Implementation of an ERAS program in patients undergoing thoracic surgery at a third-level university hospital. An ambispective cohort study.

(Short title: ERAS implementation in thoracic surgery)

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Statistical analysis

We analyzed outcomes depending on whether the patient belonged to the ERAS program or the retrospective standard cohort. The discrete and continuous variables were described as number and percentage and median (interquartile range [IQR]) and their differences analyzed using the Pearson test or the Wilcoxon rank-sum tests. Subsequently, according to the adherence rate to ERAS items (regardless of whether the patients belonged to the ERAS or the retrospective standard cohort), We performed a multivariate logistic analysis to study the association of complication rates, readmission or pain with ERAS adherence, clinical and demographic data, presenting the results in forest plots as odds ratio with 95% confidence interval. Similarly, we used Cox regression for multivariate analysis of length of stay, presenting the results in forest plot as hazard ratio with 95% confidence interval. To avoid errors by multiple comparisons, we calculated the respective q-value for each p-value to maintain a false discovery rate below 5%[15]. We considered comparisons in which p-value and q-value were below .05 as being statistically significant.

RESULTS

No patient declined inclusion in the study. The demographic characteristics and comorbidities of the patients are shown in Table 1. The two cohorts were not totally homogeneous, with a higher number of patients with hypertension in the standard cohort [26 (52%) vs ERAS 15 (30%), p = 0.03] and chronic obstructive pulmonary disease [12 (24%) vs ERAS 4 (8%), p = 0.02]. Although the number of patients with ASA class > 2 was higher in the standard group [26 (52%) vs ERAS 15 (30%)], we found no difference between the cohorts in Charlson's comorbidity index. We included these three items, along with age and sex in the subsequent multivariate analyses.

Data on ERAS adherence and compliance for each of the protocol items are shown in Table 2. Adherence to the ERAS protocol was significantly higher in the prospective than in the retrospective cohort [Median: Standard 0.29 (0.14-0.43) vs ERAS 0.71 (0.57-0.82), p < 0.001]. The VATS approach was greater in the ERAS group [29 (58%) vs Standard 11 (22%), p < 0.001], and the number of patients who ambulated on the first postoperative day [40 (80%) vs Standard 0 (0%), p < 0.001], but no difference was found in the use of regional analgesia. Also, the times to oral intake and removal of the urethral catheter were lower in the ERAS group [Median (h): Standard 24 (24-24) vs ERAS (6-7.5), and Standard 48 (24-48) vs ERAS 19 (6-24), respectively).

The primary and secondary results are shown in Table 3. We found no difference between the two groups in either surgical complications [Standard 18 (36%) vs 12 (24%], p =0.19], non-surgical complications [Standard 21 (42%) vs 12 (24%], p =0.06] or length of stay [Median (days): Standard 4 (3-6) vs 4 (3-5], p =0.19], and the ERAS group was significantly lower only in its readmission rate [Standard 15 (30%) vs 6 (12%], p =0.03]. No deaths were recorded in the ERAS group, compared to two deaths in the retrospective cohort.

Multivariate analyses are shown in Figures 1, 2 and 3. ERAS adherence was the only factor associated with a reduction in surgical complications [OR (95%CI) = 0.02 (0.00, 0.59), p = 0.03, Figure 1A], and postoperative pain [OR (95%CI) = 0.01 (0.00, 0.28), p = 0.01, Figure 2B]. It was also associated with a lower readmission rate [OR (95%CI) = 0.01 (0.00, 0.24), p = 0.007, Figure 2A] and an increased likelihood of discharge from the hospital [HR (95%CI) = 18.5 (4.39, 78.4), p < 0.001, Figure 3]. The thoracic epidural analgesia was the only factor that showed an association with lower rates of non-surgical complications [OR (95%CI) = 0.09 (0.01, 0.49), p = 0.008, Figure 1B]. It was also associated with lower rates of postoperative pain [OR (95%CI) = 0.16 (0.03, 0.86), p = 0.03, Figure 2A] and increased probability of discharge from the hospital [HR (95%CI) = 3.14 (1.39, 7.07), p = 0.006, Figure 3]. The intercostal blockade also increased the latter likelihood [HR (95%CI) = 7.55 (2.94, 19.3), p < 0.001, Figure 3].

No significant p-value was rejected after the calculation of q-value within the multiple comparability study.