World Journal of Clinical Cases

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World J Clin Cases 2024 August 6; 12(22): 4965-4972

DOI: 10.12998/wjcc.v12.i22.4965

ISSN 2307-8960 (online)

ORIGINAL ARTICLE

Retrospective Study

Safety and feasibility of enhanced recovery after surgery-based management model for ambulatory pediatric surgical procedures

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Specialty type: Medicine, research and experimental

Provenance and peer review: Unsolicited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's classification

Scientific Quality: Grade C
Novelty: Grade B
Creativity or Innovation: Grade C
Scientific Significance: Grade B

P-Reviewer: Grasshoff J, Germany

Received: April 8, 2024
Revised: May 16, 2024
Accepted: June 5, 2024
Published online: August 6, 2024
Processing time: 84 Days and 19.4 Hours

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Abstract

BACKGROUND

There is still some room for optimizing ambulatory pediatric surgical procedures, and the preoperative and postoperative management quality for pediatric patients needs to be improved.

AIM

To discuss the safety and feasibility of the enhanced recovery after surgery (ERAS)-based management model for ambulatory pediatric surgical procedures.

METHODS

We selected 320 pediatric patients undergoing ambulatory surgery from June 2023 to January 2024 at The First People's Hospital of Liangshan Yi Autonomous Prefecture. Of these, 220 received ERAS-based management (research group) and 100 received routine management (control group). General information, postoperative ambulation activities, surgical outcomes (operation time, postoperative gastro-intestinal ventilation time, and hospital stay), postoperative pain visual analogue scale, postoperative complications (incision infection, abdominal distension, fever, nausea, and vomiting), and family satisfaction were compared.

RESULTS

The general information of the research group (sex, age, disease type, single parent, family history, *etc.*) was comparable to that of the control group ($P > 0.05$), but the rate of postoperative (2 h, 4 h, and 6 h after surgery) ambulation activities was statistically higher ($P < 0.01$), and operation time, postoperative gastrointestinal ventilation time, and hospital stay were markedly shorter ($P < 0.05$). The research group had lower visual analogue scale scores ($P < 0.01$) at 12 h and 24 h after surgery and a lower incidence of total postoperative complications than the

control group (P = 0.001). The research group had higher family satisfaction than the control group (P = 0.007).

CONCLUSION
The ERAS-based management model was safe and feasible in ambulatory pediatric surgical procedures and worthy of clinical promotion.

Key Words: Ambulatory pediatric surgery; Ambulatory surgery; Enhanced recovery after surgery; Safety; Feasibility

Core Tip: Ambulatory surgical procedures have the advantages of high efficiency, high-quality services, low medical costs, and short hospital stays while providing sufficient guarantees in terms of medical quality, safety, and rapidity. However, there is some room for improvement. This study proposed a management model based on the concept of enhanced recovery after surgery, which was safe and feasible in ambulatory pediatric surgeries, accelerating postoperative ambulation, relieving postoperative pain, reducing the incidence of postoperative complications, and improving family satisfaction. This model provided a better management option for ambulatory pediatric surgical procedures.

Citation: Fan GQ, Zhang XD, He YK, Lu XG, Zhong JY, Pang ZY, Gan XY. Safety and feasibility of enhanced recovery after surgery-based management model for ambulatory pediatric surgical procedures. *World J Clin Cases* 2024; 12(22): 4965-4972
URL: https://www.wjgnet.com/2307-8960/full/v12/i22/4965.htm
DOI: https://dx.doi.org/10.12998/wjcc.v12.i22.4965

INTRODUCTION

Ambulatory surgical procedures involve specialties, such as pediatric surgery, general surgery, orthopedics, obstetrics and gynecology, and ophthalmology, which are mainly performed through day surgery centers equipped with higher clinical qualifications, anesthesia spare parts, and medical equipment[1,2]. The hospital establishes dedicated day operating rooms and wards and optimizes the management of surgical patient reception and appointment service platforms, patient family waiting areas, and billing windows[3]. Therefore, the day surgery mode has been widely popularized and applied because it involves high efficiency, high-quality service, low medical cost, and a short hospital stay[4,5]. Although ambulatory pediatric surgery is fully guaranteed in terms of medical quality, safety, and rapid medical services, there is room for optimization, such as improvement of the management quality of children before and after surgery[6-8]. Therefore, this study analyzed the safety and feasibility of a novel management model in ambulatory pediatric surgical procedures to provide a more comprehensive management model for ambulatory pediatric surgeries and enhance management quality and medical experience.

