Original Article

Outcomes after implementing the enhanced recovery after surgery protocol for patients undergoing tuberculous empyema operations

Zhaohua Xia[1,2], Kun Qiao[2], Haijiang Wang[2], Xinzhong Ning[2], Jianxing He[1,3,4]

[1]The First Clinical College, Southern Medical University, Guangzhou 510515, China; [2]Department of Thoracic Surgery, The Third People's Hospital of Shenzhen, Shenzhen 518000, China; [3]Department of Thoracic Surgery, The First Affiliated Hospital of Guangzhou Medical University, Guangzhou 510120, China; [4]Guangzhou Institute of Respiratory Disease & China State Key Laboratory of Respiratory Disease & National Clinical Research Center for Respiratory Disease, Guangzhou 510120, China

Contributions: (I) Conception and design: Z Xia; (II) Administrative support: J He; (III) Provision of study materials or patients: K Qiao; (IV) Collection and assembly of data: H Wang; (V) Data analysis and interpretation: X Ning; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Jianxing He, MD, PhD, FACS. Department of Thoracic Surgery, The First Affiliated Hospital of Guangzhou Medical University; Guangzhou Institute of Respiratory Disease & China State Key Laboratory of Respiratory Disease, No. 151, Yanjiang Rd, Guangzhou 510120, China. Email: drjianxing.he@gmail.com.

Background: Enhanced recovery after surgery (ERAS) protocols provide recommendations for care in various surgical fields. However, there is scarce information on the application of these protocols in tuberculous empyema surgery. The purpose of this research is to evaluate the outcomes of ERAS recommendations for patients who received tuberculous empyema surgery.

Methods: A retrospective analysis was performed on patients who underwent tuberculous empyema surgery in our hospital from March 2011 to March 2016. The patients were divided into an ERAS group and a conventional control group. The main outcome measure was the postoperative median length of stay (including readmissions). Principles related to ERAS were documented, and the postoperative median hospital stay was analyzed statistically between the two groups.

Results: A total of 92 patients underwent 93 consecutive tuberculous empyema surgical treatments. The postoperative fasting time, chest tube duration, and length of stay were shorter in the ERAS group compared with the control group. The volume of chest tube drainage in the ERAS group was significantly smaller than that of the control group. No statistical differences were observed in the postoperative complications and reasons for readmission between the two groups.

Conclusions: Application of ERAS recommendations in patients receiving tuberculous empyema operations decreased the length of stay and chest tube drainage compared to the control group.

Keywords: Enhanced recovery after surgery (ERAS); tuberculous empyema; length of stay; chest tube drainage

Submitted Mar 05, 2017. Accepted for publication Jun 13, 2017.
doi: 10.21037/jtd.2017.06.90
View this article at: http://dx.doi.org/10.21037/jtd.2017.06.90

Introduction

In addition to conservative drug therapy, surgical management has become a mandatory treatment option for patients with tuberculous empyema. Surgical management exhibits several advantages including facilitating diagnosis of the disease condition and stage, alleviating infection, re-expanding the compressed lung, and preventing subsequent chronic respiratory lesion. Several surgical modalities are options for primary empyema management, including surgical drainage, lavage techniques, debridement by

Table 1 The standard of care with recommendations for implementing ERAS protocols

Preoperative care
Oral carbohydrate loading
No routine preparation of medication preoperatively
Preoperative respiratory function exercise
Preoperative assessment of nutritional status and pain score
Intraoperative care
Intraoperative hypothermia was minimized by using body warming devices
All patients underwent video-assisted thoracoscopic surgery
No routine use of thoracotomy or rib fracture
Reduction in bleeding intraoperatively
Postoperative care
Opioid-based patient-controlled analgesia
Antiemetics as required
No routine use of tracheal intubation or anticoagulant drugs
Eating and drinking as tolerated without restriction from the operation day
Negative pressure suction postoperatively
Epinephrine continuous washing in thoracic cavity postoperatively
Postoperative use of respiratory exercise device
Early mobilization postoperatively
Urinary catheter removal on the first day postoperatively

ERAS, enhanced recovery after surgery.

video-assisted thoracic surgery (VATS), decortication, thoracoplasty, and open window thoracostomy (1). With the wide application of decortication by VATS, it is imperative to develop a suitable auxiliary scheme to improve postoperative recovery and quality of life.

Enhanced recovery after surgery (ERAS) protocols are currently applied for the care for subjects undergoing lung resection surgery (2). High-rank evidence retains to sustain their applications (3). ERAS involves preoperative optimization, minimization of preoperative fasting, and normal physiological restoration. However, there is relatively scarce data on the application of ERAS protocols in patients undergoing tuberculous empyema operations. Nevertheless, further studies are needed to identify differences in these specific outcomes. In addition, no investigations have yet evaluated the effect of ERAS protocols on quality of life outcomes (4). Moreover, a previous report noted heterogeneity in the characterizations of ERAS programs (5).

