Int J Clin Exp Med 2017;10(3):5778-5787
www.ijcem.com /ISSN:1940-5901/IJCEM0042203

Original Article

A pooled analysis of fast track procedure vs. conventional care in laparoscopic colorectal cancer surgery

Yue Wang[1], Guo-Hua Zhao[1], Jian Zhao[2], Helen Yang[3], Jie Lin[1]

[1]*Department of General Surgery, Cancer Hospital of China Medical University, Liaoning Cancer Hospital and Institute, Shenyang, China;* [2]*Department of Hepatobiliary Surgery, Changtu County Central Hospital, Tieling, China;* [3]*Institute of Public Health, University of California, San Francisco, USA*

Received June 16, 2016; Accepted January 19, 2017; Epub March 15, 2017; Published March 30, 2017

Abstract: Fast track (FT) procedure has proposed to accelerate recovery, reduce morbidity and shorten hospital stay. The aim of this review was to compare the safety and effectiveness of the FT procedure with that of conventional care in laparoscopic colorectal resection. A systematic literature search for relevant articles was conducted in PUBMED, EMBASE and Cochrane Library digital databases. The main endpoints were the duration of postoperative hospital stay, time to first flatus, time of first bowel movement, postoperative complication rate, readmission rate, and mortality. A total of 1317 patients from 10 studies (5 RCTs and 5 CCTs) were included. Compared with the conventional care, FT procedure reduced the postoperative hospital stay (weighted mean difference [WMD] -0.65; 95% CI: -0.76, -0.53), time to first flatus (WMD: -1.91; 95% CI: -3.31, -0.5), time to first bowel movement (WMD: -0.70; 95% CI: -0.85, -0.55), and total postoperative complication rate (RR=0.73; 95% CI: 0.60, 0.88), but there was no significant difference in the readmission rate (RR=0.66; 95% CI, 0.42, 1.05) and mortality (RR=1.53; 95% CI, 0.42, 5.66). FT procedure for laparoscopic colorectal resection is safe and efficacious. Nevertheless, more international multicenter prospective large sample RCTs are needed to determine the advantages of this approach.

Keywords: Colorectal cancer, laparoscopic surgery, fast track surgery

Introduction

Colorectal cancer (CRC) is among the most common malignant disease in the western world, whereas cancers of the upper gastrointestinal tract and liver are more predominant in the East. Moreover, many Asian countries have experienced a two to four fold increase in the frequency of CRC during the past few decades [1, 2]. For people with localized cancer, the preferred treatment is complete surgical removal with adequate margins, with the attempt of achieving a cure.

Over the past 20 years, laparoscopic surgery and FT procedure are the most important developments in abdominal surgery. FT procedure combines a number of elements aimed at enhancing recovery and reducing the profound stress response after surgery [3]. Moreover, both of them have been reported to be safe and effective, and to result in a shorter hospital stay with earlier recovery of gastrointestinal function [4-7] and lower morbidity than open colorectal surgery and standard care [8-10]. Hence, we assume that combining FT procedure and laparoscopy could result in the fastest postoperative recovery. Here, we performed a meta-analysis to evaluate the effects of FT in patients undergoing laparoscopic colorectal cancer surgery.

Methods

Data sources and search strategy

We searched PUBMED, EMBASE and Cochrane Library digital databases for all relevant articles. The search was performed in each database from time of inception until June, 2014 by two independent investigators. The medical subject headings (MeSH) and keywords collected for individually and in combination were as follows: "laparoscopic surgery" "open surgery"

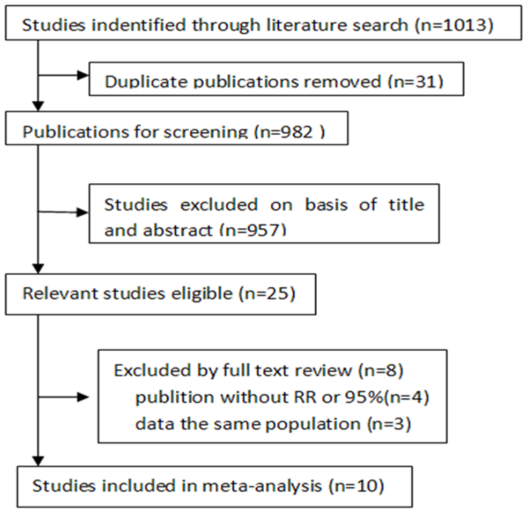

Figure 1. Flow chart depicts the selection of eligible studies.

and "fast track" or "enhanced recovery" and "colorectal". No language restrictions were imposed. The reference lists in all identified articles were checked for further relevant articles.

Eligibility criteria and study selection

Studies considered in this meta-analysis met all the following inclusion criteria: (1) Studies comparing FT procedure with conventional perioperative care in patients undergoing laparoscopic colorectal cancer surgery. (2) Studies that provided information on at least one of the outcome measures. (3) Studies with a detail description of the FT procedure. For the articles with the same population resources or overlapping data sets, the paper which included the largest population or contained more useful information was included. Two authors independently evaluated all records by title and abstract and subsequently retrieved and assessed, in detail, the full text of any potentially relevant articles using the above eligibility criteria. Differences were solved by discussion to achieve consensus, and confirmed by another author. Studies were also excluded which were not full text or non-comparative studies or open operations, not by laparoscopic surgery.

Data extraction

Two reviewers independently assessed articles for inclusion, extracted data, and assessed quality. Any disagreement was presented to a third author and resolved by discussion among the investigators. The general information extracted included the duration of the postoperative hospital stay, time to first flatus, time of first bowel movement, total postoperative complication rate, readmission rate, and 30-day postoperative mortality rate. The RCTs were evaluated using the Jadad composite scale. High-quality trials were those that scored ≥3 of a maximum possible score of 5. The controlled clinical trials were evaluated using the Newcastle-Ottawa Scale. High quality trials were those that scored ≥7 of a maximum possible score of 9. Moderate-quality trials scored ≥5.