Enhanced recovery after surgery (ERAS) is a global surgical quality improvement program that is now closely integrated with perioperative care. It not only brings great benefits to clinical medical experience and health system optimization but also provides measures for targeted prevention to optimize clinical outcomes[9-11]. The management model based on ERAS aims to reduce the risk of postoperative complications, improve surgical outcomes, and optimize perioperative management by integrating and analyzing effective methods through evidence-based medicine to promote patient recovery[12]. The ERAS-based management model has clinical value in orthopedic surgery, mainly shortening the length of hospital stay, reducing readmission rates, and improving functional recovery[13]. According to a meta-analysis, the ERAS-based management model can help reduce the cost of total treatment for surgical patients, lower total incidence of postoperative complications, and promote recovery of gastrointestinal function[14]. Purcell *et al*[15] reported that the ERAS-based management model applied to pediatric colorectal surgery significantly improved the prognosis of children and reduced their dependence and use of opioids.

There is limited research on the safety and feasibility of the ERAS-based management model for ambulatory pediatric surgical procedures. This study aimed to fill this research gap.

MATERIALS AND METHODS

General information

In total, 320 pediatric patients undergoing ambulatory surgical procedures between June 2023 and January 2024 at The First People's Hospital of Liangshan Yi Autonomous Prefecture were selected as research participants. The types of diseases in children were hernia in 236 cases, superficial mass in 30 cases, ganglion cyst in 2 cases, tendonitis stenosans in 2 cases, polydactyly in 24 cases, umbilical hernia in 11 cases, varicocele in 5 cases, and hydrocele in 10 cases. Among them, 220 cases (research group) were treated with ERAS-based management, and 100 cases (control group) received routine management.

Criteria for patient enrollment and exclusion

Inclusion criteria: The children, aged over 1-year-old, were diagnosed by the outpatient department and could be cared for by parents after discharge, with no contraindications to surgery and complete case records.

Exclusion criteria: Children with severe cardiopulmonary disease, strangulation and necrosis of the hernial contents, blood and immune system diseases, or surgery requiring only local infiltration anesthesia.

Treatment methods

The research group received ERAS-based management including: (1) Health education. After diagnosis, the nursing staff guided the families of the children to the hospital preparation center for registration and appointment, strengthened the health education of the family members of the child, and guided the family members to read about the disease; (2) Preoperative nursing. The child's clinical symptoms were closely observed, and the examination results were analyzed 3 d before surgery. Once there were abnormalities, the child's family was instructed to review or were reminded to seek medical treatment in time. The child and their family were informed to prepare for admission 1 d before surgery. One day before the procedure, the nurse strengthened communication with the child and their family to understand the child's psychological status, introduced the surgical procedure, relevant precautions, and anesthesia methods, and explained surgical safety and successfully treated cases to avoid the negative emotions of the child and enable them to maintain an optimistic attitude. The child was told to abstain from food and drink 3-6 h before surgery but was allowed to supplement glucose as needed; (3) Intraoperative nursing. During the procedure, operating room temperature and humidity were optimally adjusted. Insulation measures for children were strengthened, such as covering the nonsurgical parts of children with thermal blankets or heated mattresses and heating the liquid infused to approximately 36 °C. On the day of operation, a personalized fasting plan was initiated, and the admission procedures went through according to the order of appointment, ensuring that the time from admission to operation was < 3 h. At the same time, the evaluation of the child was strengthened. The surgeon and the anesthesiologist conducted a preoperative interview with the child to evaluate the child's condition. During the operation, regional block anesthesia was used as much as possible, and the dosage of anesthetic drugs was accurately calculated. Before the end of the operation, ropivacaine was used for local infiltration; (4) Postoperative care. The child was given lollipops to stimulate gastrointestinal motility 2 h after post-operative recovery from anesthesia and advised to drink an adequate amount of water 4 h after surgery. The child was recommended a liquid diet if there were no obvious symptoms, such as vomiting and abdominal distension, following the principle of small and frequent meals. To appease the child's emotions, nurses played cartoons that the child liked or used pacifiers to distract them. After the operation, the anesthesiologist and the surgeon reevaluated the condition of the child and allowed the child who met the discharge criteria to be discharged. By contrast, those who did not meet the discharge criteria were transferred to routine hospitalization procedures for care, and daily care was strengthened; and (5) Pain management. In the anesthesia recovery room, a diclofenac potassium suppository or local lidocaine aerosol was administered by the anesthesia nurse to prevent or alleviate postoperative wound pain. After the child returned to the day care unit, the nurse in charge chose the correct assessment tool according to the age of the child, prepared a pain assessment in time, and gave corresponding medication and non-medicated intervention for pain relief according to the degree of pain to control the pain within 2 points.

