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Enhanced Recovery after Robot-Assisted Partial Nephrectomy for Cancer: Is it Better for Patients to Have a Quick Discharge?

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Oncology · Robotics · Enhanced recovery · Renal surgery · Partial nephrectomy

Abstract
Objectives: The aim of the study was to assess the efficacy and safety of an enhanced recovery program (ERP) after robot-assisted partial nephrectomy (RAPN) for cancer. ***Methods:*** It was a monocentric, retrospective, comparative study. An ERP after RAPN was introduced at our institution in 2015 and proposed to all consecutive patients admitted for RAPN. The control group for this study was composed of patients managed immediately before the introduction of the ERP. We collected information on patient characteristics, tumor sizes, ischemia times, biology, hospital length of stays, postoperative (≤30 days) complications, and readmission rates. Group comparisons were made using the Pearson χ^2 test for qualitative data and the Student *t* test for quantitative data. ***Results:*** Between 2015 and 2017, 112 patients were included in the ERP group. Fifty patients were included in the control group. Ninety patients in the ERP group (80.4%) were discharged at or before postoperative day (POD) 2 versus 10 patients (20%) in the control group ($p < 0.001$). There was no significant difference between the ERP and control groups for the urinary retention rate (respectively 3.6 vs. 2%; $p = 0.593$). Resumption of normal bowel function was significantly shorter in the ERP group (94.6% at POD1 vs. 69.6% in the control group, $p < 0.001$). There were no significant differences for postoperative complications (15.2% in the ERP group vs. 20% in the control group, $p = 0.447$) or readmissions within 30 days (8.04 vs. 0.2%, $p = 0.140$). ***Conclusions:*** ERP after RAPN seems to reduce postoperative length of stay without increasing postoperative complications or readmissions.

Introduction

Kidney cancer is the thirteenth most frequent malignancy worldwide, with an estimated 271,000 new cases per year [1]. The development of laparoscopy for partial nephrectomy resulted in shorter length of hospital stay (LOS) and reduced morbidity and mortality compared to open surgery [2]. The advent of robotic assistance enlarged the range of kidney tumors conservatively resectable via a minimally invasive approach, with, again, a reduction in intra- and postoperative complications and LOS [3]. As a complement to minimally invasive, robotic,

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or laparoscopic procedures, enhanced recovery programs (ERPs), also known as fast-track recovery programs, have been developed and implemented, notably in the setting of digestive surgery, where they have been shown to significantly reduce LOS and postoperative morbidity and mortality [4]. In urology, ERPs have been deployed following cystectomy for bladder cancer and shown to provide those same significant reductions and improve patient quality of life [5–8]. Their cost-effectiveness has also been demonstrated [9].

However, the literature provides little data on the interest of ERPs after robot-assisted partial nephrectomy (RAPN) for cancer [10, 11]. An ERP after RAPN was deployed in our department in 2015. The objective of this study was to assess the efficacy and safety of this ERP after RAPN.

Patients and Methods

We performed a single-center, retrospective, comparative, intermediate-care study. An ERP after RAPN was implemented at our institution in February 2015 (Table 1) and proposed to all consecutive patients admitted for RAPN thereafter. The patients who followed the ERP comprised the study group for this work. Our control group was composed of patients managed immediately before the implementation of the ERP. We collected data on patient characteristics, tumor sizes, ischemia times, biologies, LOS, postoperative complications, and readmission rates.

Clinical Pathway

Consent for participation was gathered during the preoperative consultation with the surgeon after an explanation of the ERP. Patients were also given an information leaflet on the ERP at that time. They furthermore received complementary information during the preoperative consultation with the anesthesiologist.

Anesthesia

No systematic premedication was given before surgery. The administration of intraoperative perfusions was limited as much as possible by the anesthesiologist. The use of morphine analgesics and intravenous narcotics was also avoided. No nasogastric intubation was used during the intervention. At the end of surgery, the port incisions were infiltrated with lidocaine (20 cm^3). The peripheral catheter was removed on postoperative day (POD) 1.

Surgical Procedure

All RAPNs were performed by the attending surgeon following the standardized procedure. Some interventions required an intraoperative ultrasound to situate the tumor and its boundaries. No drains were left in place. The urinary catheter was removed in the recovery room the same day as surgery or at 6:00 a.m. the next day (for afternoon interventions).

