**Name of journal: World Journal of Gastroenterology**

**ESPS Manuscript NO: 1652**

**Columns:** BRIEF ARTICLES

**Fast-track surgery could improve postoperative recovery in radical total gastrectomy patients**

Feng F *et al.* FTS improves gastric surgery recovery

Fan Feng, Gang Ji, Ji-Peng Li, Xiao-Hua Li, Hai Shi, Zheng-Wei Zhao, Guo-Sheng Wu, Xiao-Nan Liu, Qing-Chuan Zhao

**Fan Feng, Gang Ji, Ji-Peng Li, Xiao-Hua Li, Hai Shi, Zheng-Wei Zhao, Guo-Sheng Wu, Xiao-Nan Liu, Qing-Chuan Zhao,** Department of Digestive Surgery, Xijing Hospital of Digestive Diseases, the Fourth Military Medical University, 127 West Changle Road, Xi’an 710032, Shaanxi Province, China

**Author contributions:** Feng F, Ji G and Li JP contributed equally to this work; Feng F and Zhao QC performed the design of the study and wrote the manuscript; Ji G, Li JP and Liu XN performed all the operations; Li XH and Shi H were mainly in charge of perioperative management of patients; Zhao ZW and Wu GS were mainly in charge of evaluating postoperative outcomes, discharge, follow-up and data analysis.

**Supported by** National Natural Scientific Foundation of China, No. 31100643

**Correspondence to: Dr. Qing-Chuan Zhao**, Department of Digestive Surgery, Xijing Hospital of Digestive Diseases, the Fourth Military Medical University, 127 West Changle Road 7, Xi’an 10032, Shaanxi Province, China. zhaoqcfmmu@126.com.

**Telephone:** +86-29-84771503 **Fax:** +86-29-84771503

**Received:** December 25, 2012 **Revised:** March 20, 2013

**Accepted: April 27, 2013**

**Published online:**

**Abstract**

**AIM:** To assess the impact of fast-track surgery on hospital stay, cost of hospitalization and complications in radical total gastrectomy.

**METHODS:** A controlled randomized clinical trial was conducted from November 2011 to August 2012 in Department of Digestive Surgery, Xijing Hospital of Digestive Diseases, the Fourth Military Medical University. A total of 122 gastric cancer patients meet the selection criteria were randomized into fast-track and conventional care group on the first day of hospitalization. All patients received elective standard D2 total gastrectomy and treated with fast-track or conventional perioperative care. Clinical outcomes including duration of flatus and defecation, white blood cell count, postoperative pain of patients, duration of postoperative stay, cost of hospitalization and complications were recorded and evaluated. Two specially trained doctors who were blinded to the treatment were in charge for evaluating postoperative outcomes, discharge and follow-up. The present study was approved by the Ethics Committee of Xijing Hospital, and was registered under chictr.org, and the identifier number was ChiCTR-TRC-11001440.

**RESULTS:** A total of 119 patients eventually finished the study, including 60 patients in the conventional care group and 59 patients in the FTS group. Two patients were excluded from the FTS group due to withdraw of their consent. One patient was excluded from the conventional care group due to irresectable tumor. Compared with conventional group, our results showed that fast-track protocol could shorten the duration of flatus (79.03 ± 20.26 h *vs* 60.97 ± 24.40 h, *P* = 0.000), duration of defecation (93.03 ± 27.95 h *vs* 68.00 ± 25.42 h, *P* = 0.000), accelerate the decrease of white blood cell count [*P* < 0.05 on postoperative day (POD) 3 and 4], alleviate pain of patients after surgery(*P* < 0.05 on POD 1, 2 and 3), reduce complications (*P* < 0.05), shorten the duration of postoperative stay (7.10 ± 2.13 d *vs* 5.68 ± 1.22 d, *P* = 0.000), reduce the cost of hospitalization (43783.25 ± 8102.36 RMB *vs* 39597.62 ± 7529.98 RMB, *P* = 0.005), and eventually promote recovery of patients.

**CONCLUSION:** Fast-track surgery could be safely applied in radical total gastrectomy and accelerate clinical recovery for gastric cancer patients.

© 2013 Baishideng. All rights reserved.

**Key words:** Fast-track surgery; Gastric cancer; Radical total gastrectomy; Perioperative care; Outcomes

**Core tip:** Fast-track surgery (FTS) is a promising comprehensive program for surgical patients, and has been applied in several surgical diseases. The value of FTS in radical distal gastrectomy has been demonstrated recently, but the safety and efficacy of FTS in radical total gastrectomy still requires further evaluation. The present study showed that FTS was feasible for perioperative care in radical total gastrectomy. Compared with conventional care, FTS could shorten the duration of flatus and defecation, accelerate the decrease of white blood cell count, decrease postoperative complications, shorten duration of postoperative stay, reduce cost of hospitalization, and eventually promote postoperative recovery of patients.

