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ORIGINAL ARTICLE

Fast-track concepts in routine pediatric surgery: a prospective study in 436 infants and children

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Abstract
Background and aims The aim of this study was to investigate fast-track concepts in routine pediatric surgery in a university clinic over 1 year.
Patients/methods Fast-track concepts were established for procedures requiring hospital admission in patients up to 15 years of age. Patients were studied prospectively from June 2006 to June 2007.
Results Out of a total of 436 potentially suitable patients, 155 (36%) were finally treated following the protocols. The mean intensity of pain in children younger than 4 years (CHIPPS, 0–10) was 1.3±1.5 the evening of the operation day and decreased to <1 at all other time points. The initial postoperative mean pain intensity in older children (Smiley/VAS, 1–10) was 3.7±2.2 and decreased constantly thereafter. The mean hospital stay of fast-track patients was significantly shorter compared with German diagnosis-related group data (4.6±2.9 versus 9.7±3.8, $p<0.01$). There were four (3%) readmissions for minor complications. At follow-up after 2 weeks, 95% of patients and parents judged fast-track care as excellent.
Conclusion Fast-track concepts are feasible in one third of pediatric patients undergoing routine in-hospital surgery. Fast-track pediatric surgery achieves accelerated convalescence, minimal hospital stay, and high patient and parent satisfaction.

Keywords Fast-track surgery · Children

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Introduction

Fast-track surgery was conceived by the Danish surgeon Henrik Kehlet to optimize perioperative care in elective surgery [1, 2]. The aim of fast-track concepts is to reduce stress and discomfort and to speed up convalescence of surgical patients. The concepts include preoperative instruction, immediate postoperative feeding and mobilization, preference of minimally invasive techniques, and specific pain control. Drains, tubes, and catheters are avoided.

Several studies confirmed that fast-track concepts reduced the hospital stay to 2 days in adult colorectal surgery [3–6]. Data on the feasibility, safety, and economical aspects of fast-track pediatric surgery are limited. Only selected procedures such as appendectomy [7, 8], nephrectomy, pyelothomy, and pyeloplasty [9–11] have been evaluated in children. We recently investigated fast-track concepts for appendectomy, bowel anastomosis, fundoplication, hypospadia repair, nephrectomy, and pyeloplasty. Fast-track surgery was feasible in 71% of these patients with overwhelming satisfaction in patients and parents [12]. However, the control of pain was unsatisfactory during the immediate postoperative period due to a restriction in the use of morphine, which interferes with immediate feeding and mobilization.

The aim of this study was to investigate fast-track concepts in routine pediatric surgery in a university clinic over 1 year. The pain treatment concepts were modified.

Patients and methods

Approval of the local ethical committee was obtained for the study. Fast-track pathways were established for all types of routine abdominal, thoracic, and urological procedures requiring hospital admission. Fast-track concepts included clinical pathways with emphasis on preoperative instruction of parents and children by a surgeon and an anesthesiologist. Admission was preferably on the morning of the operation. Minimally invasive techniques were used when appropriate [13] and oral nutrition and mobilization were started 2 h postoperatively. Drains and catheters were avoided and the pain treatment was standardized.

All patients who were admitted for elective abdominal, thoracic, or urological surgery from June 2006 to June 2007 were included in the study. Patients undergoing day surgery and minor surgery and patients operated on for other departments were not recorded. Exclusion criteria from fast-track care were age of ≤4 weeks, former prematurity with gestational age of 35 weeks or below in patients up to 6 months of age, and reoperation. New surgical methods that were subjects of other clinical studies were excluded. Patients with pectus excavatum repair were not considered suitable for fast-track surgery due to a known high intensity of postoperative pain requiring specific analgesia. In addition, the attending consultant decided whether the general condition of the patient or co-morbidities would interfere with fast-track concepts. Personal data, medical history, and details of the intra- and postoperative course were documented prospectively.

A caudal block was applied whenever possible. For postoperative analgesia, we developed a three-stage scheme, which was individually adapted to the analgetic requirement of the patient. The analgesics administered included paracetamol, ibuprofen, dipyrone, and piritramide. Nalbuphine was given in case of suddenly increasing pain (e.g., during mobilization) with a score of 3 or above in the pain scale.

