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ORIGINAL ARTICLE

Fast-track surgery in laparoscopic radical prostatectomy: basic principles

O. Gralla · F. Haas · N. Knoll · D. Hadzidiakos · M. Tullmann · A. Romer · S. Deger · V. Ebeling · M. Lein · A. Wille · B. Rehberg · S. A. Loening · J. Roigas

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Abstract Fast-track surgery describes innovative treatment concepts ensuring a faster convalescence phase. The aim of this study was to allow hospital discharge 3 days after surgery without additional complications in patients receiving LRPE for localized prostate cancer. Twenty-five patients each were randomized in the study groups to verify if a fast-track regimen could be transferred into clinical routine. The perioperative data, early complications, hospital stay as well as readmission rate were analyzed. The mean postoperative stay was 3.6 days in the fast-track group versus 6.7 days in the conventional group. The overall complications were significantly less in the fast-track procedure. The readmission rate was low and not significant. Patients receiving an LRPE benefit from a suitable fast-track concept. The postoperative hospital stay could be shortened nearly by half with a significantly decreased overall complication rate. Thus, fast-track concepts might contribute to saving resources in the long term. However, more evidence based on larger prospective trials is needed to achieve optimal quality of life for patients perioperatively.

Keywords Laparoscopic radical prostatectomy · LRPE · Fast-track surgery · Convalescence

O. Gralla (✉) · F. Haas · M. Tullmann · A. Romer · S. Deger · V. Ebeling · M. Lein · A. Wille · B. Rehberg · S. A. Loening · J. Roigas
Department of Urology, Campus Mitte, Charité—Universitätsmedizin Berlin, Schumannstrasse 20/21, 10117 Berlin, Germany
e-mail: oliver.gralla@charite.de

N. Knoll
Institute for Medical Psychology, Campus Mitte, Charité—Universitätsmedizin Berlin, Schumannstrasse 20/21, 10117 Berlin, Germany

D. Hadzidiakos
Department of Anaesthesiology, Campus Mitte, Charité—Universitätsmedizin Berlin, Schumannstrasse 20/21, 10117 Berlin, Germany

Introduction

For localized prostate cancer, surgical management is one treatment of choice. Besides open radical prostatectomy, laparoscopy found entry in urological surgery and developed over the last years to an equivalent or even favourable surgical approach in the treatment of localized prostate cancer.

However, despite satisfactory oncological outcomes with most acceptable results in long-term survival, surgical interventions always imply the risk of perioperative complications and consecutive reduction in quality of life [3, 30].

The main reasons for the need of postoperative hospitalization include intraoperative hypothermia, fluid overload, postoperative stress response, pain, immobilization, gastrointestinal atonia, and postoperative nausea and vomiting (PONV) [16, 17]. The central concern of so-called fast-track concepts is to reduce the perioperative physiological and thereby psychological stress response to optimize the patients' quality of life during the postoperative recovery process.

The strategies for minimizing the perioperative stress response are known since the early twentieth century [32]. Scientific evidence for an overall optimization of perioperative care was demonstrated by Kehlet in the late 1990s. By means of multimodal approaches after elective surgery he described the first fast-track concepts [17, 33].

"Fast-track" rehabilitation focuses on preoperative patient education, atraumatic and minimally invasive access to the operative field, optimized anesthesia under normovolemia, and prevention of intraoperative blood loss, hypoxia and hypothermia, effective analgetic therapy without high systemic doses of opioids, enforced postoperative patient mobilisation, early postoperative oral feeding, and avoidance of tubes and drains [29].

So far, several surgical disciplines such as general surgery, thoracic surgery, gynecology, orthopedic surgery or pediatric surgery have implemented fast-track concepts in their surgical routine [9, 23]. Moreover, in general, thoracic or transplantation surgery, fast-track treatments are about to become standardized procedures and have been described in several clinical trials [4, 11, 19, 20].

By using fast-track concepts, the hospital stay for surgical patients has been shown to be shortened dramatically also resulting in a reduction of "hospital-derived complications" such as thromboembolic events, pneumonia, intestinal problems or loss of muscle mass [33].

LRPE has been established in our department since 1999 with more than 1,300 cases to date. Thus, if implemented consistently, an auxiliary multimodal fast-track concept should be associated with an additional increase in quality of life during the post-surgical recovery process and a substantial reduction in hospital stay. Below, our fast-track concept for LRPE is described and the first clinical results are shown.