Feng F, Ji G, Li JP, Li XH, ShiH, Zhao ZW, Wu GS, Liu XN, Zhao QC. Fast-track surgery could improve postoperative recovery in radical total gastrectomy patients

**Available from:**

**DOI:**

**INTRODUCTION**

Fast-track surgery (FTS) was initiated by the Danish surgeon Kehlet H in the field of elective colorectal surgery in 1990s[1,2], and has rapidly gained popularity around the world because of its remarkable benefits and safety[3]. The core elements of FTS include: epidural or regional anaesthesia, perioperative fluid management, minimally invasive techniques, optimal pain control, early initiation of oral feeding and early mobilization[4]. The combination of these approaches has led to a significant reduction in complication rates, morbidity and mortality rates, duration of hospital stay and costs of hospitalization, and finally greatly improved the postoperative recovery[5-7]. In recent years, FTS has been applied in several surgical diseases, include radical prostatectomy[8], cardiac surgery[9], total knee replacement[10], cesarean section[11], coronary artery bypass grafting[12], it has also been used for specific procedures in children[13] and elderly[14].

Gastric cancer is the fourth most common cancer worldwide but the second leading cause of cancer death[15], and it is more common in men and in developing countries. Up to now, surgery is the most common treatment. For the radical gastrectomy, conventional elective gastric resection and perioperative care are associated with a morbidity of 20%-46%, mortality of 0.8%-10%[16] and a postoperative hospital stay of 8-13 d[17]. The high rate of complications will leads to prolonged duration of hospital stay and increased costs of hospitalization.

The value of FTS in radical distal gastrectomy has been demonstrated recently[18,19], but the safety and efficacy of FTS in radical total gastrectomy still requires further evaluation. Therefore, we performed a slightly modified fast-track protocol in gastric cancer patients in our department. We evaluated the feasibility and safety of FTS in gastric cancer patients through a prospective, randomized comparative study.

**MATERIALS AND METHODS**

***Patients***

This study was performed in Xijing Hospital of Digestive Diseases affiliated to the Fourth Military Medical University from November 2011 to August 2012. Selection criteria were: (1) diagnosed as gastric cancer based on clinical symptoms, imaging and pathology; (2) age between 18 and 75 years old; (3) no preoperative radiotherapy or chemotherapy; (4) no distant metastasis; (5) no history of primary diabetes mellitus, bowel obstruction, severe cardiopulmonary diseases, and immune related diseases; (6) no pregnancy or breast feeding; (7) American Society of Anesthesiologists (ASA) score of I or II; (8) underwent elective standard D2 total gastrectomy; and (9) written informed consents were obtained from all the patients and their families. Gastric cancer patients who consistent with the selection criteria were randomly divided into FTS group and conventional care group immediately after admission. The sample size of 122 patients (61 cases in each group) was calculated with an alpha level of 0.05 and 90% power for primary endpoints.

This study was approved by the Ethics Committee of Xijing Hospital. This study was registered under chictr.org, identifier number ChiCTR-TRC-11001440.

***Randomization and implementation***

All the patients were clearly informed about the aims and details of the present study and signed consent forms. Random numbers were generated by computer. Eligible patients were randomly assigned in a 1:1 ratio. The specially trained investigator prepared envelops and allocated to the doctors of the enrolled patients. The investigator did not contact with the patients throughout the clinical trail. The doctors and nurses administering the interventions, collecting the data had no role in the randomization process. Two specially trained doctors who were blinded to the treatment were in charge for evaluating postoperative outcomes, discharge and follow-up.

***Interventions***

The Patients were admitted to the hospital 1-2 d before operation. A slightly modified fast-track protocol proposed by Kehlet *et al*[20] was used in the present FTS group. Patients in the conventional surgery group received conventional perioperative care. Details of the interventions are listed in Table 1. Both groups are protocol-driven, with relative protocol details for patients, surgeons and nurses to ensure the compliance.

***Discharge criteria and readmission***

Patients were considered dischargeable postoperative if they met the following criteria: normal body temperature, controlled pain with oral analgesics, normal mobilization, no discomfort, normal oral diet, no parenteral nutrition, normal gastrointestinal function (normal flatus and defecation), Karnofsky Performance Status Scale score exceed 80 and willing to go home.

After discharge, the patients will be followed up by our specially trained surgeons through telephone within the first 24 h and once 1 wk for 4 wk, and the patients could also contact us if they had any discomfort. The patients were readmitted if any of the followings occurred: hyperpyrexia, abdominal pain, bowel obstruction, gastrointestinal hemorrhage, malnutrition, infection and poor healing of the wound.

***Data collection***

The primary clinical endpoints are the duration of hospital stay and the cost of hospitalization. The second clinical endpoints are incidence of complications such as pneumonia, surgical site infection, abdominal infection, anastomotic leak, bowel obstruction, *etc.* We recorded preoperative data concerning age, sex, body mass index (BMI), Nutritional risk screening (NRS) 2002 score, ASA score, differentiation status, TNM classification, white blood cell (WBC) count, hemoglobin, albumin, (alanine aminotransferase) ALT and (aspartate aminotransferase) AST. Surgical-related data such as operation time and blood loss were also recorded. Postoperative data such as timing of first flatus and defecation, duration of hospital stay, the cost of hospitalization and complications were recorded. WBC was detected from postoperative day (POD )1 to POD 5. Pain intensity was evaluated from POD 1 to POD 5 using the visual analog system (VAS).