Statistical analysis

The statistical analysis was performed by Stata 13.0. Meta-analyses were performed by using relative risk (RR) for dichotomous outcomes and weighted mean difference (WMD) for continuous outcomes. Pooled estimates were presented with 95% CIs. The presence and amount of heterogeneity were assessed with Q test and I^2 index, and $P<0.1$ was considered statistically significant. A random-effects model was used for pooling when there was evidence of heterogeneity; otherwise, a fixed-effects model was used. Funnel plots were created to determine the presence of publication bias, and asymmetry of each funnel plot was evaluated with Egger weighted linear regression test. For all other comparisons, statistical significance was defined by $P<0.05$, and all tests were 2-sided.

Results

Literatures

The meta-analysis was organized based on PRISMA statement (PRISMA Checklist) [11]. A total of 1013 literatures were obtained from electronic databases after duplicates removal. After reviewing the titles and abstracts, 957 articles were excluded due to no relevance, reviews, and animal experiments or not about cancer. Subsequently, the left 25 publications were further evaluated for eligibility. Fifteen literatures were removed because of no raw data or the same population. Finally, five RCTs [12-16] and five CCTs [17-21] were considered eligible for the meta-analysis. The detailed flow chart of study selection was shown in **Figure 1**. And the detail of each included study was listed in **Table 1**. Totally, there were 1317 patients included (696 in FT group vs. 624 in

Table 1. Characteristics of eligible studies

Study	Year	Region	Type	FT patients	CC patients	Follow duration	Median age		Gender (male/female)		ASA			
							FT	CC	FT	CC	FT (I/II,	III/IV)	CC (I/II,	III/IV)
Lee [12]	2011	Korea	RCT	46	54	1 mouth	61.9±11.2	60.6±10.0	26/20	30/24	43	2	51	3
Vlug [13]	2011	Netherlands	RCT	100	109	30 days	66±8.6	68±8.6	53/47	68/41	82	21	87	22
Q. Wang [14]	2012	China	RCT	40	38	>1 month	71 (65-81)	72 (65-82)	22/18	20/18	NA	NA	NA	NA
G. Wang [15]	2012	China	RCT	40	40	30 days	55.7±17.3	56.1±114.6	27/13	26/14	33	7	36	4
Feng [16]	2014	China	RCT	57	59	4 weeks	54.0±12.0	56.3±11.5	36/21	40/19	57	0	59	0
Esteban [17]	2014	Spain	CCT	100	56	30 days	68.04±9.9	64.8±14	70/80	28/28	99	49	44	11
Gouvas [18]	2012	Greece	CCT	42	33	1 mouth	64 (31-83)	68 (34-85)	22/20	11/22	37	5	29	4
Poon [19]	2010	Hong Kong	CCT	96	84	NA	72 (31-94)	72 (46-92)	51/45	50/34	83	13	68	16
Vassiliki [20]	2009	USA	CCT	82	115	NA	68.2±13.4	69.3±11.9	36/46	60/55	56	26	76	39
Huibers [21]	2012	Netherlands	CCT	43	33	NA	66 (36-79)	64 (27-88)	27/16	22/11	33	10	26	7

FT: fast; CC: conventional care; RCT: tandomized trails; CCT: clinical controlled trails.

Table 2. Fast-track elements

Study	Type	Preoperative										Postoperative							Total
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	
Lee [12]	RCT	√				√						√		√	√		√	√	7
Vlug [13]	RCT	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√	√	16
Q. Wang [14]	RCT	√	√	√	√	√			√					√	√		√	√	10
G. Wang [15]	RCT	√	√	√		√			√			√	√	√	√			√	10
Feng [16]	RCT		√	√				√		√			√	√	√	√		√	9
Esteban [17]	CCT	√	√	√		√	√	√	√			√	√	√	√		√	√	13
Gouvas [18]	CCT	√	√			√	√	√	√			√		√	√				9
Poon [19]	CCT	√				√				√		√	√	√	√			√	8
Vassiliki [20]	CCT	√		√										√	√	√		√	6
Huibers [21]	CCT	√	√	√	√	√	√	√	√			√		√	√	√	√	√	14

RCT: randomized controlled trails; CCT: clinical controlled trails. A: patients education. B: preoperative feeding. C: No bowel preparation. D: No premedication. E: fluid restriction. F: O2 concentration during operation. G: prevention of hypothermia during surgery. H: epidural analgesia. I: wound infiltration with local analgesia. J: minimally invasive. K: No routine use of NG tube. L: No routine use of drains. M: early mobilization. N: enforced early postoperative oral feeding. O: No morphine use. P: standard laxatives. Q: early remove bladder catheter.

Table 3. Jadad score of RCTS

Reference	Randomization	Blinding	Withdraw and dropout	Jadad's score	Quality
Lee [12]	2	0	1	3	High
Vlug [13]	2	1	1	4	High
Q. Wang [14]	2	0	1	3	High
G. Wang [15]	2	0	1	3	High
Feng [16]	2	1	1	4	High

RCT: randomized controlled trails. Randomization: randomization was described with appropriate method: 2 score, randomization was described without appropriate method: 1 score, no randomization: 0 score. Blinding: blinding was performed on all doctors and patients: 2 score, Blinding was partially performed on doctors and patients: 1 score, no blinding: 0 score; Withdraw and dropout: the reason of withdraw and dropout was described: 1 score, the reason of withdraw and dropout was not described: 0 score. Quality: High-quality trials should score ≥3.

conventional care group). And the FT elements were showed in **Table 2.** The Jadad score of 5 RCTS and the Newcastle-Ottawa Scale score of 5 CCTS were also evaluated (**Tables 3, 4**).