Patients and methods

From September 2004 to February 2005, 25 patients each were prospectively randomized into two study groups ($N = 50$), one receiving the conventional perioperative treatment, the other receiving a perioperative multimodal fast-track concept with distinctive changes in pre-, intra-, and post-operative care (Table 2). An exclusion criterion for study participation was severe reduced renal function due to analgetic treatment with COX-II-Inhibitors. Patients up to ASA III were included in the study. The patients' descriptive data are listed in Table 1.

Table 1 Patients' descriptive data

	M (SD, *n*)/**Md (*n*)**		*t* (*df*)/χ^2 (*df*)	*P*
	Conventional	Fast-track		
Age (years)	62.24 (7.01, 25)	61.80 (4.75, 25)	0.26 (48)	0.80
BMI	25.84 (3.00, 23)	25.82 (2.55, 25)	0.03 (46)	0.98
Gleason sum	5.92 (1.14, 24)	6.00 (1.04, 25)	−0.27 (47)	0.79
T-stage	**1(25)**	**1(25)**	**0.94(1)**	0.33
PSA (ng/ml)	10.24 (8.40, 25)	7.29 (4.99, 25)	1.51 (48)	0.14
Volume (ccm)	45.72 (20.09, 25)	45.37 (13.52, 25)	0.07 (48)	0.94
ASA	**2(25)**	**2(25)**	**1.10(2)**	0.58

Patient's descriptive data without significant differences

General treatment concept

Preoperative phase

After randomization on the day of admission, the patients in the conventional treatment group were asked to cease food intake and received colonic irrigation with a 3,000 ml polyethyleneglycol solution. Fast-track patients continued ingesting the normal hospital diet for lunch, soup for dinner, and were allowed to drink until midnight of the preoperative day. The night prior to surgery, fast-track patients received two enemas for cleaning the rectal ampulla.

Intraoperative phase

LRPE was performed in a descending manner, described previously [31]. Intraoperatively, all patients received cefuroxim/metronidazole as a single-shot antibiotic. In the conventional treatment group, intra-abdominal CO_2-pressure was adjusted to 15 mmHg, the insufflated gas had a temperature of about 18°C. Fast-track patients have been operated with an intra-abdominal pressure of 12 mmHg. Moreover, the insufflated gas was pre-heated to 37°C with a warming device (SCB-Thermoflator, Karl–Storz–GmbH, Tuttlingen, Germany). To minimize intraoperative bleeding, surgery in both groups was usually perfomed in a moderate to enhanced anti-Trendelenburg positioning to decrease the blood pressure in the lower pelvic region. Additionally, restrictive infusion therapy was performed during the ablative phase of the operation. Maintenance of normothermia for optimal coagulation and hemodynamics was achieved in both groups by extracorporal forced-air warming. Tubes or drains were inserted only if postoperative bleeding was considered likely by the operating surgeon. At the end of the procedure, patients in the fast-track group received a scrotal jockstrap.

In the conventional group, anaesthesia was conducted as a total intravenous anaesthesia with propofol (4-) 6–8 mg/kg/h and remifentanil 0.1–0.5 μg/kg/min. In the fast-track group, a balanced anaesthesia with

Table 2 Principle treatment concept

	Conventional	Fast-track
Preoperatively		
	Preoperative diagnostics, informed consent, breakfast, no further oral nutrition, 3,000 ml Klean prep®, advised discharge 6–8 p.o. day	Preoperative diagnostics, informed consent, breakfast, lunch, soup for dinner, two enema at night, drinking until 24:00, advised discharge 3 p.o. day
Intraoperatively: surgical/analgetic		
	Cefuroxim/metronidazol 15 mmHg pneumoperitoneum 18°C	Cefuroxim/metronidazol, 12 mmHg pneumoperitoneum 37°C, scrotal jockstrap
	Piritramid, metamizol, PCA-device	Piritramid, metamizol, parecoxib, 200 mg erythromycin
Postoperatively		
Operation day	2,500 ml i.v. volume; no oral nutricion; PCA, metamizol; mobilization: upright position	1,500 ml i.v. volume; 2 h p.o. tea/water; 4 h p.o. yoghurt 200 mg Erythromycin; 40 mg parecoxib Mobilization: walking in patients room and ward
P.o. day 1	2,000 ml i.v. volume, 600 ml tea/water 24 h, PCA, metamizol	No i.v. volume, "light" hospital diet, 120 mg etoricoxib
	Mobilization in patients room	Mobilization: out of bed at least 8 h
P.o. day 2	500 ml i.v. volume; tea/water PCA, metamizol; mobilization on ward	No i.v. volume; normal nutricion; 120 mg Etoricoxib; in bed just for sleeping
P.o. day 3	No i.v. volume; tea/soup; PCA; metamizol; mobilization on the ward	Debriefing, **discharge**
P.o. day 4	No i.v. volume; "light" hospital diet; metamizol; mobilisation on the ward	–
P.o. day 5	No i.v. volume; normal nutricion metamizol; mobilization on the ward MCU for anastomosis tightness (working day)	**Ambulatory** MCU for anastomosis tightness (working day)
P.o. day 6	Debriefing, **discharge**	–

