

Enhanced Recovery After Surgery (ERAS) Protocols in Thoracic Surgery

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ABSTRACT

Enhanced Recovery After Surgery (ERAS) protocols consist of multimodal, evidence-based strategies to decrease surgical-induced stress. They are conceived as pathways that encompass patient care from initial referral to discharge. Usually, they include multiple small improvements incorporated in everyday practice; these elements positively affect patient management. First developed for colorectal surgery, the ERAS approach has now been successfully applied to a wide variety of surgical specialities, resulting in improved postoperative outcomes. Collaterally, reduction of postoperative complication rate, earlier hospital discharge and lower healthcare costs have been reported. Fast-tracking or standardised critical care pathways for thoracic surgery have been known since the late '1990s, but it was not until recently that specific ERAS models have been designed. Notably, there is an increasing interest in ERAS applications to video-assisted thoracic surgery (VATS) and VATS lobectomies. A recent systematic review has warned physicians against the severe methodological limitations of the body of evidence supporting enhanced-recovery pathways; however, a further meta-analysis of randomised controlled trials has demonstrated that ERAS for lung cancer can effectively accelerate postoperative recovery and reduce hospital stay and the related costs without compromising patient safety. The ERAS Guidelines of the European Society of Thoracic Surgery embrace different patient care fields: from preadmission counselling to surgical techniques to early postoperative mobilisation and physiotherapy; most of these recommendations have a strong evidence base. Therefore, they are thought to affect patient outcomes positively. The most shared recommendations include smoking cessation four weeks before surgery, preoperative treatment of malnutrition and anaemia, use of lung-protective strategies during one-lung ventilation, employment of combined regional and general anaesthetic techniques, use of VATS techniques, early oral feeding, removal of chest tube if output ≤ 450 ml/day.

48 INTRODUCTION

49 Enhanced Recovery After Surgery (ERAS) protocols are multidisciplinary approaches aimed at
50 improving perioperative care to minimise physical and psychological discomfort in patients
51 undergoing surgery. The main purpose of ERAS is to promote the patients' return to preoperative
52 baseline function as soon as possible.

53 Enhanced recovery pathways (ERPs) were initially identified more than 20 years ago in colorectal
54 surgery and had since been introduced through several surgical specialities. These models cover
55 preoperative, intraoperative, and postoperative care and benefit patient outcomes and healthcare
56 costs. While there are differences between facilities, the preoperative patient education,
57 avoidance of extended preoperative fasting, restricting intravenous fluid administration,
58 multimodal opioid-sparing analgesia, and early ambulation are widespread core tenets.

59 Lung surgery is associated with significant postoperative morbidity risks. As such, patients
60 undergoing thoracic surgery experience multiple psychological and physiological stressors. Several
61 ERPs for thoracic surgery has been developed in the past few years. Thoracic ERPs focus primarily
62 on the multidisciplinary delivery of treatment, preoperative education, and opioid-sparing pain
63 control. Published evidence of the advantage of thoracic ERP is increasing [1]. Implementation of
64 such programs may, however, seem overwhelming.

65 This chapter describes ERAS programs' typical features in thoracic surgery and addresses the latest
66 findings in this field. While ERP has also emerged for oesophageal surgery, the emphasis here is on
67 lung surgery [2].

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70 THE HISTORY OF ENHANCED RECOVERY AFTER THORACIC SURGERY

71 Improving patient results with standardised treatment plans, such as fast track pathways, is not a
72 new concept for thoracic surgeons. However, ERAS is a unique approach since it includes all
73 perioperative treatment phases (preoperative, intraoperative, and postoperative). Given the

74 limited number of studies focusing on ERAS outcomes since 2015, it has only recently been applied
75 to thoracic surgery. Nonetheless, the evidence levels were inadequate, and the ERAS tools did not
76 substantially decrease overall complications, operative mortality, or hospital readmission. Further
77 research was supposed to enhance the trial's design to provide definitive proof of its efficacy.
78 Nevertheless, this preliminary experience has paved the way for ERAS in thoracic surgery.
79 Despite having similar features, ERAS protocols differ slightly among various institutions, as there is
80 no unique and standardised ERP. The same outcome measures (length of hospital stay, 30-day
81 mortality, chest tube-dwelling time, readmission rate, cardiopulmonary complications) were
82 reported in most studies. Patient-reported results and patient-centred outcome measures were
83 rarely reported. Multi-institutional research is yet to be conducted, with significant limitations due
84 to the differences in treatment trends across institutions and ERAS procedures variations [1].