Outcome measure

Postoperative hospital stay

Ten studies [12-21] included, postoperative hospital stay was significantly shorter in FT group than conventional group (WMD: -1.91; 95% CI: -3.31, -0.5); with some evidence of heterogeneity between trials (I^2=86.8%, P<0.01) (**Figure 2**). In subgroup analysis, there was also significant difference between RCTs and CCTs.

Table 4. Newcastle-Ottawa Scale score of CCTS

Study	Selection				Comparability		Outcome			Total	Quality
	REC	SNEC	AE	DO	SC	AF	AO	FU	FUO		
Esteban [23]	1	0	1	1	0	0	1	1	1	6	Moderate
Gouvas [21]	1	0	1	1	0	0	1	1	1	6	Moderate
Poon [22]	1	1	1	1	0	0	1	0	1	6	Moderate
Vassilikj [24]	1	1	1	1	0	0	1	0	1	6	Moderate
Huibers [25]	1	1	1	1	0	0	1	0	1	6	Moderate

REC: representativeness of the exposed cohort; SNEC: selecayion of the non-exposed cohort; AE: ascertainment; DO: demonstration that outcome of interest was not present as start of study controls for age, sex; AF: study controls for any additional factors; AO: assessment of outcome; FU: follow-up long enough for outcomes to occur, FUO: adequacy of follow-up of cohorts.

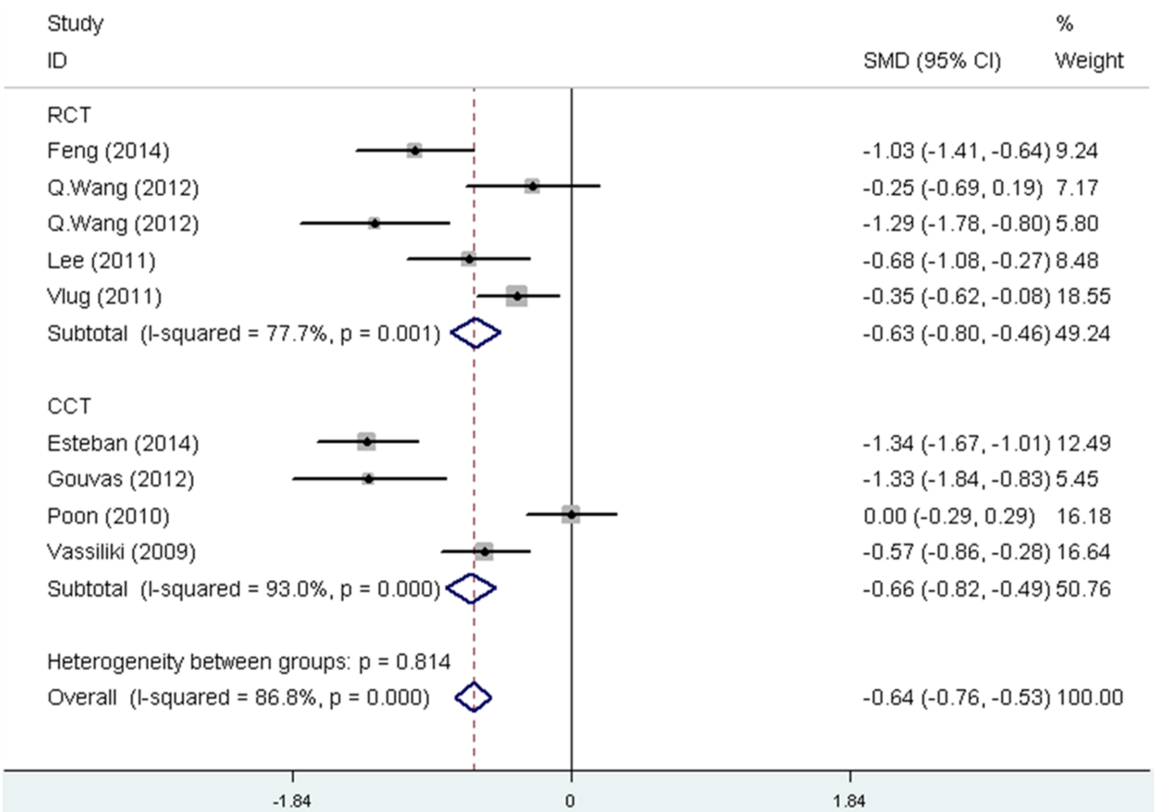

Figure 2. Forest plot for postoperative hospital stay.

Gut function

Time to first flatus was reported in 5 studies [12, 14-16, 18], the time was significantly reduced in FT group (WMD: -1.91; 95% CI: -3.31, -0.5), with some evidence of heterogeneity between trials (I^2=98.1%, P<0.01) (**Figure 3**). Then time to first bowel movement was reported in 7 trials [12, 14-17, 20, 21], and the period was also significantly shortened in FT group (WMD: -0.70; 95% CI: -0.85, -0.55), with some evidence of heterogeneity between trials (I^2=74.8%, P<0.01) (**Figure 4**). However, in subgroup analysis, there was no significant difference between groups.

Postoperative complication rate

Postoperative complication was reported in all studies [12-21]. There was a significant lower complication in FT group (RR=0.73; 95% CI, 0.60, 0.88), with no heterogeneity (I^2=13.8%, P=0.32) (**Figure 5**). In subgroup analysis, there was also significant difference between RCTs and CCTs.