Hospital Discharge

Patients were discharged from the hospital on POD1 or the morning of POD2 when the following criteria were met: pain controlled by mild opioid analgesics at the most, satisfactory mobilization (autonomous stair walking), normal eating with no nausea or vomiting, and absence of postoperative complications.

Statistical Analyses

Quantitative variables were described as means (±SEM) and compared using the Student's *t* test. Qualitative variables were described as proportions and compared using the Pearson χ^2 test. Significance was set at $p < 0.05$. IBM SPSS statistic (v19) was used for all statistical analyses.

Results

Patient, Tumoral, and Surgical Characteristics

We included 162 patients in the study: 112 in the fast track group and 50 in the control group. Table 2 provides comparisons of patient, tumoral, and surgical characteristics.

Immediate Postoperative Results (Table 3)

Hospital discharge on POD2 was possible for 71.4% ($N = 80$) of the patients in the ERP group and 20% ($N = 10$) of those in the control group ($p < 0.001$). The reasons for delayed discharge (after POD2) in the ERP group were abdominal wall abscesses ($N = 3$; 2.7%), arterial pseudoaneurysms ($N = 2$; 1.8%), macroscopic hematuria ($N = 1$; 0.9%), urinoma ($N = 1$; 0.9%), ileus ($N = 1$; 0.9%), waiting for convalescence ($N = 2$; 1.8%), pyelonephritis ($N = 2$; 1.8%), fever ($N = 1$; 0.9%), and abdominal pain ($N = 2$; 1.8%).

There was no significant difference of postoperative complications between the ERP group and the control group ($p = 0.447$). Table 3 provides a comparison of immediate postoperative results and complications during hospitalization. No drains were left postoperatively for any of the included patients.

Table 1. ERP for RAPN

RAPN care provision timeline		
Consultations		
Preoperative consultation	Surgeon	Information on therapeutic project, benefits/risks Information leaflet supplied Consent from the patient/substitute decision-maker Protocol information sent to primary care physician
Preanesthesia consultation	Anesthesiologist	Information/anesthesia technique and postoperative analgesia
		Instructions for stopping alcohol and tobacco consumption
		Review of current patient treatments No systematic premedication
Hospitalization		
Day 0 preoperative	Anesthesiologist	Preanesthesia assessment
	Surgeon	Preoperative visit/site-marking
	Registered nurse	Administration of anxiolytic or hypnotic only if requested
	Certified nursing assistant	Six hours of solids fasting before surgery/400 mL of sugared beverage allowed up to 2 h before surgery
		Stimulation to empty bladder
Day 0 operating room	Anesthesiologist	Minimal use of intraoperative perfusions
		No morphine analgesics
	Surgeon	RAPN
		No drain
	Recovery room	Port incision infiltration
		Removal of catheter at RR discharge (catheter removed at 8:00 a.m. the following day for afternoon interventions)
D0 postoperative	Registered nurse	Parenteral hydration until 8:00 a.m. on POD1
		Surveillance for micturition return
	Physical therapist	First bed-to-chair mobilization
	Certified nursing assistant	Liquids allowed 2 h after the return to the urology department
		Light meal (or liquid meal for afternoon interventions)
POD1	Registered nurse certified nursing assistant	Prokinetic/antiemetic treatment
		Chewing gum
		Normal meals
		Patient consumes ≥1 L water/day until hospital discharge
	Physical therapist	Out-of-bed sitting 3 × 2 h
		Respiratory evaluation through POD2/incentive spirometry if needed
		20 min of walking, morning and evening
POD2	Physical therapist	Walking and stair climbing in the morning, distance and speed of walking are increased
		Confirmation for 11:00 a.m. hospital discharge
	Surgeon	Instructions to the patient, information on symptoms necessitating emergency consultation
After hospitalization		
POD3	Registered nurse	Patient calls the following morning
POD30	Surgeon	Postoperative consultation

POD, postoperative day; RR, recovery room; ERP, enhanced recovery program; RAPN, robot-assisted partial nephrectomy.