***Statistical analysis***

Data were processed using SPSS 16.0 for Windows. Numerical variables were expressed as the mean ± SD unless otherwise stated. Differences between the two groups were tested using a two-tailed Student’s *t* test. Discrete variables were analyzed using Chi-Square test or Fisher's exact test. The *P* value < 0.05 was considered statistically significant.

**RESULTS**

***Clinical Characteristics***

During the study period, a total of 119 patients eventually finished the study, including 60 patients in the conventional care group and 59 patients in the FTS group. Two patients were excluded from the FTS group due to withdraw of their consent. One patient was excluded from the conventional care group due to irresectable tumor (Figure 1). The preoperative baseline characteristics of the two groups were compared in Table 2. There were no significant differences between two groups in age, sex, BMI, NRS 2002 score, ASA score, differentiation status, TNM classification, WBC count, hemoglobin, albumin, ALT, AST, operation time and blood loss (all *P* > 0.05).

***Pain intensity***

Pain intensity was evaluated from POD 1 to POD 5 using the VAS in two groups (Table 3). VAS analysis showed that pain intensity of patients in FTS group was significantly lower than that of patients in conventional care group on POD 1-3 (*P* < 0.05).

***White blood cell count***

The WBC counts of patients in two groups were detected on the morning from POD 1 to POD 5 (Table 4). The WBC count in conventional care group and FTS group both elevated on POD 1. Although the WBC count in conventional care group continued to rise on POD 2, the WBC count in FTS group began to drop (*P* < 0.05). Even the WBC count in conventional care group began to drop on POD 3, the level of WBC in FTS group was much lower than that in conventional care group (*P* < 0.05).

***Outcomes***

The outcomes were summarized in Table 5. Compared with conventional care group, the patients in the FTS group showed significantly accelerated recovery of gastrointestinal function in terms of time to first flatus and first defecation (*P* < 0.05). The duration of postoperative stay of FTS group was significantly shorter than that of conventional care group (*P* < 0.05) and the cost of hospitalization was significantly lower (*P* < 0.05).

***Complications and readmissions***

Table 6 summarizes the complications and readmissions in each group. The overall complication rate of FTS group (10.17%) was significantly lower than that of conventional group (28.33%, *P* = 0.019). In the conventional care group, ten patients suffered from pneumonia, three patients suffered from incision infection, one patient experienced urinary infection, one patient experienced abdominal infection, and one patient underwent reoperation because of ileus. In the FTS group, five patients suffered from pneumonia and one subject experienced incision infection. All the patients were cured by surgery or conservative treatment.

**DISCUSSION**

The aim of the present study was to evaluate the safety, efficacy and outcome of FTS protocol employed in the perioperative treatment of gastric cancer in comparison with conventional perioperative treatment. The data of the present study showed that FTS protocol was feasible for perioperative care of gastric cancer patients underwent radical total gastrectomy. Compared with conventional care, FTS could shorten the duration of flatus and defecation, accelerate the decrease of white blood cell count, decrease postoperative complications, shorten the duration of postoperative stay, reduce the cost of hospitalization, and eventually promote postoperative recovery of patients.

Optimal pain control is very important. Pain could not only result in stress[21], but also affect mobilization of patients after operation. Early mobility or activity is recognized as a critical step in fast-track care. Because bed rest not only increase muscle loss and insulin resistance, but also decreases pulmonary function and the supply of oxygen to tissues[22]. It has been reported that opioids may resulted in nausea, vomiting and fatigue that counteract with FTS[23]. Therefore, routine use of opioids was avoided in the FTS group. In our present study, the infiltration of surgical wounds with ropivacaine and oral intake of celecoxib were applied instead of patient controlled analgesia pump. Pain intensity was evaluated from POD 1 to POD 5 after operation using the VAS. The results showed that VAS in the FTS group was significantly lower than that of conventional care group. This indicated that ropivacaine combined with celecoxib possessed better analgesic effect than analgetic pump, and the better analgesic effect in FTS group ensured longer duration of mobilization out of bed.

Conventionally, the duration of antibiotics use was 2-3 d after gastrectomy. In the present study, the antibiotics were single applied before and after operation in FTS group (Table 1). We noticed that even with shorter usage of antibiotics in the FTS group, the white blood cell counts were decreased earlier and faster than that of conventional care group postoperative.

Nasogastric tubes have been used traditionally for decompression after gastric surgery and remain a routine part of postoperative care in many centers. Nasogastric tubes are often left for several d until the first flatus after gastric resection. This is based on the rationale that this can prevent aspiration, and reduce the risk of intestinal obstruction and anastomotic leak in clinical practice. Previous studies have shown that the small intestine might return to normal enterocinesia 6 h after abdominal surgery[24]. Recent studies comparing nasogastric decompression versus no decompression demonstrated that gastric tube may induce pulmonary complications after GC surgery[25,26] and prolong the duration of first time to flatus with no differences in anastomotic leak rate[27]. Therefore, placement of nasogastric tube is unnecessary. In our present study, nasogastric tube was not routinely used in FTS group and removed within the 24 h after surgery.