Basic treatment concepts in both study groups from preoperative preparation to hospital discharge

desflurane (3–5 vol%, minimal flow) and remifentanil (0.1–0.5 μg/kg/min) was used. Desflurane administration was guided by EEG (spectral entropy, Datex M-entropy module). Dexamethasone (4 mg i.v.) was applied routinely to prevent postoperative nausea and vomiting in the fast-track group.

Postoperative phase

For postoperative analgesia, all patients received piritramid at the end of the operation to reduce pain-related stress during the wake-up phase. In addition, all patients received 2 g metamizol i.v. Additionally, fast-track patients received parecoxib 40 mg i.v. in the post operative care unit (PACU) for immediate postoperative pain relief, whereas patients in the conventional treatment group were treated with piritramid bolus doses and received a patient-controlled anesthesia (PCA) device with piritramid for further postoperative pain treatment.

On the ward, fast-track patients received only COX-II-inhibitors p.o. as analgesic treatment in addition to oral metamizol. During the first 4 weeks of the study, 50 mg rofecoxib was administered p.o. daily. Due to the market withdrawal of rofecoxib, the medication was changed to 120 mg etoricoxib p.o. once daily. Piritramid served only as rescue medication in the fast-track group.

To stimulate bowel function, patients in the fast-track group received 200 mg erythromycin i.v. in the PACU and a second dose on the ward if needed.

Central procedures during pre-, intra-, and postoperative phase for both treatment concepts are described precisely in Table 2. In short, after atuned pre- and intraoperative modifications, fast-track patients received an opioid-free accelerated oral nutrition and mobilization management with an adapted analgetic treatment with high-dose COX-II inhibitors postoperatively.

Before randomization into one of the study groups, patients were informed about the entire treatment course, with special emphasis on the discharge policy. The planned hospital discharge date in the fast-track group was the third postoperative day with an indwelling catheter. Patients in the conventional treatment group were briefed on a postoperative hospital stay of 6–8 days with prior removal of the catheter. MCU for detecting leakage of the urethro-vesical anastomosis was carried out on the fifth working day post surgery. Patients in the conventional treatment group were discharged 1 day after MCU. Fast-track patients returned to the outpatients department ambulatory on the fifth to seventh p.o. day for MCU and left the hospital again after a leakage test.

The central outcomes of this study included general complication rates, time to discharge, and readmission rate in both groups.

Statistics

To determine group differences in the central outcome measures, independent samples *t* tests (for interval and ratio data) and χ^2 tests (for nominal and ordinal data) were conducted using an SPSS 12.0.1.

Results

The intraoperative data revealed no significant differences between the two groups. Mean operation time was 220 (fast-track) and 240 (conventional treatment) min. The amount of blood loss did not differ significantly between the groups, with a mean of 156 ml for the conventional treatment group and a mean of 240 ml for the fast-track group. The latter included one patient with a blood loss of 1,500 ml constituting a univariate outlier. No transfusions were necessary in both the groups (Table 3).

Postoperative data

The most common complication was a postoperative appearance of penoscrotal edema and hematoma. Several minor complications occurred in both of the treatment-groups, listed in Table 4.

There was only one severe complication in the conventional treatment group. After discharge, one patient returned 2 days later with diffuse abdominal discomfort. After development of progressive abdominal pain, surgery revealed an intestinal laceration with following prolonged course on the ICU and several subsequent operations including an ileostomy.

Fast-track patients were discharged after a mean of 3.6 days post-surgery, whereas patients in the conventional treatment group were discharged on postoperative day 6.7 (Table 4, Fig. 1).

In the fast-track group two patients were readmitted presenting with abdominal discomfort 2 weeks after surgery. After catheterization and antibiotic treatment both patients left the hospital after 2 days' stay without further operative intervention.

Discussion

Fast-track surgery is an interdisciplinary, multimodal concept to accelerate postoperative convalescence and reduce general morbidity to a minimum [17, 33].