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87 **ERAS IN THORACIC SURGERY**

88 While the elements of enhanced recovery (i.e., pain management, fluid restriction, early
89 mobilisation, etc.) have been singularly adopted and implemented in surgical specialities for
90 decades, the acknowledgement of ERAS as an integrated multimodal pathway for thoracic surgery
91 is relatively recent [3].

92 The latest guidelines from the European Society of Thoracic Surgeons (ESTS) delineate
93 recommendations for the perioperative management of thoracic surgery patients (Table 1) [5].
94 Some suggestions are quite generic and borrowed from other surgical specialities; for instance, the
95 management of alcohol abuse and preoperative anaemia, carbohydrate-rich diet, venous
96 thromboembolism prophylaxis and early feeding [6].

97 Early mobilisation and preoperative administration of carbohydrate-rich drinks have shown
98 encouraging outcomes. Default admission to the intensive therapy unit, on the other hand, does
99 not seem to affect postoperative admission but results in delayed patient discharge. Scientific

100 evidence has shown that ERAS tools are superior to the traditional management of thoracic
101 surgery patients allowing to reduce the length of hospital stay, decrease the healthcare costs, and
102 providing adequate postoperative quality of life. As is the case for general surgery, the ERAS
103 models provide evidence-based approaches to patient care. There are three stages of ERAS
104 practice in thoracic surgery: preoperative, intraoperative, and postoperative. The use of Video-
105 Assisted Thoracic Surgery (VATS), as opposed to thoracotomy, is possibly the most crucial aspect
106 contributing to the beneficial impact of ERAS and likely overshadows the influence of other
107 variables. This might explain the lack of gain in a comparative pre-ERAS versus post-ERAS analysis
108 based solely on VATS lobectomies [4].

109 Other studies have shown that the benefits of ERAS are more easily detected after VATS resections.
110 Indeed, the distribution and implementation of ERAS are facilitated by VATS, as the targeted
111 management of postoperative nausea and vomiting, avoidance of epidural analgesia, pain
112 treatment without opiates (if possible), and fluid administration restriction are considered
113 standard measures.

114 A multidisciplinary approach is crucial, as ERAS procedures are often put into practice by non-
115 surgeon providers and demand strong teamwork. Collaboration between surgeons,
116 anesthesiologists, and nurses is considered a prerequisite in the majority of institutions. Several
117 centres also engage a much more comprehensive range of healthcare providers (physical
118 therapists, respiratory therapists, pharmacy, pain service workers, nutrition and computer
119 specialists) or dedicated staff to enhance ERAS efficacy. The participation of key stakeholders,
120 particularly physicians and nurses who will carry out ERAS tasks, is essential for success.

121 On the contrary, few studies analyse patient-reported outcomes, though pilot experiments have
122 shown the feasibility of data collection. Several aspects of the ERAS protocols are geared towards
123 the improvement of patient overall perioperative experience. Extensive preoperative education
124 allows patients to prepare for out-of-hospital postoperative treatment appropriately. Encouraging
125 patient engagement increases overall satisfaction and compliance with ERAS patient-dependent

126 components [7].

127 All the studies mentioned above provide valuable insights to surgical teams interested in
128 developing an ERAS protocol. Above all, teamwork is fundamental, and all the healthcare providers
129 involved in perioperative care should cooperate in designing a multidisciplinary pathway.

130 Secondly, the proposed model should be flexible and incorporate incremental improvements
131 based on real-world experience. Some groups have modified ERPs over time for specific
132 populations or following unexpected events.

133 Third, there is a range of evidence-based procedures and tools that have shown promising results
134 in improving recovery: VATS, multimodal opioid-sparing anaesthesia, early removal of chest tubes
135 and Foley catheters, early mobilisation, and carbohydrate-rich diet. Besides, some common-sense
136 elements, primarily ERAS-focused preoperative education, are likely to increase patient
137 compliance.

138 The reported findings indicate that ERAS protocols are effective when applied to thoracic surgery
139 and decrease patient morbidity.

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141 **COMMENTS**

142 Fast track procedures for pulmonary resection are feasible, decrease hospital-related costs, reduce
143 the length of stay, and uphold treatment standards. Despite the growing number of scientific
144 papers discussing the advantages of ERPs for patients undergoing lung resection and the recent
145 publication of ERAS guidelines for thoracic surgery, the uncomfortable truth is that there are no
146 explicit instructions for follow-up after patient discharge or suggestions to avoid unintentional
147 hospital readmissions. Beyond doubt, ERAS and fast-track pathways have broadened the horizons
148 of perioperative care in thoracic surgery. However, most current guidelines have not been tested in
149 large populations, and most of them have been extrapolated from protocols of other surgical
150 specialities. Further research is needed to understand whether these models improve short and
151 long-term outcomes after lung resection and decrease the frequency of unplanned readmissions.