Multiple studies have demonstrated that drains are unnecessary after gastrointestinal surgery[28]. The placements of abdominal drainage is prone to increased feeling of pain, intra-abdominal fluid collection, infection, internal organ injuries and risk of fistulas, resulting in delayed recovery[17]. Alvarez Uslar et al. reported that operative morbidity and hospital stay were significantly higher in patients underwent total gastrectomy with abdominal drains than that in patients without drains[29]. However, we refrained from the abolishment of abdominal drains for total gastrectomy in China. Since all the patients received D2 total gastrectomy, the degree of lymph node dissection possibly leading to a higher risk of chyle leakage. Therefore, the use of drains after total gastrectomy continues to be an issue for debate in the development of the FTS.

Early postoperative oral diet can hasten the return of gut function, protect gut mucosal barrier function, and enhance portal circulation[30]. Early enteral nutrition with dietary fiber can alleviate intestinal barrier dysfunction and decrease incidence of bacterial translocation[31]. Although early enteral nutrition increases the incidence of vomiting and flatulence, series of reports showed that it can reduce the risk of postoperative complications and mortality[32], facilitate postoperative restoration without increasing the incidence of fistulas[33], and be safety applied in gastrectomy[34]. In the present study, the majority patients in the FTS group tolerated early oral diet or enteral nutrition by jejunal feeding tube well. We noticed that nausea and vomiting was rare, but abdominal distension did occurred in some patients, the symptoms only lasted for a short time based on the adequate mobilization out of bed and did not result in severe complications.

It is reported that the postoperative hospital stay of gastric patients could be deceased to 3.8 d in FTS group[35]. In the present study, the mean postoperative stay of patients in FTS group was 5 d, which was longer than that reported in the literatures. We found that the Chinese traditional concept of the patients is the main obstacles. They believed that surgery could cause great damage to their bodies, which could not recovery in so short time. So, they worried about the safety after discharge from hospital. Therefore, preoperative patient instruction and education is crucial to the outcome of FTS[36]. It will let the patients fully understand the safety, efficacy and benefits of FTS, guarantee the compliance of patient to medical order and FTS protocols.

From the angle of doctors, worrying about anastomotic leakage was the main reason which affected early discharge. Series of studies showed that FTS protocol did not increase the incidence of anastomotic leakage[37]. It revealed that education of FTS concepts was also very critical for doctors. Compliance with the FTS protocol is the main factor influencing the outcome of FTS[38]. Thus, we established a study group made up of designer, surgeons, anesthesiologists and nurses. We have periodically conducted meetings with all staff about the details of FTS, in order to ensure the quality of the present study.

The limitation of our present study was the inadequate adherence of FTS protocol. Epidural analgesia was critical for FTS. Because intraoperative application and postoperative use of epidural analgesia could block sympathetic introduction to outside stimulation, inhibit hormone secretions of the hypothalamic-pituitary-adrenal axis, and finally attenuate responses to stresses[39]. In our present study, tracheal intubation and general anesthesia were applied in both groups, which may partially decrease the efficacy of FTS.

The present study indicates that FTS could promote postoperative recovery, decrease rate of complications, shorten duration of hospital stay, and reduce the cost of hospitalization. Our data indicate that FTS is a safe and efficient perioperative management strategy in patients undergoing radical total gastrectomy. Along with the further understanding of stress and development of FTS perioperative care, FTS could probably be safely applied in critically ill patients and emergency surgery, and major operation like tumor resection may become daytime operation in the near future.

**COMMENTS**

***Background***

Fast-track surgery (FTS) is a promising comprehensive program for surgical patients in elective surgery. In recent years, FTS has been applied in several surgical diseases, include radical prostatectomy, cardiac surgery, total knee replacement, cesarean section, coronary artery bypass grafting, it has also been used for specific procedures in children and elderly. The value of FTS in radical distal gastrectomy has been demonstrated recently, but the safety and efficacy of FTS in radical total gastrectomy still requires further evaluation.

***Research frontiers***

The value of FTS in radical distal gastrectomy has been demonstrated recently. Chen *et al* evaluate the safety and effectiveness of fast-track surgery combined with laparoscopy-assisted radical distal gastrectomy for gastric cancer. They found that Combination of FTS and LADG (laparoscopy-assisted radical distal gastrectomy) in gastric cancer is safe, feasible, and efficient and can improve nutritional status, lessen postoperative stress, and accelerate postoperative rehabilitation.

***Innovations and breakthroughs***

The data of the present study showed that FTS protocol was feasible for perioperative care of gastric cancer patients. Compared with conventional care, FTS could shorten the duration of flatus and defecation, accelerate the decrease of white blood cell count, decrease postoperative complications, shorten the duration of postoperative stay, reduce the cost of hospitalization, and eventually promote postoperative recovery of patients.