Real-time clinical practice usually incorporates advancements over time as new evidence becomes available. Therefore, the purpose of this study was to evaluate the recommendations of an ERAS program for tuberculous empyema patients undergoing VATS. The study was conducted over a 5-year period to determine whether the introduction of ERAS protocols shortens the length of hospital stay for patients and improves their quality of life.

Methods

Subject enrollment

All subjects were diagnosed with tuberculous empyema based on the following criteria: patients exhibited fever, emaciation, fatigue, chest pain, cough, and shortness of breath with a history of tuberculosis pleurisy. Local chest percussion demonstrated dullness or flatness, and auscultation indicated that breath sounds were absent or diminished. Thoracentesis obtained straw yellow colored turbid liquid or pus. X-ray or computed tomography demonstrated pleural wall thickening and pleural effusion, together with oppressive pulmonary atrophy.

All of the subjects received at least 2 weeks of standard antituberculosis therapy before surgery to control tuberculosis and prevent dissemination and recurrence. The therapy consisted of 0.3 g isoniazid once a day, 0.45 g rifampicin once a day, 0.75 g ethambutol once a day, and 0.5 g pyrazinamide 3 times a day. The inclusion criteria included age ≥14 and ≤70 years old; no severe organic disease in the brain, heart, liver, and kidney; no pulmonary cavity, bronchiectasis, or bronchial stenosis; no bronchopleural fistula or pyothorax penetrating the chest wall; pleural thickening <1.0 cm without calcification; and no obvious thoracic collapse or intercostal stenosis. The exclusion criteria were age <14 or >70 years old, high surgical risk due to severe organic disease, ineffective antituberculosis therapy, and significant foci absorption after antituberculosis therapy. The subjects were randomly divided into the ERAS group and the conventional control group.

ERAS procedure

All patients were treated by VATS lesion clearance plus fibrous dissection. The ERAS principles for preoperative, intraoperative, and postoperative care are listed in *Tables 1* and *2* (6). Each patient met with the nurses and

Table 2 Comparison between ERAS group and control

Time	ERAS	Control
Preoperative management		
Fasting	Eve 1,000 mL of 10% glucose orally; 3 h before operation 500 mL of 10% glucose orally	All night fasting
Premedicate	Non-routine	Routine
Respiratory function excise	Routine	Non-routine
Preoperative nutrition and pain score evaluation	Routine	Non-routine
Intraoperative management		
Warming	Routine	Non-routine
Operation method	VATS	Thoracotomy
Reducing intraoperative bleeding	Routine	Non-routine
Postoperative management		
Analgesia	PCA, 200 mg flurbiprofen axetil in 150 mL NS, loading 3 mL, sustained for 48 h	PCA, 150 mg morphine in 150 mL NS, 1 mg/mL, only bolus dose, no background dose. 1 mg per bolus, time locking 10 min
Antiemetic drug	Routine	Non-routine
Tracheal intubation	Non-routine	Routine
Anticoagulant	Non-routine	Routine
Vacuum aspiration	Routine	Non-routine
Early stage drinking and eating	Routine	Non-routine
NA thoracic cavity washing	Routine (5 h, 100 mL/h)	Non-routine
Respiratory function excise	Routine	Non-routine
Early ambulation	Routine (1st day after surgery)	Non-routine
Early catheter removal	Yes (24 h after surgery)	No (3–4 days after surgery)

ERAS, enhanced recovery after surgery; VATS, video-assisted thoracic surgery; PCA, patient controlled analgesia.

physicians in the outpatient clinic before surgery. At this time, the patients were informed of their prospective date of discharge. After surgery, patient-controlled non-opioid analgesia was employed until the patient seemed comfortable with regard to oral analgesia.

Patients were considered ready for discharge when their indexes were regular and their pain was suitably managed by oral analgesics. The patients also needed to have an adequate diet and social support. Increased levels of C-reactive protein and prothrombin and decreased hemoglobin were not considered contraindications for discharge; however, these tendencies and evidence of stability were believed to be important. Each patient was reexamined on the 7th day after discharge.

Data collection

The intraoperative information included the size of the incision, continuous rinsing with adrenaline saline, regional blockade with intercostal nerve block or intravenous morphine, and persistent negative pressure aspiration (7,8). The postoperative data included the time of chest tube placement, volume of pleural fluid drainage, and the incidence of complications.

