

Application of Different Anesthetic and Multimodal Analgesic Regimens in Enhanced Recovery After Surgery for Open Pancreaticoduodenectomy: Postprint

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Abstract

Objective To evaluate the safety and efficacy of different anesthesia and multimodal analgesia strategies within enhanced recovery after surgery (ERAS) protocols for open pancreaticoduodenectomy (PD). **Methods** A retrospective cohort study was conducted, collecting clinical data from 39 PD patients at Peking Union Medical College Hospital between March 2016 and April 2018. Nineteen patients received ERAS treatment (ERAS group) and 20 received conventional treatment (control group). The two groups were compared regarding intraoperative hemodynamic parameters, peripheral tissue perfusion status, anesthesia-related early postoperative recovery indicators, length of hospital stay, ICU stay duration, and hospitalization costs. **Results** The ERAS group demonstrated significantly lower intraoperative opioid consumption and blood lactate concentration at the end of surgery compared to the control group (both $P < 0.05$). On postoperative day 1, peripheral white blood cell count, neutrophil count, blood glucose, early postoperative opioid consumption, pain and nausea scores, analgesia satisfaction, time to urinary catheter and gastric tube removal, time to first postoperative ambulation, time to first flatus, and hospitalization costs were all significantly superior in the ERAS group (all $P < 0.05$). No significant differences were observed between the two groups in operative time, intraoperative hemodynamic parameters, or blood loss (all $P > 0.05$). **Conclusion** The application of this study's surgical anesthesia and multimodal analgesia strategy can effectively reduce surgical stress, decrease opioid consumption, promote early postoperative recovery, shorten hospital stay, and reduce hospitalization costs in PD patients.

Full Text

Application of Different Perioperative Anesthesia Plans and Multimodal Analgesia in Enhanced Recovery After Surgery for Open Pancreaticoduodenectomy

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Abstract

Objective: This study aimed to evaluate the safety and effectiveness of different anesthetic approaches and multimodal analgesia within an Enhanced Recovery After Surgery (ERAS) strategy when applied to patients undergoing pancreaticoduodenectomy (PD).

Methods: In this retrospective cohort study, we consecutively collected clinical data from 39 patients undergoing pancreaticoduodenectomy at Peking Union Medical College Hospital between March 2016 and April 2018. Among these, 19 patients received ERAS strategy (ERAS group) and 20 received traditional strategy (control group). We compared differences in intraoperative hemodynamic changes, postoperative rehabilitation, length of stay, and medical costs between the two groups.

Results: Intraoperative opioid consumption and postoperative lactate acid levels in the ERAS group were lower than those in the control group (both $p < 0.05$). White blood cell and neutrophil counts on postoperative day 1, blood glucose, pain scores, postoperative nausea and vomiting, postoperative analgesia satisfaction, time to remove transurethral catheter and nasogastric tube, time to exhaust and ambulation, and medical costs were all improved compared to the control group (all $p < 0.05$). Whereas operating duration, intraoperative hemodynamic changes, and intraoperative bleeding were comparable between the two groups (all $p > 0.05$).

Conclusions: Multimodal analgesia in ERAS strategy is safe when applied to PD patients. It could effectively mitigate operative stress, decrease opioid exposure, expedite postoperative rehabilitation, shorten the length of hospital stay, and decrease medical costs.

Keywords: Enhanced Recovery After Surgery; pancreaticoduodenectomy; perioperative

Introduction

Enhanced Recovery After Surgery (ERAS) represents a comprehensive multidisciplinary strategy first proposed by Wilmore and Kehlet to reduce surgical stress and medical expenses. Through accumulated clinical experience, ERAS protocols have expanded from initial colorectal surgery applications to upper gastrointestinal, hepatobiliary, orthopedic, gynecologic, and urologic procedures. The ERAS Society has established perioperative management guidelines for pancreaticoduodenectomy. However, due to the complex nature of this operation and high postoperative complication rates, implementation requires further validation within the context of China's healthcare system. Current research demonstrates that thoracic epidural catheterization or paravertebral blockade for intraoperative and postoperative analgesia can significantly reduce postoperative complications. This study retrospectively analyzed clinical data from patients undergoing open pancreaticoduodenectomy at our institution to investigate the clinical application of different anesthesia and multimodal analgesia strategies within an ERAS framework.

1. Materials and Methods

1.1 General Information We conducted a retrospective cohort study analyzing clinical data from 39 patients who underwent open pancreaticoduodenectomy in Professor Dai Menghua's group at our hospital between March 2016 and April 2018. Nineteen patients received ERAS strategy (ERAS group), while 20 received conventional treatment (control group). Specific anesthesia and multimodal analgesia protocols are detailed in . This study was approved by our hospital's ethics committee (Approval No.: ZS-1089).

1.2 Inclusion and Exclusion Criteria **Inclusion criteria:** (1) Age 18-75 years with American Society of Anesthesiologists (ASA) physical status I-III; (2) Diagnosed with pancreatic disease or periampullary malignancy (including benign and malignant tumors of the lower bile duct and ampulla) requiring open pancreaticoduodenectomy; (3) Disease deemed resectable or borderline resectable according to National Comprehensive Cancer Network (NCCN) guidelines (Version 2, 2015) with no distant metastasis; (4) Complete clinical medical records; (5) Not participating in other treatment studies.

