



# Enhanced recovery after surgery in thoracic surgery: the past, the present and the future

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## The past

Enhanced recovery after surgery (ERAS) is a multimodal plan of care based on the application of multiple standardized evidence-based elements and aimed at improving the perioperative patient experience, by accelerating recovery, reducing complications and shortening hospital stay. The multiple elements, which constitute the ERAS pathway cover all temporal domains of the perioperative care: preoperative, intraoperative and postoperative. They are based on the concept of marginal gains. The individual elements may have limited effect on the outcome when used in isolation but they act synergistically when applied in combination to reduce the surgical stress and hasten recovery (1).

The concept of ERAS has been popularized in colorectal surgery, where it has shown the greatest benefit compared to standard care. It has been subsequently applied also to other specialties showing positive results in terms of outcomes (2).

The elements of ERAS or fast track in thoracic surgery are not new. Several years ago, Cerfolio and colleagues (3,4) identified modifiable and non-modifiable factors, which could contribute to improve fast track rate. Among the modifiable factors, the most relevant were the management of chest tubes, pain control, and social support plans. In addition some patient related characteristics increased the risk of a failed fast tracked care: age older than 70 years, obesity (BMI >38), being user of narcotics, anti-anxiolytics or alcohol and poor preoperative pulmonary function. They also provided some recommendations specific for these groups of patients in order to streamline their surgical care and improve their outcomes (i.e., avoid epidurals, avoid

postoperative narcotics, preoperative and postoperative pulmonary and physical rehabilitation, smoking cessation, plan social support, etc.).

The literature on ERAS in our specialty is very scant however. A recent systematic review identified only 6 studies, only one of which was a randomized trial (5). These studies used variable elements in the context of what they defined as fast track protocols. The outcomes analyzed also varied but in general the adoption of standardized perioperative elements of care was able to shorten the length of stay in the majority of the studies. However, the incidence of complications was reduced in only 1 of the three studies, in which this outcome was analyzed (6). Only two studies evaluated the incidence of readmissions and they reported discordant results, one showing no difference between ERAS and non-ERAS patients (7) and the other showing a 3-fold increase of readmissions in the fast tracked patients (8).

## The present

To complicate the interpretation of these non-univocal findings, the majority of the studies about ERAS in our specialty did not include patients submitted to video-assisted thoracoscopic surgery (VATS), mostly because they were conducted prior to the widespread use of this approach. This is a crucial point as minimally invasive surgery is considered one of the mainstays of ERAS. In particular, compared to open surgery VATS has been shown to reduce the incidence of complications and hospital mortality, shorten hospital stay, and improve functional recovery, pain and quality of life (9-14). These beneficial

effects of VATS over open surgery are even more evident in high-risk patients (15).

In order to fill the knowledge gap of ERAS in the context of minimally invasive thoracic surgery we recently concluded a retrospective analysis comparing patients undergoing VATS lobectomy before and after the start of a formal ERAS program in our center (16). We were not able to find any substantial difference in terms of cardiovascular and pulmonary complications, 30- or 90-day mortality rates and length of stay between the two groups. 30- and 90-day readmission rates were also similar between the groups. The most likely explanation for this disappointing finding was that the pre-ERAS 'standard' care already involved several ERAS components (i.e., the pre-operative information and health advice, antibiotic prophylaxis, minimally invasive surgery, single chest drain, digital drainage system and multimodal analgesia), which were sufficient to provide VATS patients with good outcomes. It is therefore questionable whether the inclusion of other elements such as preoperative warming, energy drink before surgery, incentive spirometry, motivational talks etc. would be justified in light of the increased costs and not evident benefit. This is particularly true for patients submitted to VATS lobectomy, which is sufficiently non-invasive, low risk, and typically associated with uncomplicated recovery to ensure a positive outcome even without the addition of other elements of ERAS. VATS represents the principal element of an ERAS for thoracic surgery, and this likely masks the effect of the other elements.

In the attempt to standardize enhanced recovery practice in thoracic surgery and align our specialty to other surgical ones, the European Society of Thoracic Surgeons (ESTS) established a collaboration with the ERAS Society and created a task force to develop a set of guidelines specific for our specialty.