152 However, for us, the appropriate transfer of care between the three phases of the perioperative
153 period must be encouraged and emphasised, especially at the processes' level, ensuring sufficient
154 reciprocal contact and adequate recovery [8].

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157 **CONCLUSIONS**

158 ERAS pathways have proven beneficial for several surgical specialities, such as colorectal surgery.
159 As concerns thoracic surgery, there is emerging evidence of ERAS efficacy. However, solid research
160 is needed to fill the substantial knowledge gaps that prevent fast-track models from being adopted
161 in real life. Comprehensive guidelines based on prospective and randomised trials and focusing on
162 transversal cost-effectiveness evaluation should be supported. The conventional endpoint may not
163 adequately assess the benefits of ERAS in the era of minimally invasive surgery. Therefore a higher
164 emphasis should be placed on appropriate goals aligned with patient-centred treatment efficacy
165 [6].

166 **REFERENCES**

- 167 [1] Van Haren RM, Atay SM. *Enhancing the study of enhanced recovery after thoracic surgery: methodology and*
 168 *population-based approaches for the future*. J Thorac Dis 2019;**11**:S612-S18.
- 169 [2] Haywood N, Nickel I, Zhang A, Byler M, Scott E, Julliard W *et al*. *Enhanced Recovery After Thoracic Surgery*. T
 170 horac Surg Clin 2020;**30**:259-67.
- 171 [3] Gonfiotti A, Viggiano D, Bongiolatti S, Bertolaccini L, Solli P, Bertani A *et al*. *Enhanced Recovery after Surgery (*
 172 *ERAS®) in thoracic surgical oncology*. Future Oncology 2018;**14**:33-40.
- 173 [4] Gonfiotti A, Viggiano D, Voltolini L, Bertani A, Bertolaccini L, Crisci R *et al*. *Enhanced recovery after surgery an*
 174 *d video-assisted thoracic surgery lobectomy: The Italian VATS Group* surgical protocol*. Journal of Thoracic Disease 201
 175 **8**;**10**:S564-S70.
- 176 [5] Batchelor TJP, Rasburn NJ, Abdelnour-Berchtold E, Brunelli A, Cerfolio RJ, Gonzalez M *et al*. *Guidelines for enh*
 177 *anced recovery after lung surgery: recommendations of the Enhanced Recovery After Surgery (ERAS(R)) Society and the*
 178 *European Society of Thoracic Surgeons (ESTS)*. Eur J Cardiothorac Surg 2019;**55**:91-115.
- 179 [6] Bertolaccini L, Brunelli A. *Devising the guidelines: the techniques of uniportal video-assisted thoracic surgery-*
 180 *postoperative management and enhanced recovery after surgery*. Journal of thoracic disease 2019;**11**:S2069-S72.
- 181 [7] Semenkovich TR, Hudson JL, Subramanian M, Kozower BD. *Enhanced Recovery After Surgery (ERAS) in Thorac*
 182 *ic Surgery*. Semin Thorac Cardiovasc Surg 2018;**30**:342-49.
- 183 [8] Rodriguez M, Aymerich M. *Enhanced recovery after surgery pathways in thoracic surgery, do they end at disc*
 184 *harge?* Ann Transl Med 2019;**7**:S357.

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Preoperative phase • Preadmission information, education, counselling • Preoperative nutrition screening and counselling • Smoking cessation • Alcohol dependency management • Anaemia identified, investigated, corrected • Rehabilitation, pulmonary rehabilitation
Perioperative phase • Clear fluids until 2 hours before; oral carbohydrate load • Venous thromboembolism prophylaxis • Antibiotic prophylaxis and skin preparation • Intraoperative hypothermia prevention • Lung-protective anaesthetic strategies • Combined use of regional and general anaesthesia • Postoperative nausea and vomiting control • Multimodal opioid-sparing analgesia • Early replacement of intravenous fluids with oral intake • Prevention of atrial fibrillation • Video-assisted thoracoscopic surgery when possible (muscle-sparing incision when thoracotomy is necessary)
Postoperative phase • Use of a single chest tube, with no external suction • Early removal of chest tube(s) • Avoidance of urinary drainage when possible (reasonable if epidural/spinal anaesthesia) • Early mobilisation and physical therapy within 24 hours

187 **Table 1.** ERAS Society and European Society of Thoracic Surgeons guidelines for enhanced recovery
188 after thoracic surgery (adapted from [5]).