Original Article

Impact of the duration of corticosteroid treatment for postoperative acute lung injury following lung cancer surgery

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Background: Acute lung injury (ALI) is one of the most serious pulmonary complications following lung resection. Despite the known beneficial effects of corticosteroid treatment for postoperative ALI, limited data are available regarding corticosteroid treatment duration. This study aimed to evaluate the beneficial effects of a short-course corticosteroid in patients with postoperative ALI following lung resection surgery for lung cancer.

Methods: This retrospective observational study included 91 patients who were treated with corticosteroids for postoperative ALI among 7,317 patients who underwent lung resection surgery for lung cancer between January 2017 and March 2021. Patients were divided into two groups, short (≤14 days, n=31) and long (≥15 days, n=60) courses, on the basis of corticosteroid treatment duration.

Results: While similar baseline characteristics were observed between the two groups, the short-course group had a higher corticosteroid loading dose than the long-course group; however, the cumulative dose in the first 7 days was not different between the two groups. Overall, in-hospital mortality rates were 3.2% and 26.7% in the short- and long-course groups, respectively (P=0.01). Moreover, the long-course group had higher additional intensive care unit (ICU) admission (32.3% *vs.* 60.0%, P=0.02) and persistent air leakage (0% *vs.* 13.3%, P=0.09). In the logistic regression analysis, corticosteroid treatment duration was marginally associated with in-hospital mortality [adjusted odds ratio (OR), 9.03; 95% confidence interval (CI): 0.96–84.9, P=0.054].

Conclusions: Short-course corticosteroid treatment was associated with a lower rate of surgical site complications, additional ICU admission, and in-hospital mortality, which suggests the necessity of efforts for reducing the total duration by weighing the benefits and adverse effects of corticosteroid treatment for postoperative ALI.

Keywords: Lung neoplasm; operative procedure; acute lung injury (ALI); acute respiratory distress syndrome (ARDS); glucocorticoid

Submitted Aug 11, 2024. Accepted for publication Nov 17, 2024. Published online Jan 22, 2025.
doi: 10.21037/jtd-24-1295
View this article at: https://dx.doi.org/10.21037/jtd-24-1295

Introduction

Postoperative acute lung injury (ALI), a major complication of lung resection surgery, is marked by the abrupt onset of hypoxemia and lung infiltrates without an identifiable cause (1). While ALI is a relatively rare complication (1-5), it is associated with high mortality rates, particularly in patients who underwent pneumonectomy (6).

Postoperative ALI shares similar clinical and radiological features with acute respiratory distress syndrome (ARDS) (7-9). Consequently, treatment strategies for postoperative ALI are aligned with those for ARDS, including general supportive care, lung protective ventilation and restrictive fluid therapy (10). Unfortunately, there is currently no pharmacologic therapy proven to improve short- or long-term survival in patients with ARDS (10). However, corticosteroids may be an effective approach for reducing the risk of death in patients with ARDS (11). Nonetheless, the use of corticosteroids for treating postoperative ALI following lung resection remains controversial (12). Some studies have suggested that corticosteroids suppress the production of cytokines, such as IL-6 and TNF-α in monocytes and macrophages, thereby reducing inflammatory and oxidative responses (12-14). Early administration of low-dose corticosteroids has been shown to be beneficial for patients with post-operative ALI after lung resection surgery (12,15). However, there is limited data on the optimal duration of corticosteroid treatment in this patient population. In addition, concerns exist regarding the potential negative impact of corticosteroids on wound healing in post-resection patients (16).

Therefore, this study aimed to evaluate the beneficial effects of a short-course corticosteroid treatment compared with long-course treatment in patients with postoperative ALI following lung resection surgery for lung cancer. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1295/rc) (17).

Highlight box

Key findings

- For patients with postoperative acute lung injury (ALI), short-course corticosteroid treatment was associated with lower rates of surgical site complications, additional intensive care unit admissions, and in-hospital mortality.

What is known and what is new?

- Data on the optimal duration of corticosteroid treatment in patients with ALI following lung resection surgery is limited
- This study demonstrates the beneficial effects of a short-course corticosteroid regimen compared to a long-course regimen in patients with postoperative ALI.

What is the implication, and what should change now?

- In patients with postoperative ALI, efforts should be made to reduce the total duration of corticosteroid treatment by carefully weighing the benefits and adverse effects of this therapy.