Table 2. Characteristics of patients, tumors, and surgeries

Patient characteristics	Control group (*N* = 50)	ERP group (*N* = 112)	*p* value
Age, mean (SEM), years	60.2 (1.85)	58.2 (1.28)	0.379
Male sex, *N* (%)	38 (76)	77 (68.8)	0.348
BMI mean (SEM)	27 (0.84)	26.2 (0.43)	0.393
Preoperative renal function			
Blood Cr, mean (SEM), umol/L	82.9 (3.21)	82.5 (2.19)	0.816
eGFR (MDRD), mean (SEM), mL/min/1.730 m^2	79.7 (3.04)	82.3 (1.86)	0.475
Tumor characteristics			
Side, *N* (%)			
Right	26 (52)	47 (42)	
Left	23 (46)	62 (55.4%)	0.493
Bilateral	1 (2)	3 (2.7%)	
Location, *N* (%)			
Upper pole	10 (20)	46 (41.1)	
Mid pole	5 (10)	20 (17.9)	
Lower pole	17 (34)	33 (29.5)	<0.001
Posterior	7 (14)	12 (10.7)	
Missing data	11 (22)	1 (0.9)	
Tumor size, mean (SEM), mm	28 (1.29)	28.7 (0.98)	0.688
RENAL score mean (SEM)	7.33 (0.45)	0.53 (0.21)	0.121
Ischemia time, mean (SEM), min	20.5 (0.79)	19 (0.62)	0.688

eGFR (MDRD), estimated glomerular filtration rate (Modification of Diet in Renal Disease); RENAL score, radius, exophytic/endophytic properties, nearness of tumor to the collecting system or sinus in millimeters, anterior/posterior location relative to polar lines nephrometry scoring system; SEM, standard error of the mean; ERP, enhanced recovery program.

Postoperative Course after Hospital Discharge (Table 4)

In the ERP and control groups, 23 (20.53%) and 5 patients (10%), respectively, needed a post-discharge medical consultation ($p = 0.169$), and 9 (8.04%) and 1 (0.2%), respectively, needed to be readmitted to the hospital ($p = 0.140$). The reasons for emergency room or primary care physician consultations and hospital readmissions in the 30 days following surgery are presented in Table 4. There were no deaths in the 30 days following surgery.

Discussion

The results of our study suggest that an ERP after RAPN for cancer reduces LOS without increasing postoperative complications and readmissions in the 30 days following surgery. In our study, LOS after RAPN was significantly shorter in the ERP group (discharge at POD2: 71.4 vs. 20% in control group; $p < 0.001$). Compared to open surgery, the development of laparoscopic and then robot-assisted procedures had already resulted in reductions in LOS [2, 3]. RAPN brought further improvement, significantly ($p = 0.004$) reducing the LOS in comparison to laparoscopic partial nephrectomy, as demonstrated by Choi et al. [12] in their meta-analysis covering 2,240 patients. Kaouk et al. [13] reported a mean LOS of 3.6 days for their 252 RAPN cases.

ERPs are designed as a supplement to the management of patients undergoing surgery. Regardless of the surgical setting, all ERPs share certain key elements: controlled preoperative pain management with minimal use of morphine analgesics, limited fasting time both pre- and postoperatively, and early and repeated mobilization of the patient. The positive effects of ERPs have been widely demonstrated in the literature [4, 14–16], as has their cost-effectiveness, traceable to shorter LOS, and fewer severe complications [9].

In urological surgery, ERPs were originally developed for cystectomies due to their high rate of postoperative morbidity, notably as concerns the return to intestinal motility [7]. Several studies have illustrated reductions in postoperative complications and LOS when cystectomies are associated with an ERP [5–8].

Table 3. Immediate postoperative results after RAPN with an ERP compared to the control group

