hospital stay, reduce hospitalization expenses, and contribute to postoperative recovery. Therefore, FTS should be further promoted and applied in clinical practice.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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