Methods

Study design and population

Data was collected from all consecutive patients diagnosed with postoperative ALI after lung resection surgery for lung cancer at Samsung Medical Center, a large tertiary care hospital in Seoul, South Korea, between January 2017 and March 2021. This retrospective study adhered to the Declaration of Helsinki (as revised in 2013) and was approved by the institutional review board of Samsung Medical Center (SMC 2021-06-038). Informed consent was waived due to the retrospective observational nature of the study. Furthermore, patient information was anonymized and de-identified before analysis.

Postoperative ALI diagnosis

During the study period, most patients who developed acute hypoxemic respiratory distress within one week following lung resection surgery underwent chest computed tomography (CT) for the diagnosis of postoperative ALI and subsequently early corticosteroid treatment was initiated based on our previous study (15). Postoperative ALI was diagnosed by (I) sudden onset of respiratory distress within 7 days postoperatively; (II) diffuse pulmonary infiltrates on chest CT scan; (III) impaired oxygenation requiring oxygen supplementation; and (IV) symptoms not fully explained by pulmonary edema of cardiac origin or fluid overload (15). The study excluded patients with respiratory distress caused by factors other than post-operative ALI, such as respiratory or systemic infections.

Corticosteroid treatment

During the study period, a multidisciplinary team comprising thoracic surgeons and pulmonary intensivists managed postoperative ALI. Corticosteroids were administered to patients diagnosed with post-operative ALI

who were experiencing hypoxemia. At our institution, a loading dose of 1–2 mg/kg methylprednisolone followed by infusion of 1 mg/kg/day from days 1 to 7, 0.5 mg/kg/day from days 8 to 14, 0.25 mg/kg/day from days 15 to 18, and 0.125 mg/kg/day from days 19 to 21 have been recommended since 2017 (15). However, maintenance and tapering regimen after loading dose and total treatment duration were determined at the discretion of the attending physician. Regarding corticosteroid treatment duration, ≤14 and ≥15 days were defined as the short- and long-course groups, respectively.

Data collection

Clinical data were collected through review of the extracted electronic medical records, including demographic characteristics, body mass index, smoking history, and comorbidities. Furthermore, cancer-related data including pathological stage and history of neoadjuvant treatment were recorded. In addition, perioperative data including predicted postoperative pulmonary function, side of resection, type of surgery, approach type, total operation time, one-lung ventilation (OLV) time, plateau airway pressure during OLV, average tidal volume during OLV, and intraoperative volume infusion were extracted. Moreover, the following data regarding treatment modalities following ALI development were extracted: mechanical ventilation, vasopressor, tracheostomy, continuous renal replacement therapy, and extracorporeal membrane oxygenation, as well as additional admission to the intensive care unit (ICU). Regarding complications, surgical site complications such as persistent air leakage and bleeding and corticosteroid treatment-related complications such as arrhythmia, delirium, and superimposed infection were evaluated.

All patients were followed up until hospital discharge. Therefore, in-hospital mortality was the main outcome measure, and complications and length of hospital stay were the secondary outcome measures.

Statistical analyses

All data are presented as number (percentages) for categorical variables and median [interquartile ranges (IQRs)] for continuous variables. The baseline characteristics and outcome measures of interest were compared between the short- and long-course groups using the Mann-Whitney *U*-test for continuous variables and chi-square or Fisher's exact test for categorical variables. The association between corticosteroid treatment duration and in-hospital mortality was evaluated using multiple logistic regression analysis adjusting for variables with a P value of <0.25 on univariate analyses (18), as well as a priori variables that were clinically relevant (19). Data are presented as adjusted odds ratios (ORs) with 95% confidence intervals (CIs). All tests were two-sided, and P values of <0.05 were considered statistically significant. Statistical analyses were performed using R software (version 4.1.0; R Development Core Team, Vienna, Austria).

Results

During the study period, 7,317 patients underwent lung resection surgery for lung cancer, of whom 91 (1.24%) developed ALI (*Figure 1*). The baseline characteristics of the study patients are presented in *Table 1*. Over 90% of the patients were male and ever-smokers, with a mean age of 68 years. Hypertension (31.9%) was the most common comorbidity, followed by chronic obstructive pulmonary disease (23.1%). Fourteen patients (15.4%) who had undergone neoadjuvant treatment before surgery were included.