Pain measurements took place at 8.00, 12.00, and 18.00 h. Pain assessment was performed by the attending nurse using the Children's and Infant's Postoperative Pain Scale (CHIPPS) [14] in children younger than 4 years and the Smiley scale and Visual Analogue Scale (VAS) [15, 16] in older children. The CHIPPS scale includes the assessment of pain during motion of the patient. Assessments using the Smiley scale and VAS were performed separately at rest and in motion. Whenever the intensity of pain increased above 3 on a 10-point scale, a higher stage of the treatment scheme was used [17].

Oral nutrition and mobilization was documented at 8.00, 12.00, and 18.00 h. Mobilization was scored [12] as follows: (1) sitting on the edge of the bed or short mobilization out of the bed; (2) short walk in the patient's room or feeding outside of the bed; (3) walk along the corridor or mobilization in the pram.

The discharge criteria were good general condition, body temperature below 38°C, a pain score below 3 on the 10-point scale during mobilization without opioids, complete oral nutrition, mobilization score of at least 2, exclusion of local infection, uncomplicated micturition and defecation, and patient's and parent's consent. The discharge was scheduled by a consultant.

For follow-up, the PPP33 questionnaire for the perioperative period, modified for children, was used [18]. The questionnaire comprises questions regarding patient information, anxiety, autonomy, pain, complaints, and comfort. The questionnaires were completed by the parents at follow-up assessment 2 weeks after discharge. The duration until full convalescence (postoperative days), intercurrent outpatient treatment, and readmissions were documented. Complications associated with fast-track surgery were defined as complications with a delay in diagnosis and treatment owing to early discharge.

The length of hospital stay of patients in the present study was compared with data derived from the German diagnosis-related groups (G-DRGs) for patients with a similar diagnosis and case mix index. The G-DRG data of the German health care system were calculated with an appropriate grouper software (SBG grouper, SBG, Berlin, Germany). The Mann–Whitney U test was used for statistical analysis, where appropriate. Numeric values were calculated as mean values with SD. Significance was considered at $p<0.01$.

Results

Out of a total of 436 patients, 155 (36%) were finally treated according to the fast-track protocols. Of these, 100 were boys (65%) and 55 girls (35%) with a mean age of 7.3± 6.4 years.

The types of procedures and their exclusion rates are shown in Fig. 1. The exclusion rates of different types of procedures varied from 0 in laparoscopic pyleoplasty to 63% in thoracic procedures including lung resection and to 74% in bowel anastomosis. Overall, 281 patients had to be excluded from fast-track surgery. Of these, 253 patients (90%) were excluded preoperatively, mostly due to impaired general condition of the patient or co-morbidities (n=76), age <4 weeks (n=53), and catheters or drains interfering with early discharge (n=51) (Fig. 2). The reasons for exclusion from fast-track surgery during the postoperative period in 28 patients (10%) were impaired general condition (n=25) and pain, catheters, or drains (n=3).

The details of the pain assessment in patients who underwent fast-track surgery are presented in Fig. 3. In

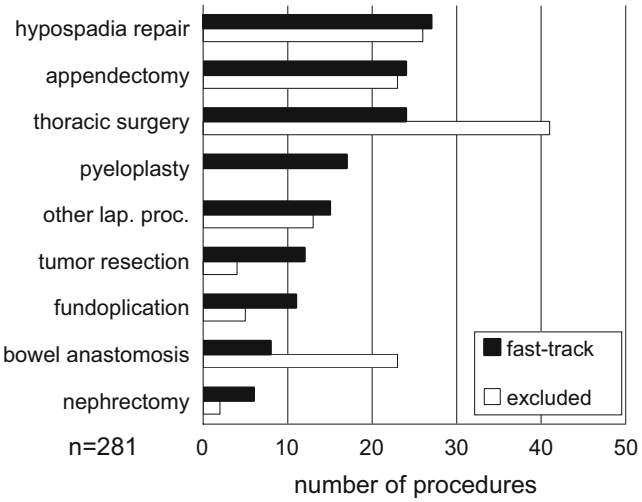

Fig. 1 Feasibility of fast-track surgery according to type of procedure in patients undergoing abdominal, thoracic, and urologic surgery. Data of procedures performed less than five times are not shown

children younger than 4 years, the mean intensity of pain at the evening of the operation day was 1.3±1.5 (CHIPPS, 0–10) and further deceased at all time points thereafter. In older children, the mean intensity of pain at the evening of the operation day was 3.7±2.2 at rest and 4.1±2.3 in motion (Smiley/VAS, 1–10). The mean pain intensity at rest was below 3 the next morning (2.9±2.2), and in motion at 18.00 of the first postoperative day (2.9±1.9).