***Applications***

The data indicate that FTS is a safe and efficient perioperative management strategy in patients undergoing radical total gastrectomy. Along with the further understanding of stress and development of FTS perioperative care, FTS could probably be safely applied in critically ill patients and emergency surgery, and major operation like tumor resection may become daytime operation in the near future.

***Terminology***

FTS: Fast-track surgery, was initiated by the Danish surgeon Kehlet H in the field of elective colorectal surgery in 1990s, is a promising comprehensive program for surgical patients in elective surgery; visual analogue scale system is a psychometric response scale which can be used in questionnaires. It is a measurement instrument for subjective characteristics that cannot be directly measured.

***Peer review***

I would like to congratulate on this study.

**REFERENCES**

1 **Bardram L**, Funch-Jensen P, Jensen P, Crawford ME, Kehlet H. Recovery after laparoscopic colonic surgery with epidural analgesia, and early oral nutrition and mobilisation. *Lancet* 1995; **345**: 763-764 [PMID: 7891489]

2 **Kehlet H**, Slim K. The future of fast-track surgery. *Br J Surg* 2012; **99**: 1025-1026 [PMID: 22696149 DOI: 10.1002/bjs.8832]

3 **Slim K**. Fast-track surgery: the next revolution in surgical care following laparoscopy. *Colorectal Dis* 2011; **13**: 478-480 [PMID: 21435146 DOI: 10.1111/j.1463-1318.2011.02589.x]

4 **Wilmore DW**, Kehlet H. Management of patients in fast track surgery. *BMJ* 2001; **322**: 473-476 [PMID: 11222424]

5 **Wang G**, Jiang Z, Zhao K, Li G, Liu F, Pan H, Li J. Immunologic response after laparoscopic colon cancer operation within an enhanced recovery program. *J Gastrointest Surg* 2012; **16**: 1379-1388 [PMID: 22585532 DOI: 10.1007/s11605-012-1880-z]

6 **Ionescu D**, Iancu C, Ion D, Al-Hajjar N, Margarit S, Mocan L, Mocan T, Deac D, Bodea R, Vasian H. Implementing fast-track protocol for colorectal surgery: a prospective randomized clinical trial. *World J Surg* 2009; **33**: 2433-2438 [PMID: 19707815 DOI: 10.1007/s00268-009-0197-x]

7 **Varadhan KK**, Neal KR, Dejong CH, Fearon KC, Ljungqvist O, Lobo DN. The enhanced recovery after surgery (ERAS) pathway for patients undergoing major elective open colorectal surgery: a meta-analysis of randomized controlled trials. *Clin Nutr* 2010; **29**: 434-440 [PMID: 20116145 DOI: 10.1016/j.clnu.2010.01.004]

8 **Gralla O**, Haas F, Knoll N, Hadzidiakos D, Tullmann M, Romer A, Deger S, Ebeling V, Lein M, Wille A, Rehberg B, Loening SA, Roigas J. Fast-track surgery in laparoscopic radical prostatectomy: basic principles. *World J Urol* 2007; **25**: 185-191 [PMID: 17171563]

9 **Jawahar K**, Scarisbrick AA. Parental perceptions in pediatric cardiac fast-track surgery. *AORN J* 2009; **89**: 725-731 [PMID: 19348820 DOI: 10.1016/j.aorn.2008.11.029]

10 **Husted H**, Troelsen A, Otte KS, Kristensen BB, Holm G, Kehlet H. Fast-track surgery for bilateral total knee replacement. *J Bone Joint Surg Br* 2011; **93**: 351-356 [PMID: 21357957 DOI: 10.1302/0301-620X.93B3.25296]

11 **Antipin EE**, Uvarov DN, Svirskiĭ DA, Antipina NP, Nedashkovskiĭ EV, Sovershaeva SL. [Realization of Fast track surgery principles during cesarean section]. *Anesteziol Reanimatol* 2011; **(3)**: 33-36 [PMID: 21851019]

12 **Liang YX**, Zhou YB, Shen Y, Gu MN. Whether awake coronary artery bypass grafting is contrary to fast-track surgery? *Eur J Cardiothorac Surg* 2012; **41**: 719; author reply 720 [PMID: 22345203 DOI: 10.1093/ejcts/ezr051]

13 **Mattioli G**, Palomba L, Avanzini S, Rapuzzi G, Guida E, Costanzo S, Rossi V, Basile A, Tamburini S, Callegari M, DellaRocca M, Disma N, Mameli L, Montobbio G, Jasonni V. Fast-track surgery of the colon in children. *J Laparoendosc Adv Surg Tech A* 2009; **19 Suppl 1**: S7-S9 [PMID: 19260794 DOI: 10.1089/lap.2008.0121.supp]

14 **Day A**, Fawcett WJ, Scott MJ, Rockall TA. Fast-track surgery and the elderly. *Br J Anaesth* 2012; **109**: 124; author reply 124 [PMID: 22696563 DOI: 10.1093/bja/aes196]

15 **Price TJ**, Shapiro JD, Segelov E, Karapetis CS, Pavlakis N, Van Cutsem E, Shah MA, Kang YK, Tebbutt NC. Management of advanced gastric cancer. *Expert Rev Gastroenterol Hepatol* 2012; **6**: 199-208; quiz 209 [PMID: 22375525 DOI: 10.1586/egh.11.103]