Exclusion criteria: (1) Patients whose gastrointestinal reconstruction did not include pancreaticojejunostomy; (2) Incomplete clinical data; (3) Patients with contraindications to epidural anesthesia.

1.3 Observation Indicators We recorded preoperative and postoperative peripheral blood hemoglobin, white blood cell and neutrophil counts, and blood glucose concentrations. Intraoperative indicators included surgical duration, hemodynamic parameters, opioid consumption, fluid infusion volume, and blood lactate concentration changes. Postoperative recovery indicators included time to removal of gastric tube and urinary catheter, time to first mobilization and

flatus, postoperative nausea and vomiting scores, rescue analgesic dosage, length of ICU stay, total hospitalization time, medical costs, and patient satisfaction.

1.4 Statistical Analysis Statistical analysis was performed using SPSS 25.0 software. Normally distributed continuous data were expressed as mean \pm standard deviation and compared using t-tests. Categorical data were analyzed using chi-square tests or Fisher's exact probability method. A p-value < 0.05 was considered statistically significant.

2. Results

2.1 General Patient Data As shown in , there were no significant differences between the two groups in gender, body mass index (BMI), ASA classification, pylorus-preserving procedure ratio, surgical time, or intraoperative blood loss (all $p > 0.05$).

2.2 Intraoperative Tissue Perfusion Indicators and Opioid Exposure There were no significant differences between groups in intraoperative hemodynamic parameters, allogeneic red blood cell transfusion volume, plasma volume, or urine output (all $p > 0.05$). However, the ERAS group demonstrated significantly lower blood lactate concentration before leaving the operating room ($p = 0.002$) and significantly higher colloid infusion volume ($p = 0.001$) compared to the control group. Intraoperative fentanyl consumption was substantially lower in the ERAS group ($p = 0.001$).

2.3 Postoperative Early Peripheral Blood Inflammatory Markers Preoperative peripheral blood hemoglobin, white blood cell, and neutrophil counts showed no significant differences between groups (all $p > 0.05$). On postoperative day 1, both groups exhibited decreased hemoglobin and increased white blood cell counts, neutrophil counts, and blood glucose levels. The ERAS group showed significantly lower white blood cell counts ($p = 0.01$), neutrophil counts ($p = 0.03$), and blood glucose levels ($p = 0.03$) compared to the control group. Hemoglobin levels were slightly higher in the ERAS group but without statistical significance [Figure 1: see original paper].

2.4 Postoperative Analgesia, Early Recovery Indicators, Hospital Stay, and Costs The ERAS group exhibited significantly lower resting visual analogue scale (VAS) pain scores on postoperative day 1 ($p = 0.03$) and day 3 ($p = 0.01$), as well as lower activity VAS scores on day 1 ($p = 0.004$) and day 3 ($p = 0.001$). Postoperative opioid consumption was significantly reduced in the ERAS group ($p < 0.001$). The ERAS group also demonstrated superior performance in time to urinary catheter removal ($p = 0.012$), nasogastric tube removal ($p = 0.021$), first ambulation ($p = 0.01$), and flatus ($p = 0.02$), with higher analgesia satisfaction scores ($p = 0.001$). Total hospitalization time and

medical costs were significantly lower in the ERAS group ($p = 0.004$ and $p = 0.021$, respectively) .

3. Discussion

Multimodal analgesia and optimized perioperative anesthesia strategies have been successfully implemented across various surgical specialties. Our findings demonstrate that ERAS protocols can be safely applied to pancreaticoduodenectomy patients, effectively reducing operative stress, decreasing opioid requirements, and accelerating postoperative recovery. The ERAS group showed significantly reduced intraoperative fentanyl consumption and lower postoperative lactate concentrations, suggesting improved tissue perfusion and metabolic status.

The use of thoracic epidural analgesia, while potentially causing peripheral vasodilation and hemodynamic fluctuations, did not result in significantly different hemodynamic instability compared to the control group when managed with appropriate fluid therapy and vasopressors. This approach ensured adequate organ perfusion while reducing opioid exposure and its associated complications, such as postoperative nausea, vomiting, and ileus. Previous studies have shown that patient-controlled epidural analgesia (PCEA) can reduce postoperative opioid consumption, lower the incidence of deep vein thrombosis, and shorten hospital stay.

Our ERAS strategy, which incorporated preoperative nutritional support, non-traditional bowel preparation, intraoperative and postoperative epidural analgesia, and perioperative temperature management, resulted in significantly lower postoperative stress markers including white blood cell counts, neutrophil counts, and blood glucose levels. Early mobilization and selective nasogastric tube removal further contributed to improved recovery metrics.

Study limitations include: (1) This retrospective cohort study had a relatively small sample size and short implementation period, which may introduce selection bias; (2) The study focused exclusively on open pancreaticoduodenectomy and did not evaluate the strategy' s applicability to laparoscopic approaches, which are increasingly utilized. Future research should employ prospective, multicenter randomized controlled trials with larger sample sizes to validate these findings and explore the protocol' s effectiveness in minimally invasive pancreaticoduodenectomy.

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