The control group adopted a conventional management model. Before the operation, the nurse strengthened the health education for the child's families, cleaned and disinfected the operation site, and asked the child to fast and refrain from drinking for 8-12 h. Before the surgery, the nurse guided the child to empty the bladder, assisted the child in correctly placing the surgical position, and prepared drugs and instruments. Insulation measures for the child were strengthened during the operation. The child's oral secretions were promptly cleaned up after the operation to keep the respiratory tract unobstructed. Vital signs were closely observed after surgery. The child was advised to partake liquid foods after they woke up for 6 h. The child's oxygenation function and complications were observed, and the related activities were guided from 1 d after surgery.

Detection indicators

Patient general information, postoperative ambulation activities, surgical outcomes, postoperative pain, postoperative complications, and satisfaction of family members were observed and recorded in both groups. After surgery, children were encouraged to turn over in bed and ambulate as early as possible, and patient ambulation was recorded within 2 h, 4 h, and 6 h after surgery. The surgical outcomes of the two groups were compared by recording operation time, post-operative gastrointestinal ventilation time, and hospital stay. Preoperative and postoperative pain severity was assessed using the visual analogue scale (VAS; score range: 0-10), which is directly proportional to the degree of pain. Post-operative complications were mainly assessed by observing and recording the number of cases of incision infection, abdominal distension, and other adverse events, and the incidence rate was calculated. Finally, the family members were asked to complete a self-made nursing satisfaction questionnaire (0-100 points) to understand their satisfaction with care. The score positively correlated with satisfaction degree, with scores > 90, 70-90, and < 70 suggesting very satisfied, satisfied, and dissatisfied, respectively.

Statistical methods

Measurement data were statistically described as the mean ± standard deviation, and between-group comparisons were made using independent sample *t*-tests. Counting data were expressed as the ratio (percentage), and between-group comparisons were performed using χ^2 tests. SPSS 21.0 (IBM Corp., Armonk, NY, United States) was used for data analysis. *P* value < 0.05 denoted statistical significance.

Table 1 Comparison of general patient data

Indicators	Research group, *n* = 220	Control group, *n* = 100	χ^2/t	*P* value
Sex			0.316	0.574
Male	150 (68.18)	65 (65.00)		
Female	70 (31.82)	35 (35.00)		
Age in yr	7.84 ± 4.14	7.53 ± 3.47	0.652	0.515
Disease type			9.913	0.194
Hernia	167 (75.91)	69 (69.00)		
Polydactyly	12 (5.45)	12 (12.00)		
Umbilical hernia	5 (2.27)	6 (6.00)		
Hydrocele of tunica vaginalis	6 (2.73)	4 (4.00)		
Varicocele	4 (1.82)	1 (1.00)		
Superficial mass	22 (10.00)	8 (8.00)		
Ganglion cyst	2 (0.91)	0 (0.00)		
Tendonitis stenosans	2 (0.91)	0 (0.00)		
Single parent			0.217	0.641
Yes	35 (15.91)	18 (18.00)		
No	185 (84.09)	82 (82.00)		
Family medical history			1.108	0.293
With	11 (5.00)	8 (8.00)		
Without	209 (95.00)	92 (92.00)		

Data are *n* (%) or mean ± standard deviation.