Table 3 Intraoperative data

	M (SD, *n*)/Md (*n*)/frequencies positives (*n*)		*t* (*df*)/χ^2 (*df*)	*P*
	Conventional	Fast-track		
Duration (min)	220.12 (56.96, 25)	240.00 (64.70, 25)	−1.15 (48)	0.26
Blood loss (ml)	156.88 (71.81, 16)	275.24 (315.24, 21)[a]	−1.47 (35)	0.15
Drainage	*n* pos = 1 (25)	*n* pos = 2 (25)	**0.36 (1)**	0.55
Transfusion	*n* pos = 0 (25)	*n* pos = 0 (25)	–	–
Nerve sparing	*n* pos = 11 (25)	*n* pos = 12 (25)	**0.08 (1)**	0.78

[a] One patient exhibited 1,500 ml blood-loss during the operation. Deletion of this outlier results in a mean blood-loss of 214.00 ml (SD = 147.34) for fast-track patients

Table 4 Complications and length of hospital stay

	M (SD)/frequencies positives		*t* (*df*)/χ^2 (*df*)	*P*
	Conventional *n* = 25	Fast-track *n* = 25		
Complications, total postoperative	*n* patients with complications = 14[a]	*n* patients with complications = 6	**5.33 (1)**	0.02
Penoscrotal	*n* pos = 12	*n* pos = 5	**4.37 (1)**	0.04
Cardial	*n* pos = 1	*n* pos = 0	**1.02 (1)**	0.31
Major complications	*n* pos = 1	*n* pos = 0	**1.02 (1)**	0.31
Urinary retention	*n* pos = 1	*n* pos = 0	**1.02 (1)**	0.31
Paresthesia	*n* pos = 0	*n* pos = 1	**1.02 (1)**	0.31
Pneumonia	*n* pos = 1	*n* pos = 0	**1.02 (1)**	0.31
Mortality	0	0	**–**	–
Readmission	*n* pos = 1	*n* pos = 2	**0.36 (1)**	0.55
Discharge (days postop.)	6.72 (0.94)	3.60 (1.22)	10.12 (48)	<0.001

[a] Two patients had multiple complications

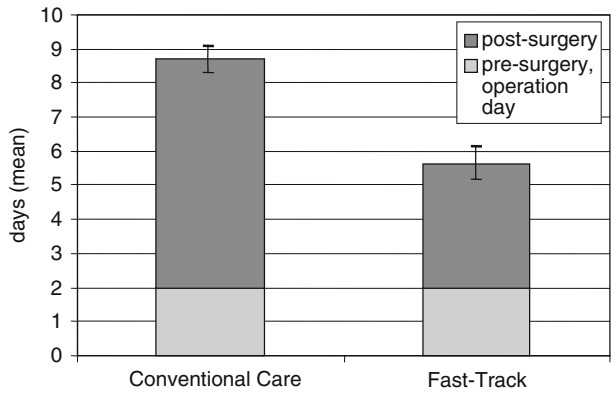

Fig. 1 Length of hospital stay for pre- (including day of operation) and postoperative days between conventional care and fast-track patients

Additionally, LRPE as a nowadays routine surgical procedure yields a number of benefits when compared to open or perineal procedures, including postoperative pain management, patient acceptance, and general quality of life [5, 22, 27]. Combining fast-track concepts with laparoscopic surgery should thus result in improved clinical outcome and optimized convalescence phase for patients. Heinzer et al. [10] recently reported their initial experiences with a fast-track concept for the open radical retropubic prostatectomy. To our knowledge no such treatment combinations for LRPE have been reported so far.

With this treatment combination our expectations have been entirely fulfilled regarding the study objectives. Patients in the fast-track group could be discharged from hospital care on postoperative day 3.6. The incidence of complications was generally low but even significantly reduced, more importantly no severe complication occurred in the fast-track group. Only two patients with minor complications were readmitted for conservative treatment.

Central features in fast-track LRPE

To contribute to the fast-track concept, anaesthesia was performed with short-acting drugs (desflurane and remifentanil) and guided by EEG parameters (spectral entropy) in order to achieve short times to extubation, adequate vigilance and co-operativity immediately after surgery. Moreover normovolemia and normothermia were meticulously maintained in order to reduce postoperative complications of the coagulatory system, wound infection, cardiovascular complications due to sympathetic activity and to improve patients' comfort.

One central feature in fast-track procedures is early postoperative oral feeding. Patients in the fast-track group were allowed to drink 2 h after surgery; yoghurt and protein-rich drinks were given 4 h postoperatively. On the first postoperative day, the patients received normal hospital diet.

According to widespread belief, postoperative nutrition is often started not before the visible return of bowel function. However, several fast-track related studies have brought evidence for beneficial effects after early postoperative feeding [6, 7, 34]. In fast-track concepts for e.g. colonic resection with intestinal anastomoses, nutrition may start on the operation day as well with no added complications concerning postoperative ileus or anastomotic leakage [15, 30]. Since radical prostatectomy is primarily no intestinal procedure, apart from colon mobilisation or detaching adhesions, the context in intestinal function perfectly predestines LRPE for implementation of fast-track concepts.