When divided into two groups according to corticosteroid treatment duration, 31 (34%) patients received short-course corticosteroid treatment with a median of 8.0 (IQR, 5.0–9.5) days, and the remaining 60 (66%) patients received long-course treatment with a median of 28.0 (IQR, 21.0–32.5) days. Comparisons of the baseline characteristics of the two groups are shown in *Table 1*. No significant differences in age, sex, smoking history, or underlying comorbidities were observed. However, serum C-reactive protein levels were higher in the long-course group (13.2±6.7 *vs.* 17.0±7.9 mg/dL, P=0.02).

The comparisons of the perioperative characteristics are presented in *Table 2*. However, no significant differences were noted between the two groups, except for a median duration of total operation time that was more likely to be longer in the long-course group (180.0 *vs.* 213.5 min, P=0.06). Furthermore, a trend toward more minimally invasive surgery was noted in the short-course group (48.4% *vs.* 31.7%, P=0.18). However, the median duration of OLV was not different between the two groups (104.0 *vs.* 126.5 min, P=0.20).

Corticosteroid treatment was initiated after a median of 4.0 (IQR, 3.0–6.0) days postoperatively. The comparisons of dose and duration of corticosteroid treatment are summarized in *Table 3*. The short-course group had a higher

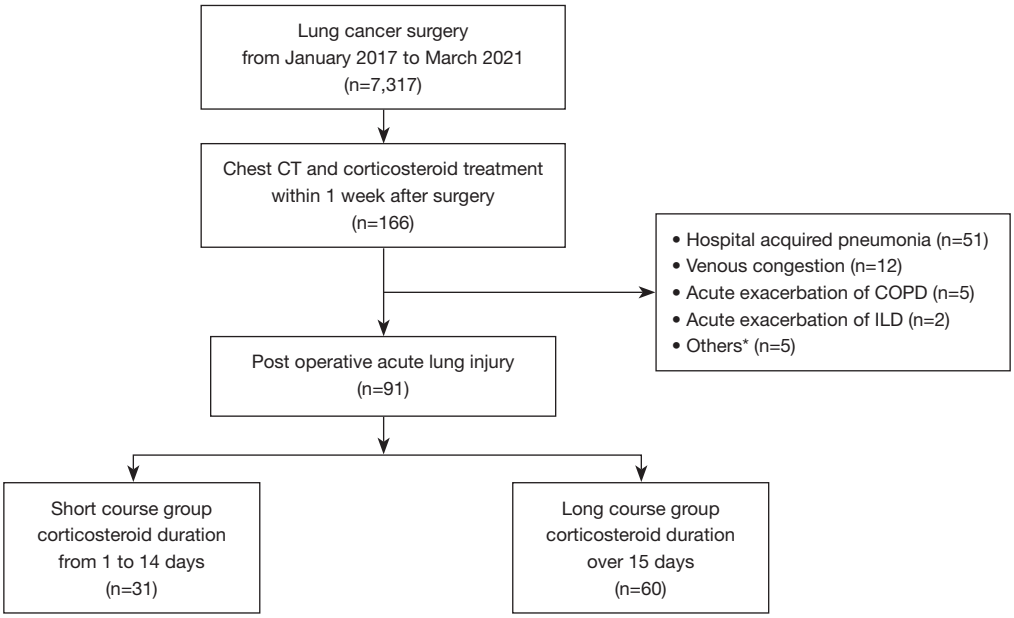

Figure 1 Scheme of group distribution. *, others include diffuse alveolar hemorrhage (n=2), lung infarction (n=1), pleurodesis-associated lung injury (n=1), and radiotherapy-induced pneumonitis (n=1). CT, computed tomography; COPD, chronic obstructive pulmonary disease; ILD, interstitial lung disease.

loading dose than the long-course group (120.0 *vs.* 85.0 mg, P=0.04). However, the cumulative dose in the first 7 days was not different between the two groups.

Overall, 17 (18.7%) patients died during hospitalization, and the in-hospital mortality rates were 3.2% and 26.7% in the short- and long-course groups, respectively (P=0.01) (*Table 4*). Further, additional ICU admission required for postoperative ALI was higher in the long-course group (60.0%) than that in the short-course group (32.3%) (P=0.02). Although surgical site complications such as persistent air leakage were more likely to develop in the long-course group (0% *vs.* 13.3%, P=0.09), complications during corticosteroid treatment were not different between the two groups.

The results of univariate and multivariate analyses with logistic regression models for in-hospital mortality are presented in *Table 5*. In-hospital mortality was associated with the type of surgery, serum C-reactive protein and oxygenation levels at the time of diagnosis with postoperative ALI, and corticosteroid treatment duration. However, after adjusting for potential confounding factors, corticosteroid treatment duration was marginally associated with in-hospital mortality (adjusted OR, 9.03; 95% CI: 0.96–84.9; P=0.054).