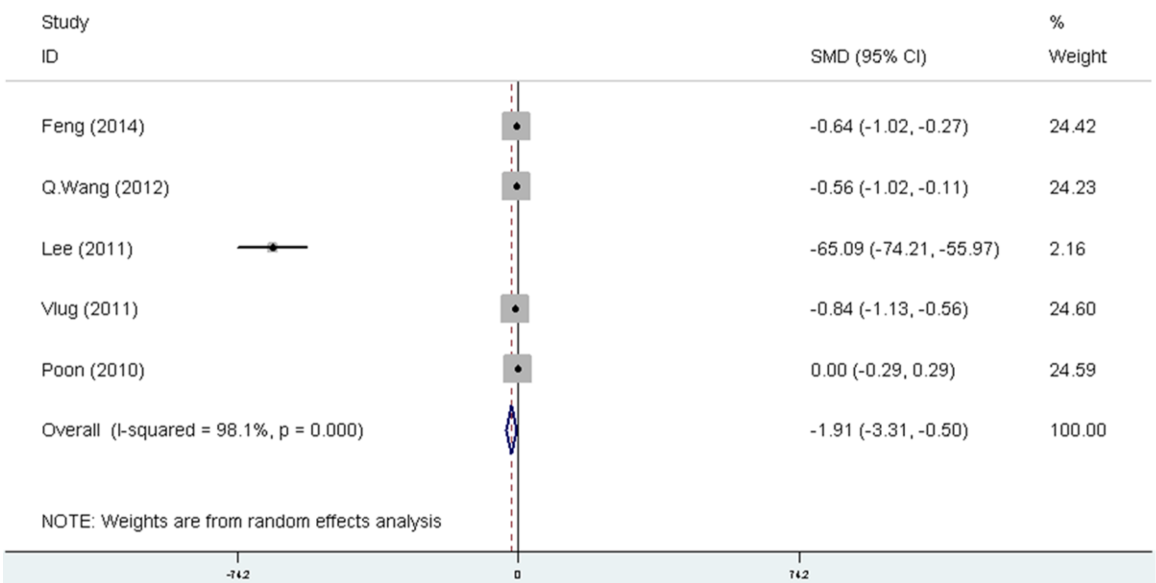

Figure 3. Forest plot for time to first passage of flatus.

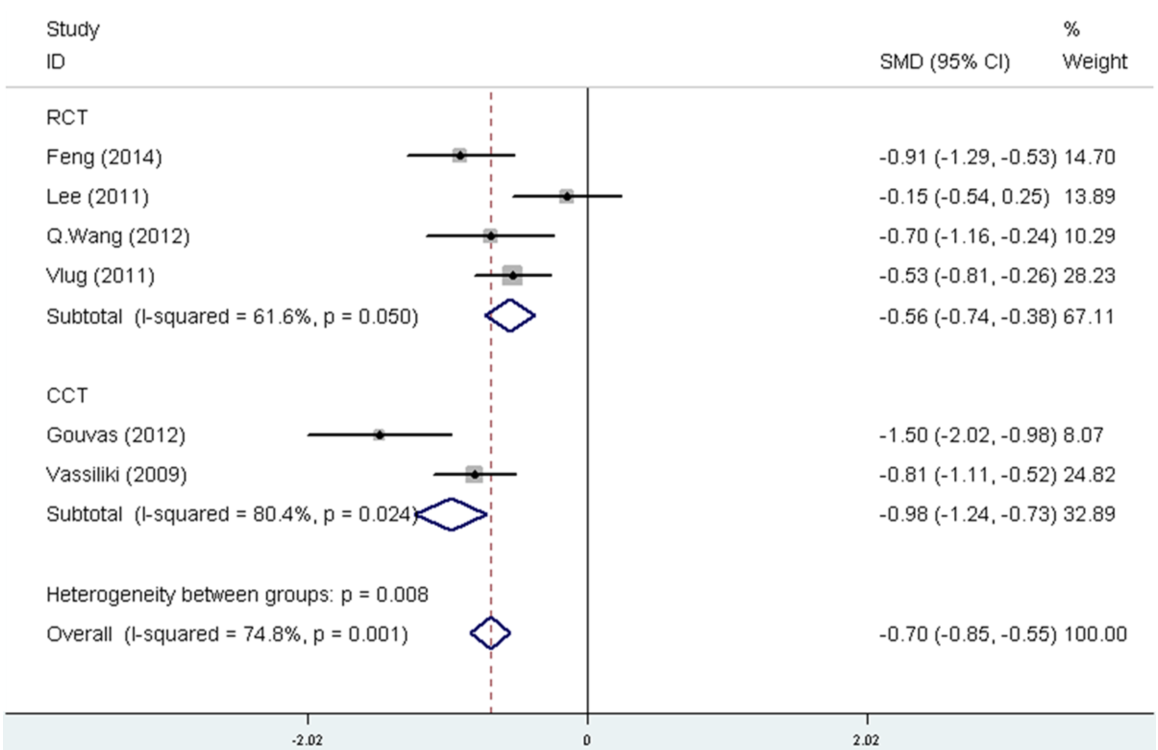

Figure 4. Forest plot for time to first passage of stool.

Readmission rate

Readmission rates were reported in 9 studies [13-21]. There was no significant difference in readmission rates between the two groups (RR=0.66; 95% CI, 0.42, 1.05), with no heterogeneity between trials (I^2=0%, P=0.98). In subgroup analysis, there was no significant difference between RCTs and CCTs.