Table 3 Demographics and preoperative information

Variables	ERAS group [45]	Conventional control group [47]	P value
Age	35±11	32±11	0.123
Gender (male, %)	35 (77%)	34 (72%)	0.547
Symptom			
Fever	17 (37%)	23 (49%)	0.280
Cough	28 (62%)	23 (48%)	0.200
Thoracic collapse	29 (64%)	32 (68%)	0.712
Pulmonary tuberculosis	19 (42%)	17 (36%)	0.552
ASA score 1 or 2	40 (88%)	39 (82%)	0.416
Affected side			0.542
Left	22	20	
Right	23	27	
Largest diameter of pus cavity (cm)	12.5±2.0	9.7±3.3	0.191
Largest fiberboard thickness (mm)	8.5±2.3	7.2±3.5	0.559

ERAS, enhanced recovery after surgery.

Statistical analysis

All data analyses were performed on SPSS 22.0 software. The measurement data were depicted as the mean ± standard deviation (SD) and were compared by the *t*-test. The enumeration data were compared by the chi-square test. A P value less than 0.05 was considered to indicate statistical significance.

Results

General information

A total of 94 patients who underwent tuberculous empyema operations performed by a single surgical team at the Shenzhen Third People's Hospital between March 2011 and March 2016 were evaluated in this retrospective analysis. Two patients were excluded from further analysis because of coagulation hemothorax clearance plus fibrous dissection (n=1) and pleural biopsy rather than lesion clearance plus fibrous dissection (n=1). The 92 patients had a total of 93 hospital admissions for tuberculous empyema procedures. One patient (1.08%) underwent two tuberculous empyema operations. The patient demographics and baseline characteristics, including age, gender, symptoms, ASA score, position, pus cavity diameter, and fiberboard thickness were collected and listed in *Table 3*. No statistical differences were observed in the preoperative information between the two groups.

Perioperative comparison

Perioperative results are shown in *Table 4*. There were no statistical differences in the operation time, size of incision, and intraoperative blood loss between the two groups. No patients suffered from open surgery conversion in either group. Compared with the conventional control group, the patients in the ERAS group exhibited a significantly shorter postoperative fasting time, chest tube duration, and length of stay in the hospital (P<0.05). In addition, the volume of chest tube drainage in the ERAS group was smaller than in the conventional control group (P<0.05).

Comparison of complications

In total, 5 of the 92 patients (5.4%) had complications, including perioperative pulmonary atelectasis (n=2, 2.16%), bronchopleural fistula (n=1, 1.08%), postoperative active bleeding (n=1, 1.08%), and wound infection (n=1, 1.08%) (*Table 5*). No patient died postoperatively. The reasons for readmission included bronchopleural fistula (n=1, 1.08%), pleural effusion (n=1, 1.08%), and nearby recurrence (n=1, 1.08%) (*Table 6*). No significant differences were found in

Table 4 Perioperative indicators

Indicator	ERAS group [45]	Conventional control group [47]	P value
Operation time (min)	244±93	207±77	0.317
Size of incision (cm)	11.1±3.2	12.2±2.2	0.218
Intraoperative blood loss (mL)	748±520	521±347	0.081
Conversion to thoracotomy	0	0	N/A
Postoperative fasting time(hours)	5.2±0.8	9.4±1.9	0.008
Chest tube duration (days)	5.1±2.7	7.4±3.5	0.032
Postoperative chest tube drainage (L)	1.23±0.88	1.43±0.94	0.035
Postoperative length of stay (days)	8.9±3.9	13.7±7.1	0.018

ERAS, enhanced recovery after surgery.

Table 5 Complications

Variables	ERAS group [45]	Conventional control group [47]	P value
Pulmonary	2	1	–
Cardiac	0	0	–
Other	1	1	–
Death	0	0	–
Total complications	3	2	0.644

ERAS, enhanced recovery after surgery.

Table 6 Reasons for readmission

Variables	ERAS group [45]	Conventional control group [47]	P value
Bronchopleural fistula	0	1	–
Pleural effusion	0	1	–
Short-term recurrence	1	0	–
Total	1	2	0.556

ERAS, enhanced recovery after surgery.

the complication and readmission rates between the ERAS group and conventional control group (P>0.05).