Discussion

This observational study compared the efficacy of short-course and long-course corticosteroid treatments in patients with post-operative ALI after lung resection surgery. Patients treated with a short-course regimen experienced lower rates of surgical site complications, additional ICU admissions, and in-hospital mortality.

Postoperative ALI following lung resection surgery has been recognized as a potential complication reported as post-pneumonectomy pulmonary edema (20). However, ALI can also occur even after lobectomy or less extensive resections (15). A recent population-based cohort study using the national health insurance claims data in Korea reported that 0.5% of the patients who underwent lung cancer surgery experienced postoperative fatal respiratory events, such as ARDS (ICD-10 code J80) or respiratory failure (ICD-10 code J96), in which a relatively large number of sublobar resection surgeries (25.8%) but only 2.9% of pneumonectomy were included (21). In the present study, the overall prevalence rate of ALI was 1.2%, which is relatively low compared with previous studies that reported rates of 4–10%, 3–5%, and 1–4% for pneumonectomy, bi-lobectomy or lobectomy, and sublobar resection (1-5),

Table 1 Baseline characteristics of the study population

Baseline characteristics	Total (n=91)	Short-course group (n=31)	Long-course group (n=60)	P value
Age, years	68.0 (64.0–72.0)	65.0 (63.0–72.0)	68.0 (64.5–72.5)	0.39
Sex, male	84 (92.3)	29 (93.5)	55 (91.7)	>0.99
Ever-smoker[†]	82 (90.1)	28 (90.3)	54 (90.0)	>0.99
Body mass index, kg/m^2	24.4 (22.5–26.0)	25.1 (23.1–26.1)	23.8 (22.2–25.7)	0.16
Comorbidities				
Chronic obstructive pulmonary disease	21 (23.1)	6 (19.4)	15 (25.0)	0.73
Interstitial lung disease	6 (6.6)	0 (0.0)	6 (10.0)	0.16
Hypertension	29 (31.9)	12 (38.7)	17 (28.3)	0.44
Other malignancies	13 (14.3)	2 (6.5)	11 (18.3)	0.22
Pulmonary function test				
FVC, L	3.6 (3.1–4.0)	3.7 (3.2–4.0)	3.5 (3.0–4.0)	0.68
FEV_1, %	82.0 (75.0–89.5)	81.0 (76.5–86.0)	82.5 (75.0–93.5)	0.41
DL_{CO}	71.0 (64.0–81.0)	70.0 (64.0–81.0)	71.0 (63.5–81.0)	0.84
PPO-FEV_1	61.6 (51.7–69.9)	61.9 (56.4–67.1)	61.4 (51.5–72.2)	0.69
PPO-DL_{CO}	52.9 (46.2–62.8)	52.1 (45.5–63.0)	53.7 (46.2–62.8)	0.88
Neoadjuvant treatment	14 (15.4)	5 (16.1)	9 (15.0)	>0.99
From surgery to ALI diagnosis, days	4.0 (3.0–5.0)	4.0 (2.0–5.0)	4.0 (3.0–5.0)	0.34
Laboratory data				
C-reactive protein, mg/dL	16.4 (9.8–20.2)	13.1 (7.3–18.3)	17.0 (10.6–23.1)	0.04
Creatinine, mg/dL	0.8 (0.6–0.9)	0.8 (0.7–0.9)	0.8 (0.6–0.9)	0.43
Oxygenation status at the day of diagnosis				
SpO_2 (%)	92.0 (88.0–94.0)	91.0 (87.5–93.5)	92.0 (88.0–94.0)	0.43
FiO_2	0.2 (0.2–0.3)	0.2 (0.2–0.3)	0.3 (0.2–0.4)	0.18
SpO_2/FiO_2 ratio	366.7 (233.8–438.1)	414.3 (297.1–440.5)	330.4 (223.8–438.1)	0.24

Data are presented as number (%) or median (interquartile range). The clinical characteristics of the study patients are based on the time of diagnosis. [†], includes current and former smokers. FVC, forced vital capacity; FEV_1, forced expiratory volume in 1 s; DL_{CO}, diffusing capacity for carbon monoxide; PPO, predicted postoperative; ALI, acute lung injury; SpO_2, oxygen saturation; FiO_2, fraction of inspired oxygen.

respectively, although we screened with CT scans patients who developed acute hypoxemic respiratory distress within 7 days following lung cancer surgery. This relatively low prevalence may be partly explained by the small number of pneumonectomy cases (6), and our lung protective ventilation strategy during surgery (22).