RESULTS

Comparison of general patient data

The research and control groups did not differ markedly in general patient data (sex, age, disease type, single parent, and family history) ($P > 0.05$) (Table 1).

Effect of the two management models on postoperative ambulation activities of pediatric patients undergoing ambulatory surgery

The rates of ambulation activities at 2 h, 4 h, and 6 h after surgery were markedly higher in the research group than the control group ($P < 0.05$) (Table 2).

Effect of the two management models on the surgical outcomes of pediatric patients undergoing ambulatory surgery

We evaluated the influence of the two management models on the surgical outcomes of pediatric patients undergoing ambulatory surgery by detecting operation time, postoperative gastrointestinal ventilation time, and hospital stay. The data revealed statistically shorter operation time, postoperative gastrointestinal ventilation time, and hospital stay in the research group than the control group ($P < 0.05$) (Figure 1).

Effect of the two management models on postoperative pain in pediatric patients undergoing ambulatory surgery

We used VAS to evaluate the impact of the two management models on postoperative pain in pediatric patients undergoing ambulatory surgery. According to the evaluation data, VAS scores at 12 h and 24 h after surgery were significantly lower in the research group than the control group ($P < 0.05$) (Figure 2).

Effect of the two management models on postoperative complications in pediatric patients undergoing ambulatory surgery

The incidence of incision infection, abdominal distension, fever, and nausea and vomiting were counted to evaluate the influence of the two management models on postoperative complications in children undergoing ambulatory surgery. The total incidence of adverse events in the research group was 6.82%, which was markedly lower than 19.00% in the control group ($P < 0.05$) (Table 3).

Table 2 Effect of the two management models on postoperative ambulatory activities in pediatric patients undergoing ambulatory surgery

Indicators	Research group, *n* = 220	Control group, *n* = 100	χ^2	*P* value
Ambulation activities within 2 h after surgery	66 (30.00)	12 (12.00)	12.084	< 0.001
Ambulation activities within 4 h after surgery	59 (26.82)	15 (15.00)	5.401	0.020
Ambulation activities within 6 h after surgery	95 (43.18)	24 (24.00)	10.830	0.001

Data are *n* (%).