Immediate postoperative course	Control group (N = 50)	ERP group (N = 112)	p value
Removal of urinary catheter, N (%)			
No urinary catheter	0	38 (33.9)	
POD0	7 (14)	34 (30.4)	<0.001
POD1	25 (50)	38 (33.9)	
POD2	16 (32)	2 (1.8)	
Urinary retention	1 (2)	4 (3.6)	0.593
Mobilization, N (%)			
POD0	3 (6)	75 (67)	
POD1	32 (64)	37 (33)	<0.001
≥POD2	15 (30)	0	
Nutrition, N (%)			
Diet begun on			
POD0	4 (8)	109 (97.3)	
POD1	32 (64)	3 (2.7)	<0.001
POD2	14 (28)	0	
Resumption of normal bowel function			
POD1	32 (69.6)	106 (94.6)	
POD2	13 (28.3)	6 (5.4)	<0.001
≥POD2	1 (2.2)	0	
Biology			
eGFR (MDRD) at day 1, mean (SEM), mL/min/1.73 m^2	69.1 (2.51)	72.1 (1.47)	0.302
Discharge, N (%)			
POD1	0	10 (8.9)	
POD2	10 (20)	80 (71.4)	<0.001
POD3	23 (46)	8 (7.1)	
>POD3	9 (18)	14 (12.5)	
Postoperative complications during hospitalization, N (%)			
Total complications	10 (20)	17 (15.2)	0.447
Types of complications			
Macroscopic hematuria	3 (27.3)	3 (17.6)	
Arterial pseudoaneurysm	2 (4)	2 (1.8)	
Urinoma	0	1 (0.9)	0.494
Acute pyelonephritis	2 (4)	2 (1.8)	
Abdominal wall abscess	2 (4)	4 (3.6)	

eGFR (MDRD), estimated glomerular filtration rate (Modification of Diet in Renal Disease); POD, postoperative day; ERP, enhanced recovery program; RAPN, robot-assisted partial nephrectomy.

A primary strength of our study is that it contributes to alleviating a dearth of data on ERPs for RAPN in the literature [10, 11]. We developed our protocol based on current recommendations and validated protocols used in other oncological surgery settings. With it, we were able to discharge 80.3% of the patients (90/112) in the ERP group before POD2 in good conditions. The rate of readmission in the ERP group was low (8.04%) and not significantly different from that observed in the control group (1/50, 0.2%; p = 0.140), suggesting that our ERP protocol after RAPN is safe for patients. Our readmission rate was furthermore consistent with others studies: Patel et al. [11] reported a POD30 readmission rate of 4.5% in 157 patients who underwent laparoscopic partial nephrectomy or RAPN with an ERP, and Abaza and Shah [10] a rate of 2.7% in 150 patients who underwent RAPN with an ERP and hospital discharge at POD1. Although comparable to these other readmission rates, ours was nonetheless higher. This difference may be due to the fact that our patients were among the first to undergo the ERP in our institution, and we were maybe more likely to readmit patients.

Table 4. Postoperative course after hospital discharge and reasons for post-discharge consultation or readmission in the 30 days following RAPN with an ERP compared to the control group

Postoperative course after hospital discharge	Control group N (%)	ERP group N (%)	*p* value
Need for medical consultation ≤POD30	5 (10)	23 (20.53)	0.169
Primary care physician	0	6 (5.4)	
Emergency room (urology)	5 (10)	16 (14.3)	
Reasons for consultation			
Scar pain	1 (0.2)	8 (7.14)	
Fever	1 (0.2)	7 (6.25)	
Abdominal pain	0	1 (0.89)	0.193
Urinary infection	1 (0.2)	2 (1.79)	
Macroscopic hematuria	1 (2)	4 (3.57)	
Lower back pain	2 (4)	1 (0.89)	
Readmission ≤POD30	1 (0.2)	9 (8.04)	0.140
Abdominal wall abscess	0	1 (0.89)	
Urinary fistula	0	2 (1.79)	
Renal artery pseudoaneurysm	1 (0.2)	3 (2.68)	
Febrile urinary tract infection	0	2 (1.79)	
Intraperitoneal hematoma	0	1 (0.89)	

POD, postoperative day; ERP, enhanced recovery program; RAPN, robot-assisted partial nephrectomy

Another interest in our protocol is the absence of postoperative drains and rapid removal of urinary catheters in the ERP group. This eases the mobilization of patients and reduces postoperative complications [17, 18]. Indeed, Peyronnet et al. [17] showed that the absence of drainage after RAPN did not increase the rate of postoperative complications (21.9% [no drains] vs. 20.2% [drains]; $p = 0.67$) and reduced LOS (4.5 vs. 5.5 days; $p = 0.007$). As for urinary catheters, Yoo et al. [18] reported that their prolonged use was associated with increases in urinary tract infections, morbidity and mortality, LOS and costs. Tremblais et al. [19] showed that the absence of urinary catheters during RAPN in an ERP was associated with shorter LOS (2.16 days [catheter] vs. 2.56 days [no catheter]; $p = 0\ 0.05$) and not associated with an increase in urinary retention (3% [no catheter] vs. 6% [catheter]; $p = 0.39$). In our study, 38 patients (33.9%) in the ERP group had no urinary catheter. Furthermore, 34 patients (30.4%) with catheters in the ERP group had them removed on the day of surgery versus 7 (14%) in the control group ($p < 0.01$). There was no significant difference for urinary retention between the 2 groups (4 patients [3.6%] in the ERP group vs. 1 [2%] in the control group; $p = 0.593$). Our results on this subject appear to suggest that the absence of a urinary catheter reduces complications and LOS without increasing urinary retention.