While no drugs have been identified to directly target the underlying pathophysiological mechanisms of ARDS (10), the role of corticosteroids in ARDS management has been thoroughly investigated (11). The beneficial effects of corticosteroids in ARDS management are in line with the hypothesis that early corticosteroid treatment can suppress fibroproliferation, an early response to lung injury (23). In addition to the anti-inflammatory effect, other potentially desired actions of corticosteroids including antioxidant, pulmonary vasodilation, and anti-edematous effects have been suggested (24). In our previous study, early administration of corticosteroids in patients with postoperative ALI following lung cancer surgery was associated with greater improvement in lung injury (15).

Table 2 Perioperative characteristics of the study population

Perioperative characteristics	Total (n=91)	Short-course group (n=31)	Long-course group (n=60)	P value
Pathological stage				0.15
I	36 (39.6)	16 (51.6)	20 (33.3)	
II	34 (37.4)	7 (22.6)	27 (45.0)	
III	20 (22.0)	7 (22.6)	13 (21.7)	
IV	1 (1.0)	1 (3.2)	0 (0.0)	
Side of resection				0.20
Right	51 (56.0)	14 (45.2)	37 (61.7)	
Left	40 (44.0)	17 (54.8)	23 (38.3)	
Surgical approach				0.18
Open thoracotomy	57 (62.6)	16 (51.6)	41 (68.3)	
Minimally invasive surgery	34 (37.4)	15 (48.4)	19 (31.7)	
Type of surgery				0.36
Lobectomy	73 (80.2)	27 (87.1)	46 (76.7)	
Bi-lobectomy or pneumonectomy	18 (19.8)	4 (12.9)	14 (23.3)	
Total operation time, min	203.0 (174.0–249.5)	180.0 (154.5–242.5)	213.5 (181.5–251.0)	0.06
Intraoperative volume of infusion, mL	1,000 (800–1,375)	950 (750–1,250)	1,100 (800–1,425)	0.46
One lung ventilation				
Total one lung ventilation time, min	123.0 (93.0–160.5)	104.0 (86.0–158.5)	126.5 (101.0–160.5)	0.20
Plateau airway pressure, cmH_2O	16.0 (14.0–17.5)	16.0 (15.0–18.0)	15.0 (14.0–17.0)	0.11
Average tidal volume, mL	325.0 (300.0–366.0)	330.0 (300.0–385.5)	325.0 (302.5–360.0)	0.60

Data are presented as number (%) or median (interquartile range). The clinical characteristics of the study patients are based on the time of diagnosis.

Table 3 Corticosteroid treatment

Variables on corticosteroid treatments	Total (n=91)	Short-course group (n=31)	Long-course group (n=60)	P value
Time interval from surgery to corticosteroid initiation, days	4.0 (3.0–6.0)	4.0 (3.0–6.0)	4.5 (3.0–6.0)	0.47
Total corticosteroid duration, days	21.0 (9.5–28.0)	8.0 (5.0–9.5)	28.0 (21.0–32.5)	<0.001
Corticosteroid dose, mg				
Loading dose	120.0 (67.0–120.0)	120.0 (120.0–122.5)	85.0 (60.0–120.0)	0.04
Cumulative dose in the first 7 days	485.0 (420.0–685.0)	480.0 (345.0–722.5)	490.0 (420.0–685.0)	0.36
Total dose	945.0 (557.0–1,321.5)	510.0 (373.5–877.5)	1,096.5 (802.5–1,722.5)	<0.001

Data are presented as median (interquartile range). The clinical characteristics of the study patients are based on the time of diagnosis.