Postoperative mortality

Mortality was reported in 8 studies [13-17, 19-21]. There was no significant difference in

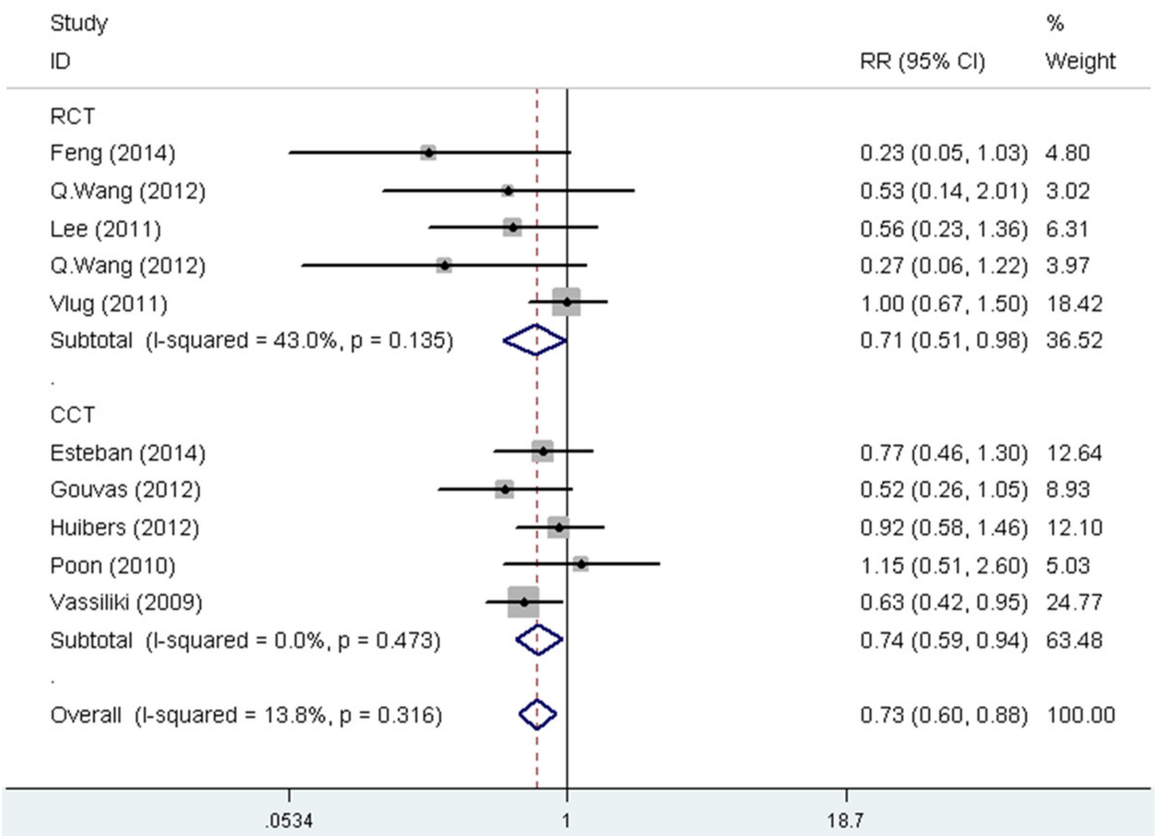

Figure 5. Forest plot for postoperative complication rate.

mortality between the two groups (RR=1.53; 95% CI, 0.42, 5.66), with no heterogeneity between trials (I^2=0%, P=0.94). However, subgroup analysis of RCTs and CCTs did not show a significant difference between the two groups.

Discussion

Summary

Standard colorectal resection is usually associated with a complication rate of 20-30% and a postoperative hospital stay of 8-12 days. Recently, perioperative care has been improved with newer anaesthetic and analgesic techniques, development of minimally invasive surgery, and drugs to reduce surgical stress. Both the laparoscopic technique and FT procedure are able to enhance recovery and shorten the postoperative hospital stay. Thus, we conducted the present study to provide evidence in support of this theory. Our results showed that FT procedure with laparoscopic colorectal surgery was linked with a significant reduced in postoperative hospital stay, time to first flatus and first bowel movement in comparison with conventional perioperative care. And, there were no significant differences in readmission rates, and mortality between two groups.

Previous research

Previous studies have attempted to evaluate the role of fast track procedure vs. conventional care in laparoscopic colorectal cancer surgery. These previous studies demonstrated similar results with our study. Ping Li, et al. [22] indicated that compared with conventional care, FT has fewer complications and a similar incidence of readmission after approximately 1 month. FT had a pooled RR of 0.60 (95% CI: 0.46-0.79) compared with a pooled RR of 0.69 (95% CI: 0.34-1.40) for conventional care. Similarly, Gouvas N et al. [23] found that primary hospital stay (WMD -2.35, 95% CI: -3.24, -1.46) and total hospital stay (WMD -2.46, 95% CI -3.43, -1.48) were significantly shorter for FT programs. Morbidity was also lower in the FT group. Readmission rates were not significantly different. No increase in mortality was found. In addition, Zhuang CL et al. [24] conducted a similar systematic review. Thirteen studies were included. In comparison with traditional care, enhanced recovery after surgery programs were associated with significantly decreased primary hospital stay (WMD=-2.44; 95% CI, -3.06, -1.83), total hospital stay (WMD=-2.39; 95% CI, -3.70 to 1.09), total complications (RR=0.71; 95% CI, 0.58-0.86), and general complications (RR=0.68; 95% CI, 0.56-0.82). No significant differences were found for readmission rates, surgical complications, and mortality.