This document will propose standardized and evidence-based recommendations about the following subjects: patient education and counseling, nutritional assessment, smoking cessation policy, pulmonary pre-habilitation and rehabilitation, preoperative fasting and carbohydrate treatment, pre-anesthesia medication, VTE prophylaxis, antibiotic prophylaxis, preventing intraoperative hypothermia, anesthetic protocols, postoperative nausea and vomiting control, regional anesthesia and pain control, perioperative fluid management, surgical approach (thoracotomy or minimally invasive surgery), chest drain management, urinary drainage, early mobilization and prevention of atrial fibrillation.

## The future

As discussed above, most of the inconsistent results associated with ERAS in our specialty derived from the fact thoracic surgery standard care includes many of the elements, which are considered as "enhanced care" in other specialty. The concepts of pain control, fluid restriction, early as possible mobilization, physiotherapy are all well known to thoracic surgeons and used since decades in our specialty.

Particularly in the current era of minimally invasive thoracic surgery, we may now be in a 'post-ERAS' world. It is possible in fact that sufficient beneficial components of ERAS are now received by the majority of the patients and that this should now be regarded as 'standard' rather than 'enhanced' care (16).

We may now need to progress to an ERAS-plus phase in our specialty to observe improved outcomes and to compete with alternative non-surgical treatment especially for high-risk patients with lung cancer. We should go beyond the traditional ERAS dogma and refine the elements compounding the so-called enhanced care. Standardized care should evolve into a tailored surgical care modulated to the characteristics and preferences of the patients. One example of this evolved ERAS could be the use of high-technology fitness tests to more precisely identify the high-risk surgical candidates. Their identification can lead to the institution of intensive pre-habilitation programs and optimization of their preoperative treatment to reduce their surgical risk. Moreover, the extent of surgery can also be tailored according to the surgical risk whenever technically and oncologically feasible (i.e., minimally invasive anatomic segmentectomy instead of larger resections).

We recently conducted an internal audit at our institution to evaluate whether the frequency of use of preoperative cardiopulmonary exercise test (CPET) by the individual surgeons was associated with early and long-term outcomes after anatomic lung resection for lung cancer. We found that only 24% of patients submitted to lobectomy or segmentectomy received a CPET evaluation before surgery. Fifty percent of all patients with CPET were operated by a single surgeon (who requested CPET in 40% of his patients). The other 5 surgeons of the team made a less frequent use of this test (from 8% to 20% of their patients). In patients operated on by the frequent user of CPET, the 90-day mortality rates were not different between patients with CPET and those without CPET (3.6 vs. 1.6%,  $P=0.4$ ). In patients operated on by the occasional users of CPET

instead, the 90-day mortality rate of those with CPET was 3-fold higher than the one of those without CPET (10.6% *vs.* 3.3%,  $P=0.007$ ). Among patients with CPET, those operated by the frequent user of CPET had a 90-day mortality rate 3-fold lower than the cumulative mortality of those operated by the occasional users (3.6% *vs.* 10.6%,  $P=0.1$ ) and a better 2-year survival rate (84% *vs.* 66%, log-rank  $P=0.014$ ). The most interesting finding was that the two groups of patients (operated by the frequent user *vs.* the occasional users) had similar baseline and physiologic characteristics and surgical approach. The only significant difference between the two groups was the higher rate of anatomic segmentectomies performed by the frequent user compared to those performed by the other surgeons (16% *vs.* 2.4%,  $P=0.003$ ), which may have had a positive impact on the outcomes. The increased use of segmentectomies in the group of patients with CPET operated on by the frequent user of CPET may reflect a change in surgical strategy based on the results of the test guided by the perceived usefulness of the test (larger experience leading to higher confidence). The usefulness of test may have not been perceived in a similar way by the other surgeons (more inexperienced in interpreting the test hence with less confidence in its results), who did not modify their surgical strategies according to the test results.

The above-mentioned audit is just an example of evolved ERAS in our specialty.

We need to be more proactive in identifying specific pathways of care or surgical strategies tailored to the risk profile of our patients.

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