16 **Sasako M**, Sano T, Yamamoto S, Kurokawa Y, Nashimoto A, Kurita A, Hiratsuka M, Tsujinaka T, Kinoshita T, Arai K, Yamamura Y, Okajima K. D2 lymphadenectomy alone or with para-aortic nodal dissection for gastric cancer. *N Engl J Med* 2008; **359**: 453-462 [PMID: 18669424 DOI: 10.1056/NEJMoa0707035]

17 **Wang D**, Kong Y, Zhong B, Zhou X, Zhou Y. Fast-track surgery improves postoperative recovery in patients with gastric cancer: a randomized comparison with conventional postoperative care. *J Gastrointest Surg* 2010; **14**: 620-627 [PMID: 20108171 DOI: 10.1007/s11605-009-1139-5]

18 **Chen Hu J**, Xin Jiang L, Cai L, Tao Zheng H, Yuan Hu S, Bing Chen H, Chang Wu G, Fei Zhang Y, Chuan Lv Z. Preliminary experience of fast-track surgery combined with laparoscopy-assisted radical distal gastrectomy for gastric cancer. *J Gastrointest Surg* 2012; **16**: 1830-1839 [PMID: 22854954]

19 **Kim JW**, Kim WS, Cheong JH, Hyung WJ, Choi SH, Noh SH. Safety and efficacy of fast-track surgery in laparoscopic distal gastrectomy for gastric cancer: a randomized clinical trial. *World J Surg* 2012; **36**: 2879-2887 [PMID: 22941233 DOI: 10.1007/s00268-012-1741-7]

20 **Kehlet H**, Wilmore DW. Multimodal strategies to improve surgical outcome. *Am J Surg* 2002; **183**: 630-641 [PMID: 12095591]

21 **Panerai AE**. Pain stress and headache. *Neurol Sci* 2012; **33 Suppl 1**: S1-S3 [PMID: 22644159 DOI: 10.1007/s10072-012-1032-y]

22 **Soop M**, Carlson GL, Hopkinson J, Clarke S, Thorell A, Nygren J, Ljungqvist O. Randomized clinical trial of the effects of immediate enteral nutrition on metabolic responses to major colorectal surgery in an enhanced recovery protocol. *Br J Surg* 2004; **91**: 1138-1145 [PMID: 15449264]

23 **Rugyte D**, Edberg KE. [Patient-controlled analgesia in the treatment of postoperative pain in children and adolescents]. *Medicina (Kaunas)* 2002; **38**: 1078-1082 [PMID: 12532720]

24 **Nelson R**, Tse B, Edwards S. Systematic review of prophylactic nasogastric decompression after abdominal operations. *Br J Surg* 2005; **92**: 673-680 [PMID: 15912492]

25 **Carrère N**, Seulin P, Julio CH, Bloom E, Gouzi JL, Pradère B. Is nasogastric or nasojejunal decompression necessary after gastrectomy? A prospective randomized trial. *World J Surg* 2007; **31**: 122-127 [PMID: 17186430]

26 **Yoo CH**, Son BH, Han WK, Pae WK. Nasogastric decompression is not necessary in operations for gastric cancer: prospective randomised trial. *Eur J Surg* 2002; **168**: 379-383 [PMID: 12463426]

27 **Yang Z**, Zheng Q, Wang Z. Meta-analysis of the need for nasogastric or nasojejunal decompression after gastrectomy for gastric cancer. *Br J Surg* 2008; **95**: 809-816 [PMID: 18551533 DOI: 10.1002/bjs.6198]

28 **Kehlet H**, Wilmore DW. Evidence-based surgical care and the evolution of fast-track surgery. *Ann Surg* 2008; **248**: 189-198 [PMID: 18650627 DOI: 10.1097/SLA.0b013e31817f2c1a]

29 **Alvarez Uslar R**, Molina H, Torres O, Cancino A. Total gastrectomy with or without abdominal drains. A prospective randomized trial. *Rev Esp Enferm Dig* 2005; **97**: 562-569 [PMID: 16266223]

30 **Henriksen MG**, Jensen MB, Hansen HV, Jespersen TW, Hessov I. Enforced mobilization, early oral feeding, and balanced analgesia improve convalescence after colorectal surgery. *Nutrition* 2002; **18**: 147-152 [PMID: 11844646]

31 **Hou H**, Ping X, Zhu Y, Zhao Z, Li Y, Li J. Dietary fiber alleviates intestinal barrier dysfunction in post-trauma rats. *Clin Invest Med* 2010; **33**: E117 [PMID: 20370991]

32 **Lewis SJ**, Andersen HK, Thomas S. Early enteral nutrition within 24 h of intestinal surgery versus later commencement of feeding: a systematic review and meta-analysis. *J Gastrointest Surg* 2009; **13**: 569-575 [PMID: 18629592 DOI: 10.1007/s11605-008-0592-x]