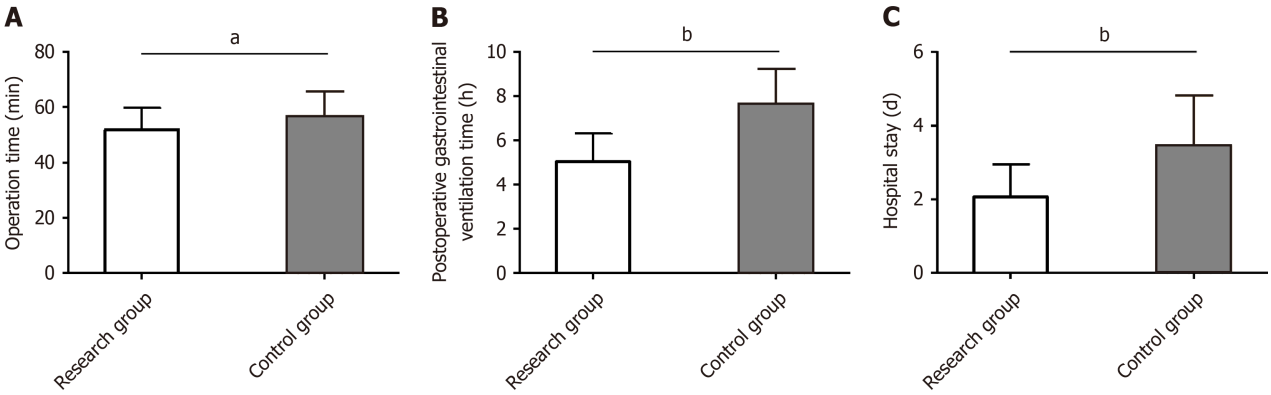

Figure 1 Effect of the two management models on surgical outcome in pediatric patients undergoing ambulatory surgery. A: The research group had a significantly shorter operation time than the control group; B: The research group had a significantly shorter postoperative gastrointestinal ventilation time than the control group; C: The research group had a significantly shorter hospital stay than the control group. [a]*P* < 0.05, indicates a statistically significant difference between two group; [b]*P* < 0.01, indicates a statistically significant difference between two group.

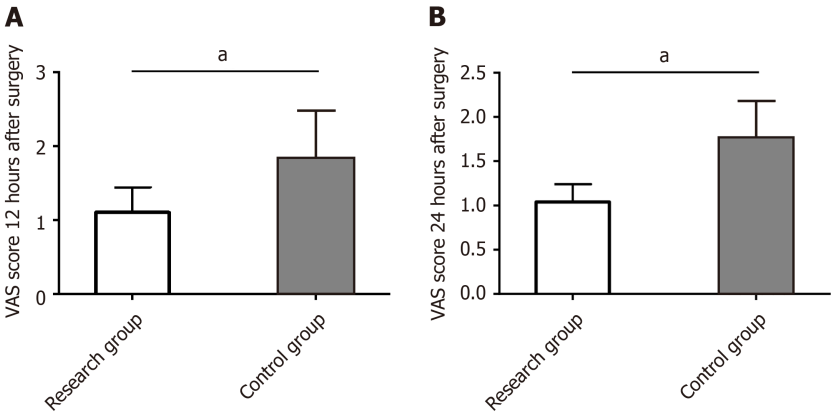

Figure 2 Effect of the two management models on postoperative pain in pediatric patients undergoing ambulatory surgery. A: The research group had a markedly lower visual analogue scale score than the control group at 12 h after surgery; B: The research group had a markedly lower visual analogue scale score than the control group at 24 h after surgery. [a]*P* < 0.01, indicates a statistically significant difference between the two groups. VAS: Visual analogue scale.

Effect of the two management models on the satisfaction of the family members of pediatric patients undergoing ambulatory surgery

Statistical analysis of the satisfaction of family members in the two groups showed that total satisfaction was 98.18% in the family members of the research group. This was significantly higher than 92.00% in the control group ($P < 0.05$) (Table 4).

DISCUSSION

This study included 320 pediatric patients undergoing ambulatory surgical procedures, with the control group receiving

Table 3 Effect of the two management models on postoperative complications in pediatric patients undergoing ambulatory surgery

Indicators	Research group, *n* = 220	Control group, *n* = 100	χ^2	*P* value
Incision infection	0 (0.00)	4 (4.00)		
Abdominal distension	4 (1.82)	5 (5.00)		
Fever	4 (1.82)	4 (4.00)		
Nausea and vomiting	7 (3.18)	6 (6.00)		
Total	15 (6.82)	19 (19.00)	10.744	0.001

Data are *n* (%).

Table 4 Effect of the two management models on the satisfaction of family members of pediatric patients undergoing ambulatory surgery

Indicators	Research group, *n* = 220	Control group, *n* = 100	χ^2	*P* value
Very satisfied	155 (70.45)	45 (45.00)		
Satisfied	61 (27.73)	47 (47.00)		
Dissatisfied	4 (1.82)	8 (8.00)		
Overall satisfaction	216 (98.18)	92 (92.00)	7.279	0.007

Data are *n* (%).

conventional management and the research group receiving ERAS-based management. We compared and analyzed the clinical advantages of the two management models in 320 pediatric patients undergoing ambulatory surgery to provide a better clinical management model for patients.