As described, high intra-abdominal pressure produced by pneumoperitoneum during laparoscopic procedures may have detrimental effects on intra-abdominal perfusion [18, 26]. To reduce the risk of intestinal complications due to splanchnic hypoperfusion, we lowered the intra-abdominal pressure from 15 to 12 mmHg to avoid possible hypoperfusion due to vascular compression. Since the intra-abdominal pressure of 15 mmHg in our conventional procedure was chosen arbitrarily anyhow, operating surgeons often could not find any difference of surgical conditions in fast-track patients. Since low temperature of insufflated gas is also suspected to account for post-surgical complications, we used a warming device in the fast-track group for the intra-abdominal gas supply to avoid splanchnic vasoconstriction [8, 12, 13].

Another important feature in fast-track concepts is the optimal analgetic treatment for postoperative pain relief. Opioids are high potent analgetic drugs, but are known to cause intestinal inactivity, which counteracts the intended benefits of fast-track procedures [2, 35]. Thus, a more compatible postoperative pain medication is crucial. Since LRPE is known to induce less postoperative pain, we avoided opioids as much as possible during postoperative course in the fast-track group [25]. A high-dose application of the COX-II inhibitor Etoricoxib (120 mg once daily) with 500 mg Metamizol as rescue medication was applied for postoperative pain management.

Enforced mobilization after surgery is a third central feature in fast-track procedures. The necessity of postoperative immobilization after elective surgery is as delayed onset of oral feeding one of the predominant dogmata in conservatively guided departments. Postoperative mobilization may have supportive effects on intestinal function, diminishes thrombembolic effects

[1] and ameliorates pulmonary function with consecutive decrease in occurrence of pneumonia [14, 21, 28].

Effective and best possible post-surgical mobilization can only be accomplished with a completely instructed nursing and physiotherapeutic staff. Beyond that the patient should be informed about the postoperative ambulatory policy. In a fast-track concept, beyond the general hint for the need of mobilization during the daily rounds, the necessity to mobilize should be stressed out on a regular basis by anyone of the entire medical staff when contacting the patient. Though, not harmful or of pathologic value, especially for patients receiving "minimal invasive" laparoscopic surgery, a swollen and discolored scrotum may be bothersome and might sometimes impair the patient's ability or intention to mobilize early, which again plays a pivotal role in fast-track concepts. To overcome the increased incidence of penoscrotal edema and hematoma in the conventional group, patients in the fast-track group received a jockstrap for modest pressure on the scrotum to avoid fluid influx in the scrotal and penile tissue during enforced mobilization. Thereby, the occurrence of penoscrotal hematoma or swelling could decrease significantly in the fast-track group.

Beyond it, we abstained from perturbing drainages as far as possible and relied on ultrasound controls, clinical signs and serum parameters.

Fast-track surgery is a multimodal interdisciplinary concept, which is conducted by surgeons, anaesthesiologists, nursing and physiotherapeutic staff. When combining the knowledge of all included disciplines, these concepts can lead to less complication as described in several clinical trials. In our study, though only a limited number of patients were included, we could show a significantly decreased occurrence of overall complications and a marked decrease of the most frequent complication in the fast-track group. There was only one severe complication during the study, which occurred in the conventional treatment group; only two patients in the fast-track group needed a readmission. More importantly no higher incidence of complications in the fast-track group was observed.

In this study, one central outcome parameter was the date of discharge. Fast-track patients were discharged from the hospital on average 3 days earlier than patients in the conventional treatment group. Although all patients were informed before inclusion into the study about the entire perioperative course including discharge policy, it was underscored that the earliest possible discharge (i.e., 3 days post-surgery) remained optional for all fast-track patients.

Conclusions

With our study we aimed to investigate the feasibility of a fast-track concept for LRPE. Preliminary results indicated the expected benefits of the fast-track procedure over conventional care. The postoperative hospital stay could be shortened nearly by half with a significantly decreased overall complication rate. We implemented this concept in our department; moreover we adapted these findings and developed concepts for all other ablative and reconstructive laparoscopic operations. Due to sparse impact on intestinal function and respect to crucial importance of early onset of postoperative nutrition, urological procedures are perfectly predestined for implementation of fast-track concepts.

However, further studies with larger number of patients, a longer follow-up, and subjective outcome measures, such as quality of life, need to be conducted to comprehensively explore the costs and benefits of fast-track concepts in urological surgery.

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