The mobilization score was 0 (no mobilization) in 51% of the patients at the evening of the operation day. A score of 3 (full mobilization) was reached in 82% of the patients and a score of 2 in 13% of the patients at the third postoperative day (Fig. 4). Oral nutrition was completed by 140 patients (90%) at 12.00 of the first postoperative day and by all patients at 12.00 of the third day.

The mean hospital stay in fast-track patients was 4.6± 2.9 days versus 9.7±3.8 days in G-DRG patients with a similar case mix index in hospitals with a similar structure ($p<0.01$, Fig. 5).

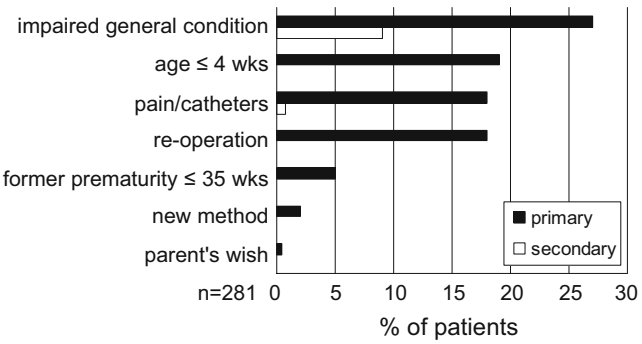

Fig. 2 Rates of exclusion from fast-track surgery. Primary: exclusion before the operation. Secondary: exclusion after the operation during fast-track surgery, in percent of patients

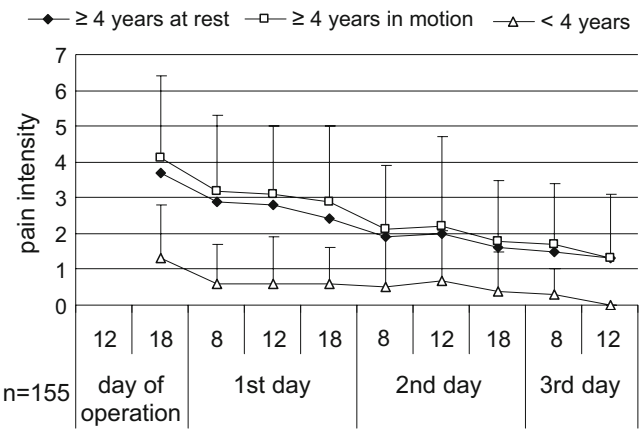

Fig. 3 Pain intensity of fast-track patients, assessed with the CHIPPS scale in children less than 4 years of age or with the Smiley/VAS scale in older children

Follow-up 2 weeks after discharge was performed in 135 parents (87%). There were four readmissions (2.5%). One patient complained of persistent abdominal pain after appendectomy, another suffered from urinary tract infection 1 week after pyeloplasty. Two patients were treated with a suprapubic catheter because of painful micturition 8 and 14 days after hypospadia repair.

At follow-up, no problems that could be attributed to fast-track surgery were reported. The question "should the pain treatment have been better?" was answered with "not correct" or "rather not correct" by 126 (93%) of the parents. The statement "the care was optimal during the hospital stay" was "correct" or "rather correct" for 128 (95%). The statement "the current well-being of my child is excellent" was "correct" or "rather correct" for 123 (91%). A clear majority of parents ($n=123$, 91%) was generally satisfied

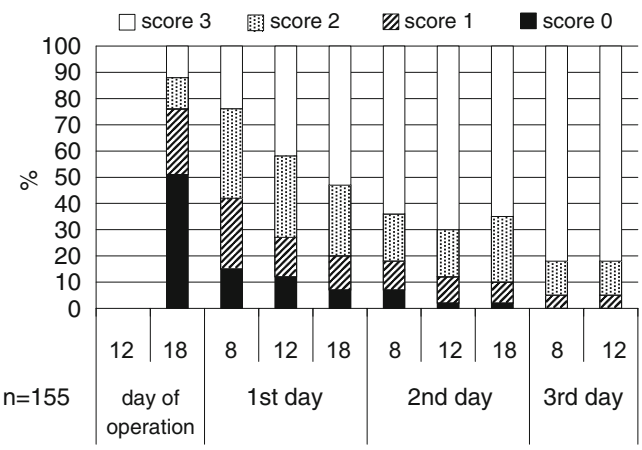

Fig. 4 Mobilization in patients undergoing fast-track surgery. 0: No mobilization. 1: Sitting on the edge of the bed or short mobilization out of the bed (infant). 2: Short walk in the patient's room or feeding outside the bed. 3: Walk along the corridor or mobilization in the pram