Heterogeneity analysis

Heterogeneity was detected across the studies. This phenomenon may reflect differences in study design, study population, geographic location, exposure measurement and confounder adjusted for. Distinctions among the FT elements could explain the heterogeneity. In this study, we predefined 15 FT elements, but only 7 to 14 elements were successfully applied. Then in the future perioperative education of patients has a critical role in FT. So it is necessary to demonstrate the detailed treatment program, the different steps of FT procedure and relevant measures for the patients to make them better understand and accept the fast-track rehabilitation program. Next, the difference in patient selection among included studies is another source for heterogeneity. Poon JT et al. [25] included a ratio of patients with advanced-stage tumors which was much higher than in other studies. Tsikitis VL et al. [26] enrolled more patients with ASA scores of 3 and 4. Also, Wang Q et al. [12] studied on elderly patients with a higher mean age than in other studies.

Some points to say

The role of epidural anesthesia or regional anesthesia in FT procedure should be stressed. Postoperative epidural analgesia can avoid stress-induced neurological, endocrinological and homeostatic changes or the blocking of sympathetic nerve-related surgical stress response, reduce complications such as nausea, vomiting and enteroparalysis after operation, promote early ambulation, improve the intestinal function and shorten the hospital stay time of patients after resection of colorectal cancer [27-32]. However, studies from Lancet [33] and Anesthesia & Analgesia [34] proposed epidural analgesia may not be necessary in laparoscopic colorectal surgery and can be replaced by opioid-sparing multimodal analgesia, including oral paracetamol, non-steroidal anti-inflamatory drugs, gabapentanoids, systemic local anaesthetics, or continuous infusion of the wound with local anaesthetic. Hence, more prospective researches should be made to determine the role of epidural analgesia in FT for laparoscopic colorectal surgery.

Conventional care in colorectal surgery includes preoperative bowel preparation, but several researches showed this approach to be unnecessary and with the potential to increase morbidity. Guenaga KF et al. [35] said there was evidence that this intervention may be associated with an increased rate of anastomotic leakage and wound complications. Next, Slim K et al. [36] proposed Mechanical bowel preparation before colorectal surgery was associated with a 75% excess risk of anastomotic leakage (OR=1.75, 95% CI: 1.05-2.90). In addition, Zmora O et al. [37] showed the overall infectious complications rate was 10.2% in group of mechanical bowel preparation and 8.8% in group colorectal surgery without preoperative mechanical bowel preparation. Wound infection, anastomotic leak, and intra-abdominal abscess occurred in 6.4%, 3.7%, and 1.1% versus 5.7%, 2.1%, and 1%, respectively.

Another major concerns regarding FT procedure is the increased readmission rate. A pooled study from University of Copenhagen [38] showed FT procedure could considerably reduce the primary hospital stay, but increase readmission rate in FT group. However, another European study [39] indicated planned discharge on or about the third day after segmental colonic resection can reduce readmissions to generally acceptable levels. Our review also found no significant difference in readmission rate.

There seemed to be a turning point after which reducing the primary hospital stay further would increase the readmission rate. This, in part, could be prevented by applying strict discharge criteria. These discharge criteria comprised the ability to tolerate solid food, full mobilization and pain medication limited to oral analgesics.

Finally several large institutes have shown that higher American Society of Anesthesiologists (ASA) grade was associated with increased postoperative morbidity. Ragg JL et al. [40] showed that ASA' Grades III to V was Independent risk factors for mortality and morbidity. Skala K et al. [41] indicated that ASA' Grades III to V was correlated with postoperative morbidity (OR=2.9, 95% CI 1.9-4.5). Hightower CE et al. [42] manifested that ASA rank were significantly associated with postoperative morbidity. Feroci F et al. [43] also suggested that patients >75 years of age with an ASA grade of III or V have high complication rates.

Limitations and strengths

There are several limitations of the meta-analysis, which always inherits the errors of the original studies. First, although the estimates of each study are standardized in our analyses to reduce the potential of confounding, some residual confounding is inevitable. For instance, we are unable to investigate the underlying effect of the covariates in the original studies, such as the skill and experience of the operating surgeon, efficacy of perioperative care, and quality of anesthesia may differ between the FT and conventional care groups. And high heterogeneity was identified in the primary and total hospital stay and time to first flatus and bowel movement. Second, publication bias is always an important issue in the meta-analyses. Publication bias is a problem when interpreting our results. Negative studies are less likely to be published in indexed journals, leading to potential publication bias. We saw no evidence of such publication bias in the Egger's linear regression test, but the funnel plot seemed asymmetrical. However, according to the Cochrane Handbook for Systematic Reviews of Interventions, Egger's teat typically has low power. Finally, although we made our best to track and acquire unpublished work and grey literature, especially university theses or conference proceedings, there were inevitability some studies left. As a result, publication bias may have influenced the results. And only English literatures were included in this study, it was possible that our findings were biased for many non-English literatures.

Our study also has several strengths. Meta-analysis as a method allows for greatly increased statistical power than what can generally be achieved in individual studies, we also use a systematic approach to collect relevant studies into a coherent whole, including 1317 participants from different countries, which allows a more detailed and definitive analyses than what has previously been shown. The large sample size affords increased statistical power. Moreover, the present meta-analysis includes an approved quality evaluation system. Thus, it minimizes potential bias. Further, the likelihood of important selection or publication bias in our meta-analysis is small.

Conclusion

The evidence from the present meta-analysis shows that FT procedure is safe and effective. FT procedure can significantly shorten the postoperative hospital stay, accelerate the postoperative recovery, and, notably, enhance safety when compared with conventional care. In the future, more high-quality and well-designed studies are needed to provide more solid evidence and to assess the benefits of FT procedure in elderly patients and patients having other GI surgery.

Acknowledgements

We thank Long-Fei Xie for its linguistic assistance during the preparation of this manuscript. The project is sponsored by The PhD Start-up Fund of Liaoning Province, China (No. 201601413) and Liaoning BaiQianWan Talents Program [2017] No. 45.