Discussion

The results of this study demonstrate that implementation of ERAS protocols for patients receiving tuberculous empyema operations led to a significant decrease in the median postoperative length of hospital stay from 13.7 to 8.9 days. This reduction is in agreement with a previous study of outcomes of tuberculous empyema operations (9). However, there is still lack of information about the role of ERAS protocols in patients undergoing tuberculous empyema operations. Therefore, it may be necessary to optimize the nontechnical aspects of the ERAS protocols rather than focusing attention on the minimally invasive procedures. A previous study (10) reported that this optimization is important given the similarity in economic cost between minimally invasive surgery and open surgery. Thoracic surgeons performing VATS to treat tuberculous empyema require a relatively high level of technique, and the procedure has a long-term learning curve. Moreover, it should be noted that the present research did not evaluate other important aspects, such as the time required to resume work or ordinary activities following surgery. In terms of these aspects, VATS may demonstrate beneficial results compared with conventional open thoracotomy.

In two studies of patients (9,11) who underwent conventional hepatic resection, the mean lengths of stay were 6 and 7 days. A study on the application of the ERAS protocol for hepatic resection seemed to reduce the length of stay to shorter than 4 days. However, this improvement led to a higher readmission rate, which increased to 22% (6). This result emphasizes the need for early postoperative and follow-up care for patients when applying the ERAS protocol. Success of the ERAS protocol requires that surgeons pay close attention to patients to treat potential complications after tuberculous empyema operations and to minimize readmissions.

In this study, the incidence of postoperative

complications was steady throughout the evaluation period. A previous study (12) demonstrated both a decreased complication rate and an increased readmission rate related to ERAS protocols. However, additional research is needed to determine the optimal postoperative length of stay and chest tube duration that minimizes the readmission rate. There are notable differences between the present study and the former report with regard to discharge exercises. For instance, Lin *et al.* (13) reported that a postoperative length of stay of 6 days was ideal, and considered discharge before this time to be too early. It is difficult to confirm in a retrospective study if discharge was premature; however, it should be noted that the same discharge criteria were maintained throughout this study.

There are several limitations in this study. One limitation is that it was a retrospective study, so it was inconvenient to collect all data on readmissions and complications because the patients could visit other hospitals and this information may have been lost. Additionally, this study could not fully evaluate factors affecting quality of life, which should be examined in future research.

Acknowledgements

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

References

1. Al-Kattan KM. Management of tuberculous empyema. Eur J Cardiothorac Surg 2000;17:251-4.
2. Ansari BM, Hogan MP, Collier TJ, et al. A Randomized Controlled Trial of High-Flow Nasal Oxygen (Optiflow) as Part of an Enhanced Recovery Program After Lung Resection Surgery. Ann Thorac Surg 2016;101:459-64.
3. Kehlet H, Wilmore DW. Evidence-based surgical care and the evolution of fast-track surgery. Ann Surg 2008;248:189-98.
4. Loop T. Fast track in thoracic surgery and anaesthesia: update of concepts. Curr Opin Anaesthesiol 2016;29:20-5.
5. Eskicioglu C, Forbes SS, Aarts MA, et al. Enhanced recovery after surgery (ERAS) programs for patients having colorectal surgery: a meta-analysis of randomized trials. J Gastrointest Surg 2009;13:2321-9.
6. Connor S, Cross A, Sakowska M, et al. Effects of introducing an enhanced recovery after surgery programme for patients undergoing open hepatic resection. HPB (Oxford) 2013;15:294-301.
7. Deng B, Tan QY, Zhao YP, et al. Suction or non-suction to the underwater seal drains following pulmonary operation: meta-analysis of randomised controlled trials. Eur J Cardiothorac Surg 2010;38:210-5.
8. Sanni A, Critchley A, Dunning J. Should chest drains be put on suction or not following pulmonary lobectomy? Interact Cardiovasc Thorac Surg 2006;5:275-8.
9. Chen B, Zhang J, Ye Z, et al. Outcomes of Video-Assisted Thoracic Surgical Decortication in 274 Patients with Tuberculous Empyema. Ann Thorac Cardiovasc Surg 2015;21:223-8.
10. Zehr KJ, Dawson PB, Yang SC, et al. Standardized clinical care pathways for major thoracic cases reduce hospital costs. Ann Thorac Surg 1998;66:914-9.
11. Molnar TF. Current surgical treatment of thoracic empyema in adults. Eur J Cardiothorac Surg 2007;32:422-30.
12. Schatz C. Enhanced Recovery in a Minimally Invasive Thoracic Surgery Program. AORN J 2015;102:482-92.
13. Lin DX, Li X, Ye QW, et al. Implementation of a fast-track clinical pathway decreases postoperative length of stay and hospital charges for liver resection. Cell Biochem Biophys 2011;61:413-9.

Cite this article as: Xia Z, Qiao K, Wang H, Ning X, He J. Outcomes after implementing the enhanced recovery after surgery protocol for patients undergoing tuberculous empyema operations. J Thorac Dis 2017;9(7):2048-2053. doi: 10.21037/jtd.2017.06.90