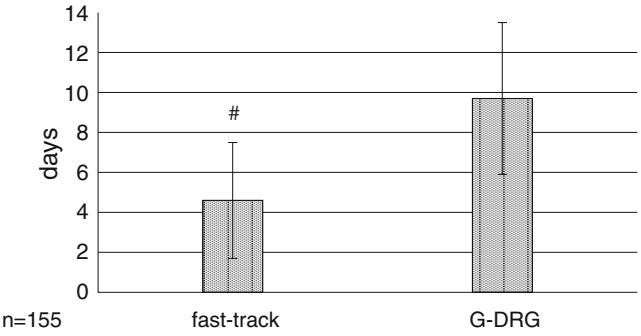

Fig. 5 Mean hospital stay of fast-track patients compared with data derived from the German reimbursement system with G-DRGs (with a similar case mix index and hospitals with a similar structure). #$p<0.01$ against G-DRG

with the treatment during the hospital stay. Parents stated that the convalescence was completed after a mean of 5.5± 5.2 days after discharge.

Discussion

Fast-track concepts could be applied successfully in one third of the infants, children, and adolescents undergoing routine abdominal, thoracic, or urological surgery. This was considerably lower compared to our previous study [12], in which only six selected types of procedures had been investigated. In the present analysis, the feasibility of fast-track care in different routine pediatric surgical procedures differed considerably. Fast-track concepts could be applied in nearly all older children without concomitant disease undergoing urological procedures, such as nephrectomy or pyeloplasty, which corresponds well with our and other previous experiences [11, 19, 20]. However, we found that only 26% of the patients undergoing bowel anastomosis and 37% of those undergoing intrathoracic procedures, such as lung resections, were suitable for fast-track surgery.

Exclusion from fast-track surgery mostly took place before the operation by the attending consultant. The most frequent reasons for exclusion were impaired general condition of the patient, co-morbidities, age ≤4 weeks, and catheters or drains interfering with early discharge. However, it remains to be investigated in how far fast-track concepts might also be used with appropriate monitoring and adaptation of the clinical pathways in these patients. In 90% of the patients who were considered suitable for fast-track surgery beforehand, the concepts were applicable. Only 10% had to be excluded during the postoperative course, mostly due to impaired general condition. This confirms that the inclusion criteria for fast-track surgery in the present study were appropriate.

We encountered no complications attributable to fast-track surgery during the postoperative period, which corresponds well with reports from studies on adult patients [21] and on children undergoing selected procedures [7–9]. In the present study, full oral nutrition was accomplished on the first postoperative day in 90% of patients, and 95% of the patients were fully mobilized on day 3. Sangkhathat et al. [22] had achieved full oral nutrition by "early enteral feeding" without fast-track treatment in children after a mean of 45 h after colostomy closure. This stresses the fact that the full fast-track concept is mandatory to achieve optimal results.

There is common agreement that analgesia is insufficient when the intensity of pain exceeds one third of the maximum of conventional pain scales [17, 23]. Our data show that analgesia was optimal in children younger than 4 years throughout the whole study. Older children scored an intensity of pain of approximately one third of the maximum at the evening of the operation day, and lower at all other time points. In our previous fast-track study, analgesia was insufficient in all age groups at the evening of the operation day. Thus, the modification of our analgesic regimen with individual adaptation used in the present study was effective.

The mean hospital stay of the fast-track patients was 4.6 days compared to 9.7 days in patients with similar diagnosis and a similar case mix index in hospitals with a similar structure in Germany. Thus, fast-track surgery is highly effective in reducing the hospital stay in routine pediatric surgery. Parents stated that convalescence was completed after a mean of 6 days after discharge. This corresponds well with previous experiences in selected procedures with a time to school return of 7–8 days [24, 12]. We conclude that children after fast-track surgery may be expected to require approximately 1 week of convalescence at home after discharge.

As in our first study, we could not confirm earlier reports of a higher readmission rate in fast-track surgery [6]. Only four patients (3%) of our series were readmitted within 2 weeks after discharge. Fast-track surgery did not result in a delay in diagnosis or treatment in any of these patients.

Conclusion

One third of routine pediatric surgical patients undergoing abdominal, thoracic, or urological procedures are suitable for fast-track surgery. In these patients, fast-track concepts can be applied safely and effectively. They lead to accelerated convalescence and excellent patient and parent satisfaction. Compared to an earlier study, individually adapted pain treatment concepts were highly effective.

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