Disclosure of conflict of interest

None.

Address correspondence to: Jie Lin, Department of General Surgery, Cancer Hospital of China Medical University, Liaoning Cancer Hospital and Institute, Shenyang, China. E-mail: gre031025@hotmail.com

References

[1] Sung JJ, Lau JY, Goh KL and Leung WK. Increasing incidence of colorectal cancer in Asia: implications for screening. Lancet Oncol 2005; 6: 871-876.

[2] Coleman MP, Quaresma M, Berrino F, Lutz JM, De Angelis R, Capocaccia R, Baili P, Rachet B, Gatta G, Hakulinen T, Micheli A, Sant M, Weir

HK, Elwood JM, Tsukuma H, Koifman S, E Silva GA, Francisci S, Santaquilani M, Verdecchia A, Storm HH and Young JL. Cancer survival in five continents: a worldwide population based study. Lancet Oncol 2008; 9: 730-756.

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

[4] Delaney CP, Marcello PW, Sonoda T, Wise P, Bauer J, Techner L. Gastrointestinal recovery after laparoscopic colectomy: results of a prospective, observational, multicenter study. Surg Endosc 2010; 24: 653-661.

[5] Story SK and Chamberlain RS. A comprehensive review of evidence-based strategies to prevent and treat postoperative ileus. Dig Surg 2009; 26: 265-275

[6] Veldkamp R, Kuhry E, Hop WC, Jeekel J, Kazemier G, Bonjer HJ, Haglind E, Påhlman L, Cuesta MA, Msika S, Morino M and Lacy AM. Laparoscopic surgery versus open surgery for colon cancer: short-term outcomes of a randomised trial. Lancet Oncol 2005; 6: 477-484.

[7] Wind J, Polle SW, Fung Kon Jin PH, Dejong CH, von Meyenfeldt MF, Ubbink DT, Gouma DJ and Bemelman WA. Systematic review of enhanced recovery programmes in colonic surgery. Br J Surg 2006; 93: 800-809.

[8] Gouvas N, Tan E, Windsor A, Xynos E and Tekkis PP. Fast-track vs standard care in colorectal surgery: a meta-analysis update. Int J Colorectal Dis 2009; 24: 1119-1131.

[9] Guillou PJ, Quirke P, Thorpe H, Walker J, Jayne DG, Smith AM, Heath RM and Brown JM. Short-term endpoints of conventional versus laparoscopic-assisted surgery in patients with colorectal cancer (MRC CLASICC trial): multicentre, randomized controlled trial. Lancet 2005; 365: 1718-1726.

[10] Muller S, Zalunardo MP, Hubner M, Clavien PA and Demartines N. A fast-track program reduces complications and length of hospital stay after open colonic surgery. Gastroenterology 2009; 136: 842-847.

[11] Moher D, Liberati A, Tetzlaff J and Altman DG. Preferred reporting items for systematic reviews and metaanalyses: the PRISMA statement. BMJ 2009; 339: b2535.

[12] Wang Q, Suo J, Jiang J, Wang C, Zhao YQ and Cao X. Effectiveness of fast-track rehabilitation vs conventional care in laparoscopic colorectal resection for elderly patients: a randomized trial. Colorectal Dis 2012; 14: 1009-1013.

[13] Wang G, Jiang Z, Zhao K, Li G, Liu F, Pan H and Li J. Immunologic response after laparoscopic colon cancer operation within an enhanced recovery program. J Gastrointest Surg 2012; 16: 1379-1388.

[14] Vlug MS, Wind J, Hollmann MW, Ubbink DT, Cense HA, Engel AF, Gerhards MF, van Wagensveld BA, van der Zaag ES, van Geloven AA, Sprangers MA, Cuesta MA and Bemelman WA. Laparoscopy in combination with fast track multimodal management is the best perioperative strategy in patients undergoing colonic surgery: a randomized clinical trial (LAFA-study). Ann Surg 2011; 254: 868-875.

[15] Lee TG, Kang SB, Kim DW, Hong S, Heo SC and Park KJ. Comparison of early mobilization and diet rehabilitation program with conventional care after laparoscopic colon surgery: a prospective randomized controlled trial. Dis Colon Rectum 2011; 54: 21-28.

[16] Feng F, Li XH, Shi H, Wu GS, Zhang HW, Liu XN and Zhao QC. Fast-track surgery combined with laparoscopy could improve postoperative recovery of low-risk rectal cancer patients: a randomized controlled clinical trial. J Dig Dis 2014; 15: 306-313.

[17] Gouvas N, Gogos-Pappas G, Tsimogiannis K, Tsimoyiannis E, Dervenis C and Xynos E. Implementation of fast-track protocols in open and laparoscopic sphincter-preserving rectal cancer surgery: a multicenter, comparative, prospective, non-randomized study. Dig Surg 2012; 29: 301-309.

[18] Poon JT, Fan JK, Lo OS and Law WL. Enhanced recovery program in laparoscopic colectomy for cancer. Int J Colorectal Dis 2011; 26: 71-77.

[19] Esteban F, Cerdan FJ, Garcia-Alonso M, Sanz-Lopez R, Arroyo A, Ramirez JM, Moreno C, Morales R, Navarro A and Fuentes M. A multicentre comparison of a fast track or conventional postoperative protocol following laparoscopic or open elective surgery for colorectal cancer surgery. Colorectal Dis 2014; 16: 134-140.

[20] Tsikitis VL, Holubar SD, Dozois EJ, Cima RR, Pemberton JH and Larson DW. Advantages of fast-track recovery after laparoscopic right hemicolectomy for colon cancer. Surg Endosc 2010; 24: 1911-1916.