First, the rate of postoperative ambulation activities was significantly higher in the research group than the control group at 2 h, 4 h, and 6 h after surgery, suggesting that the management model based on the ERAS concept can promote postoperative ambulatory activities in pediatric patients undergoing ambulatory surgery and help them ambulate early. The research group showed a significantly shorter operation time, postoperative gastrointestinal ventilation time, and hospital stay than the control group, indicating that ERAS-based management can not only help shorten surgical duration but also significantly promote postoperative rehabilitation in pediatric patients undergoing ambulatory surgery.

Modrzyk *et al*[16] reported that application of the ERAS-based management model to children undergoing reverse stoma surgery helped shorten hospital stay, time to oral fluid intake, time to regular diet, and total parenteral nutrition time while relieving metabolic stress, with favorable safety and therapeutic effects. Pearson *et al*[17] reported that the ERAS-based management model significantly shortened hospitalization time, oral feeding time, and defecation time, suggesting that it is beneficial for postoperative rehabilitation, similar to our research results. This may be attributed to the use of ERAS-based management, which provides health education to children and their families to strengthen their understanding of the disease.

Second, preoperative care was given to the children to help them face the operation with a good attitude. Professional comfort care and anesthesia care were provided during the operation. The children were given meticulous and comprehensive postoperative care from the aspects of diet and psychology[18,19].

Pain assessment data showed that VAS scores were lower in the research group than the control group at 12 h and 24 h after surgery, indicating that the ERAS-based management model used in the research group is more conducive to postoperative pain relief. According to Han *et al*[20], the ERAS-based management model applied to pediatric urological reconstruction surgery provided some relief for postoperative pain while exerting a positive effect on other anesthesia results, which supports our findings. George *et al*[21] reported that average VAS scores of children undergoing colorectal surgery after receiving ERAS-based management decreased significantly both 1 d after surgery and during the hospital stay, which is in line with our observations. In this study, the pain-relieving effect of the ERAS-based management model may lie in timely and effective pain management as well as timely pain assessment and appropriate drug intervention according to the degree of pain and age of the children[22,23].

The incidence of incision infection, abdominal distension, fever, and nausea and vomiting was statistically analyzed. The total incidence of the adverse events was notably lower in the research group than the control group (6.82% *vs* 19.00%), indicating that the management model based on the ERAS concept accepted by the research group was a significant guarantee for postoperative safety. In a prospective study, Rove *et al*[24] demonstrated the high safety profile of the ERAS-based management model in children undergoing reconstruction surgery, as evidenced by a reduction in complications of any grade from 2.1 to 1.3 per child, similar to our findings.

Finally, the survey on family satisfaction identified obviously higher total satisfaction in family members in the research group than the control group, indicating that the management model based on the ERAS concept is more popular and recognized by the children's family members, similar to the research results of Heis *et al*[25].

CONCLUSION

In summary, the ERAS-based management model can guarantee the safety and feasibility of pediatric ambulatory surgical procedures, which can accelerate postoperative ambulation, relieve postoperative pain, reduce postoperative complications, and improve the satisfaction of family members, providing a better management choice for ambulatory pediatric surgical procedures.

FOOTNOTES

Author contributions: Fan GQ and Zhang XD contributed equally to this work and are co-first authors; Fan GQ and Zhang XD designed the study, collected and analyzed data, provided guidance, and wrote the manuscript; Fan GQ, Zhang XD, He YK, Lu XG, Zhong JY, Pang ZY, and Gan XY participated in the conception of the study and data collection; All authors read and approved the final version.

Supported by Liangshan Prefecture Science Research, Development, Promotion and Application Project Application Form, No. 17yyjs0011.

Institutional review board statement: This study was approved by the Ethic Committee of The First People's Hospital of Liangshan Yi Autonomous Prefecture (Approval No. 2024-003).

Informed consent statement: Patients were not required to give informed consent for the study because the analysis used anonymized clinical data, which were obtained after each patient or guardian consented to treatment through written consent.

Conflict-of-interest statement: All the authors report no relevant conflicts of interest for this article.

Data sharing statement: No additional data are available.

Country of origin: China

ORCID number: Gui-Quan Fan 0009-0005-4575-9939.

S-Editor: Liu H
L-Editor: Filipodia
P-Editor: Xu ZH

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