We think that providing patients with detailed information on the ERP during the preoperative consultation is a major factor in their compliance thereafter. The surgeon carefully explained the ERP and the care provision timeline before asking for the study consent. Our patients furthermore received an information sheet and complementary information from the anesthesiologist during the preanesthesia consultation. Furnishing written information to patients has been shown to increase their understanding of interventions in several studies [20–22]. None of our patients withdrew from the study after their inclusion.

Limiting pre- and postoperative fasting represents a genuine progress for patient management. Several studies showed that there was no significant difference in complications between patients under strict, 6-h preoperative fasting and those allowed to drink liquids up to 2 h before surgery [23]. Also, Wang et al. [24] in a randomized study on patients undergoing colorectal surgery, found that those who consumed preoperative oral carbohydrates up to 2 h before induction reported greater postoperative comfort than those who fasted strictly starting at preoperative midnight ($p = 0.005$). Preoperative fasting of 2 h for liquids and 4–6 h for solids has been validated for the anesthesia recommendations of ERPs for planned colorectal surgeries [25]. A quick postoperative return to eating (<24 h) has also been shown to reduce mortality, complications, and LOS in several randomized studies [26, 27]. In our work, 97.3% (109/112) of patients in the ERP group were able to eat the evening of the day of surgery versus only 8% (4/50) in the control group ($p < 0.001$). We also observed a significant difference for resumption of normal bowel function at POD1 between the 2 groups (94.6% for the ERP group vs. 69.6% for the control group). We also observed no significant differences for occlusion or vomiting between our 2 groups.

The main limitation of our study is the retrospective nature and the lack of randomization. Indeed, that does not allow an exact comparison between the 2 groups. However, data of ERP groups were collected prospectively. Only the control group data were collected retrospectively. Regarding randomization, in order to facilitate the care's organization and thus improve the quality of care, all patients hospitalized for RAPN benefited from ERP, unless opposed.

Another limitation of our study could be the effectiveness of the patients included. This may have resulted in a lack of statistical power. However, this is one of the only studies published on the subject, and the number of patients included was acceptable for quality statistical analysis with significant results.

In the present study, we showed that an ERP for patients undergoing RAPN for cancer seems beneficial and safe for patients. Postoperative LOS was significantly reduced without increasing complications or readmissions in the 30 days following surgery. Our results suggest that developing the routine use of ERPs in the setting of RAPN for cancer should be a priority.

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Statement of Ethics

Informed consent was signed by each patient at the preoperative consultation with the referent surgeon, after the provision of information on the protocol. Approved by the ethics committee of the department of urology in Hospital Lyon Sud.

Conflict of Interest Statement

The authors declare that they have no conflicts of interest with this study. All authors read and approved the final manuscript.

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Author Contributions

Dr. Inès Dominique: Protocol/project development, data collection or management, data analysis, and manuscript writing/editing. Dr. Corinne Palamara: data analysis and manuscript writing/editing. Mr. Emilien de Mazancourt: data collection or management and data analysis. Prof. Rene Ecochard: data collection or management, data analysis, and manuscript writing/editing. Dr. Helene Hacquard: protocol/project development, data collection or management, and manuscript writing/editing. Dr. Benjamin Tremblais: data collection or management, data analysis, and manuscript writing/editing. Dr. Nicolas Morel Journel: protocol/project development and data collection or management. Dr. Denis Champetier: data analysis and manuscript writing/editing. Prof. Alain Ruffion: protocol/project development, data collection or management, and manuscript writing/editing. Prof. Philippe Paparel: protocol/project development, data collection or management, data analysis, and manuscript writing/editing.

Availability of Data and Material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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