[21] Huibers CJ, de Roos MA and Ong KH. The effect of the introduction of the ERAS protocol in laparoscopic total mesorectal excision for rectal cancer. Int J Colorectal Dis 2012; 27: 751-757.

[22] Li P, Fang F, Cai JX, Tang D, Li QG and Wang DR. Fast-track rehabilitation vs conventional care in laparoscopic colorectal resection for colorectal malignancy: a meta-analysis. World J Gastroenterol 2013; 19: 9119-9126.

[23] Gouvas N, Gogos-Pappas G, Tsimogiannis K, Tsimoyiannis E, Dervenis C and Xynos E. Implementation of fast-track protocols in open and laparoscopic sphincter-preserving rectal cancer surgery: a multicenter, comparative, prospective, non-randomized study. Dig Surg 2012; 29: 301-309.

[24] Zhuang CL, Ye XZ, Zhang XD, Chen BC and Yu Z. Enhanced recovery after surgery programs

versus traditional care for colorectal surgery: a meta-analysis of randomized controlled trials. Dis Colon Rectum 2013; 56: 667-678.
[25] Poon JT, Fan JK, Lo OS and Law WL. Enhanced recovery program in laparoscopic colectomy for cancer. Int J Colorectal Dis 2011; 26: 71-77.
[26] Tsikitis VL, Holubar SD, Dozois EJ, Cima RR, Pemberton JH and Larson DW. Advantages of fast-track recovery after laparoscopic right hemicolectomy for colon cancer. Surg Endosc 2010; 24: 1911-1916.
[27] Carli F, Mayo N, Klubien K, Schricker T, Trudel J and Belliveau P. Epidural analgesia enhances functional exercise capacity and health-related quality of life after colonic surgery: results of a randomized trial. Anesthesiology 2002; 97: 540-549.
[28] Clemente A, Carli F. The physiological effects of thoracic epidural anesthesia and analgesia on the cardiovascular, respiratory and gastrointestinal systems. Minerva Anestesiol 2008; 74: 549-563.
[29] Steinberg RB, Liu SS, Wu CL, Mackey DC, Grass JA, Ahlén K and Jeppsson L. Comparison of ropivacaine-fentanyl patient controlled epidural analgesia with morphine intravenous patient-controlled analgesia for perioperative analgesia and recovery after open colon surgery. J Clin Anesth 2002; 14: 571-577.
[30] Taqi A, Hong X, Mistraletti G, Stein B, Charlebois P and Carli F. Thoracic epidural analgesia facilitates the restoration of bowel function and dietary intake in patients undergoing laparoscopic colon resection using a traditional, nonaccelerated, perioperative care program. Surg Endosc 2007; 21: 247-252.
[31] Marret E, Remy C, Bonnet F. Meta-analysis of epidural analgesia versus parenteral opioid analgesia after colorectal surgery. Br J Surg 2007; 94: 665-673.
[32] Augestad KM, Delaney CP. Postoperative ileus: impact of pharmacological treatment, laparoscopic surgery and enhanced recovery pathways. World J Gastroenterol 2010; 16: 2067-2074.
[33] Kehlet H, Dahl JB. Anaesthesia, surgery, and challenges in postoperative recovery. Lancet 2003; 362: 1921-28.
[34] White PF, Kehlet H, Neal JM, Schricker T, Carr DB, and Carli F. The role of the anesthesiologist in fast-track surgery: from multimodal analgesia to perioperative medical care. Anesth Analg 2007; 104: 1380-96.
[35] Guenaga KF, Matos D, Castro AA, Atallah AN and Wille-Jørgensen P. Mechanical bowel preparation for elective colorectal surgery. Cochrane Database Syst Rev 2005; 1: CD001544.
[36] Slim K, Vicaut E, Panis Y and Chipponi J. Meta-analysis of randomized clinical trials of colorectal surgery with or without mechanical bowel preparation. Br J Surg 2004; 91: 1125-1130.
[37] Zmora O, Mahajna A, Bar-Zakai B, Rosin D, Hershko D, Shabtai M, Krausz MM and Ayalon A. Colon and rectal surgery without mechanical bowel preparation: a randomized prospective trial. Ann Surg 2003; 237: 363-367.
[38] Basse L, Thorbol JE, Lossl K and Kehlet H. Colonic surgery with accelerated rehabilitation or conventional care. Dis Colon Rectum 2004; 47: 271-278.
[39] Andersen J, Hjort-Jakobsen D, Christiansen PS and Kehlet H. Readmission rates after a planned hospital stay of 2 versus 3 days in fast-track colonic surgery. Br J Surg 2007; 94: 890-93.
[40] Ragg JL, Watters DA, Guest GD. Preoperative risk stratification for mortality and major morbidity in major colorectal surgery. Dis Colon Rectum 2009; 52: 1296-1303.
[41] Skala K, Gervaz P, Buchs N, Inan I, Secic M, Mugnier-Konrad B and Morel P. Risk factors for mortality-morbidity after emergency-urgent colorectal surgery. Int J Colorectal Dis 2009; 24: 311-316.
[42] Hightower CE, Riedel BJ, Feig BW, Morris GS, Ensor JE Jr, Woodruff VD, Daley-Norman MD and Sun XG. A pilot study evaluating predictors of postoperative outcomes after major abdominal surgery: physiological capacity compared with the ASA physical status classification system. Br J Anaesth 2010; 104: 465-471.
[43] Feroci F, Lenzi E, Baraghini M, Garzi A, Vannucchi A, Cantafio S and Scatizzi M. Fast-track surgery in real life: how patient factors influence outcomes and compliance with an enhanced recovery clinical pathway after colorectal surgery. Surg Laparosc Endosc Percutan Tech 2013; 23: 259-265.