33 **Berberat PO**, Ingold H, Gulbinas A, Kleeff J, Müller MW, Gutt C, Weigand M, Friess H, Büchler MW. Fast track--different implications in pancreatic surgery. *J Gastrointest Surg* 2007; **11**: 880-887 [PMID: 17440787]

34 **Suehiro T**, Matsumata T, Shikada Y, Sugimachi K. Accelerated rehabilitation with early postoperative oral feeding following gastrectomy. *Hepatogastroenterology* 2004; **51**: 1852-1855 [PMID: 15532842]

35 **Grantcharov TP**, Kehlet H. Laparoscopic gastric surgery in an enhanced recovery programme. *Br J Surg* 2010; **97**: 1547-1551 [PMID: 20665480 DOI: 10.1002/bjs.7184]

36 **Carter J**, Szabo R, Sim WW, Pather S, Philp S, Nattress K, Cotterell S, Patel P, Dalrymple C. Fast track surgery: a clinical audit. *Aust N Z J Obstet Gynaecol* 2010; **50**: 159-163 [PMID: 20522073 DOI: 10.1111/j.1479-828X.2009.01134.x]

37 **Chopra SS**, Schmidt SC, Fotopoulou C, Sehouli J, Schumacher G. Evidence-based perioperative management: strategic shifts in times of fast track surgery. *Anticancer Res* 2009; **29**: 2799-2802 [PMID: 19596964]

38 **Maessen J**, Dejong CH, Hausel J, Nygren J, Lassen K, Andersen J, Kessels AG, Revhaug A, Kehlet H, Ljungqvist O, Fearon KC, von Meyenfeldt MF. A protocol is not enough to implement an enhanced recovery programme for colorectal resection. *Br J Surg* 2007; **94**: 224-231 [PMID: 17205493 DOI: 10.1002/bjs.5468]

39 **Rodgers A**, Walker N, Schug S, McKee A, Kehlet H, van Zundert A, Sage D, Futter M, Saville G, Clark T, MacMahon S. Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised trials. *BMJ* 2000; **321**: 1493 [PMID: 11118174 DOI: 10.1136/bmj.321.7275.1493]

**P-Reviewers** Gokhan K, Mario K

**S-Editor** Zhai HH **L-Editor E-Editor**

Analyzed (*n* = 59)

Analyzed (*n* = 60)

Allocated to FTS group

 (*n* = 61)

Received allocated intervention (*n* = 59)

Did not receive allocated intervention (*n* = 2)

2Withdrew their consent(*n* = 2)

Allocated to conventional

care group (*n* = 61)

Received allocated intervention (*n* = 60)

Did not receive allocated intervention (*n* = 1)

1Irresectable tumor (*n* = 1)

Randomized (*n* = 122)

Assessed for eligibility (*n* = 122)

**Figure 1 Flow diagram of the randomized control trial designed to compare the safety and efficacy between the two groups.** 1One patient had irresectable tumor in conventional care group; 2two patients required to quit in fast-track surgery group. All the three patients were excluded from the analysis.

**Table 1 Comparison of fast-track surgery and conventional perioperative intervention protocols**

|  |  |  |
| --- | --- | --- |
| Perioperative Intervention | Conventional | Fast-track surgery |
| Diet before surgery | No intake of food and drink after supper the day before surgery | Intake of 1000 mL 14% carbohydrate Drink 12 h and 350 mL 14% carbohydrate Drink 3 h before surgery. |
| Anesthesia | Tracheal intubation and general anesthesia | Tracheal intubation and general anesthesia |
| Thermal insulation during operation | No thermal insulation, room temperature was maintained at 22 degrees centigrade | Thermal insulation of the body and extremities, body temperature was maintained at 36 degrees centigrade |
| Operation procedure | Standard laparotomy approach | Standard laparotomy approach |
| Placement of abdominal drainage | Use of abdominal drainage tube | No routine use of abdominal drainage tube |
| Analgesia after operation | Standard use of patient controlled analgetic pump | Infiltration of surgical wounds with ropivacaine at the end of operation and 24 h after operation. Oral intake 200 mg celecoxib twice per day. |
| Mobilization after operation | Mobilize out of bed on patients’ own will. | Encourage patients to mobilize out of bed. |
| Diet after operation | Oral intake is initiated after flatus(follow a stepwise plan from water to other liquids to semi-fluids to normal food) | Oral intake of 500-1000 mL glucose saline on the day of surgery. Intake of 2000 – 3000 mL liquid food containing 1000 kca to 1200 kca per day from the 1st day after operation.  |
| Intravenous nutrition after operation | Infusion of glucose saline and amino acid injection *iv* on the day of surgery. Infusion of parenteral nutrition (25 kca per kg of body weight) *iv* before oral intake. Appropriate level of *iv* fluid intake based on the volume of liquid intake and output, and physiological need. | Infusion of parenteral nutrition *iv* if oral intake is not adequate. Appropriate level of *iv* fluid intake based on the volume of liquid intake and output, and physiological need. |
| Removal of nasogastric tube | Removal of nasogastric tube after flatus | Removal of nasogastric tube within 24 h after operation |
| Removal of urine catheter | Removal of urine catheter on the 3rd or 4th day after operation | Removal of urine catheter within 24 h after operation |
| Antibiotics | Standard use of antibiotics for 3 d after operation | Standard use of antibiotics before and after operation for one time |

**Table 2 Comparison of baseline characteristics between the two groups (mean** ± SD)

|  |  |  |  |
| --- | --- | --- | --- |
| Characteristics | Conventional | Fast-track surgery | *P* value |
| Age, yr | 55.79 ± 10.06 | 54.98 ± 11.35 | 0.682 |
| Sex  |  |  | 0.689 |
|  Male/female | 44/16 | 41/18 |  |
| BMI | 21.01 ± 1.78 | 22.44 ± 3.51 | 0.061 |
| NRS 2002 score | 0.81 ± 1.10 | 1.08 ± 1.41 | 0.424 |
| ASA score |  |  | 0.364 |
| I/II | 1/59 | 3/56 |  |
| Differentiation status |  |  | 0.857 |
| Well differentiated | 6 | 4 |  |
| Moderately differentiated | 20 | 17 |  |
| Poorly differentiated | 34 | 38 |  |
| TNM classification |  |  | 0.324 |
|  I/II/III | 21/8/31 | 14/12/33 |  |
| White blood cell | 6.20 ± 1.74 | 6.05 ± 2.08 | 0.671 |
| Hemoglobin, g/L | 133.36 ± 22.03 | 130.65 ± 22.41 | 0.520 |
| Albumin, g/L | 44.42 ± 4.89 | 42.83 ± 4.65 | 0.082 |
| ALT | 17.91 ± 11.35 | 21.29 ± 15.55 | 0.195 |
| AST | 21.84 ± 11.46 | 25.83 ± 17.00 | 0.151 |
| Operation time, min | 242.38 ± 72.89 | 226.11 ± 65.87 | 0.214 |
| Blood loss, mL | 221.17 ± 122.55 | 230.55 ± 171.82 | 0.735 |

BMI: Body mass index; ASA: American Society of Anesthesiologists; NRS: Nutritional risk screening; TNM: Tumour node metastases; ALT: Alanine aminotransferase; AST: Aspartate aminotransferase.

**Table 3 Comparison of postoperative pain intensity between the two groups (mean** ± SD)

|  |  |  |  |
| --- | --- | --- | --- |
| Time | Conventional | Fast-track surgery | *P* value |
| POD 1 | 5.41 ± 1.45 | 4.32 ± 1.65 | 0.000 |
| POD 2 | 4.43 ± 1.54 | 3.39 ± 1.65 | 0.001 |
| POD 3 | 3.63 ± 1.48 | 2.76 ± 1.36 | 0.002 |
| POD 4 | 3.02 ± 1.45 | 2.51 ± 1.87 | 0.119 |
| POD 5 | 2.21 ± 1.39 | 2.30 ± 1.56 | 0.789 |

POD: Postoperative day.

**Table 4 Comparison of white blood cell count between two groups**

|  |  |  |  |
| --- | --- | --- | --- |
| Time | Conventional | Fast-track surgery | *P* value |
| Before operation | 6.20 ± 1.74 | 6.05 ± 2.08 | 0.671 |
| POD 1 | 14.81 ± 5.34 | 14.55 ± 5.04 | 0.793 |
| POD 2 | 15.36 ± 5.36 | 12.26 ± 4.78 | 0.002 |
| POD 3 | 11.80 ± 4.80 | 9.35 ± 3.83 | 0.005 |
| POD 4 | 8.56 ± 3.70 | 7.52 ± 3.57 | 0.223 |
| POD 5 | 6.37 ± 2.34 | 6.91 ± 3.34 | 0.684 |

POD: Postoperative day.

**Table 5 Comparison of clinical outcomes between two groups**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Conventional | Fast-track surgery | *P* value |
| First flatus, h | 79.03 ± 20.26 | 60.97 ± 24.40 | 0.000 |
| First defecation , h | 93.03 ± 27.95 | 68.00 ± 25.42 | 0.000 |
| Postoperative stay, d | 7.10 ± 2.13 | 5.68 ± 1.22 | 0.000 |
| Cost of hospitalization , RMB | 43 783.25 ± 8102.36 | 39 597.62 ± 7529.98 | 0.005 |

**Table 6 Comparison of postoperative complications between the two groups**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Conventional | FTS | *P* value |
| Total cases | 17 | 6 | 0.019 |
| Pneumonia | 10 | 5 | 0.269 |
| Incision infection | 3 | 1 | 0.619 |
| Urinary infection | 1 | 0 | 1.000 |
| Abdominal infection | 1 | 0 | 1.000 |
| Gastric retention | 0 | 0 |  |
| Anastomotic leak | 0 | 0 |  |
| Deep-vein thrombosis | 0 | 0 |  |
| Ileus | 1 | 0 | 1.000 |
| Reoperation | 1 | 0 | 1.000 |
| Readmission | 0 | 0 |  |
| Mortality | 0 | 0 |  |