Table 4 Comparison of clinical outcomes in patients receiving short- and long-course corticosteroid treatment

Clinical outcomes	Total (n=91)	Short-course group (n=31)	Long-course group (n=60)	P value
Additional ICU admission	46 (50.5)	10 (32.3)	36 (60.0)	0.02
Mechanical ventilation	24 (26.4)	5 (16.1)	19 (31.7)	0.17
Tracheostomy	8 (8.8)	1 (3.2)	7 (11.7)	0.33
Renal replacement therapy	3 (3.3)	0 (0.0)	3 (5.0)	0.51
Extracorporeal membrane oxygenation	1 (1.1)	0 (0.0)	1 (1.7)	>0.99
Complications during corticosteroid treatment				
Arrhythmia	10 (11.0)	1 (3.2)	9 (15.0)	0.17
Delirium	10 (11.0)	3 (9.7)	7 (11.7)	>0.99
Superimposed infection	16 (17.6)	2 (6.4)	14 (23.4)	0.12
Surgical site complications				0.09
Persistent air leakage	8 (8.8)	0 (0.0)	8 (13.3)	
Bleeding	2 (2.2)	1 (3.2)	1 (1.7)	
Total length of admission, days	18.0 (14.0–28.0)	15.0 (11.5–17.0)	21.0 (16.0–32.0)	<0.001
Total length of ICU stay, days	3.0 (1.0–10.0)	1.0 (1.0–5.0)	4.0 (1.0–13.5)	0.01
ICU mortality	12 (13.2)	0 (0.0)	12 (20.0)	0.01
In-hospital mortality	17 (18.7)	1 (3.2)	16 (26.7)	0.01

Data are presented as number (%) or median (interquartile range). The clinical characteristics of the study patients are based on the time of diagnosis. ICU, intensive care unit.

However, information on the optimal therapy for postoperative ALI following lung resection surgery is limited.

Furthermore, there are concerns about the risk that may be caused by the side effects of corticosteroids, which may offset the benefits, particularly in the postoperative period. Corticosteroids affect all major steps of the wound healing process, specifically the inflammatory, proliferative (tissue formation), and tissue remodeling phases (25,26). Therefore, the same anti-inflammatory effect of corticosteroids that results in inhibiting the fibroproliferation of lung injury could be harmful to wound healing in the postoperative period. From the first study suggesting the beneficial effect of early corticosteroid treatment for postoperative ALI (12), the main surgical site complication in patients treated with corticosteroids was persistent air leakage, which is consistent with a previous study identifying the association between corticosteroids and persistent air leaks (27). A recent observational study evaluating risk factors for persistent air leak following lung resection surgery showed that systemic corticosteroid use as a major risk factors for its occurrence (28). Although the incidence of persistent air leak after lung resection surgery varies, accounting for 20–33% (29), it is associated with greater pulmonary morbidity including atelectasis, pneumonia, or empyema (30), along with longer hospital stay, a higher incidence of ICU readmission and an increased in-hospital mortality rate (31). In the present study, persistent air leak was more likely to develop in the long-course group, although the cumulative dose of corticosteroids in the first 7 days was not different. This may be partly responsible for the observed significant association between corticosteroid treatment duration and in-hospital mortality.

While this study aimed to assess the association between the duration of corticosteroid treatment and in-hospital mortality, due to the multifaceted nature of postoperative clinical situations, a multivariate analysis was conducted. Despite this comprehensive analysis, although the type of surgery, serum C-reactive protein and oxygenation levels at the time of diagnosis with postoperative ALI, and corticosteroid treatment duration were associated with in-hospital mortality in univariate analysis, no individual factor

Table 5 Association between the duration of corticosteroid treatment and in-hospital mortality

Variables	Univariate		Multivariate	
	OR (95% CI)	P value	OR (95% CI)	P value
Age	1.06 (0.98–1.14)	0.14	1.05 (0.96–1.15)	0.26
Ever-smoker[†]	0.78 (0.15–4.16)	0.77		
Body mass index, kg/m^2	0.95 (0.79–1.15)	0.63		
Comorbidities				
Chronic obstructive pulmonary disease	1.03 (0.30–3.58)	0.96		
Interstitial lung disease	0.86 (0.09–7.90)	0.89		
PPO-FEV_1	0.99 (0.95–1.03)	0.56		
PPO-DL_{CO}	1.00 (0.96–1.04)	0.85		
Neoadjuvant treatment	1.97 (0.53–7.25)	0.30		
Side of resection				
Right	Ref.			
Left	0.64 (0.21–1.92)	0.42		
Surgical approach				
Open thoracotomy	Ref.		Ref.	
Minimally invasive surgery	0.18 (0.04–0.82)	0.02	0.22 (0.04–1.16)	0.07
Type of surgery				
Lobectomy	Ref.			
Bi-lobectomy or pneumonectomy	1.32 (0.37–4.66)	0.66		
One lung ventilation				
Total one lung ventilation time, min	0.99 (0.98–1.01)	0.37		
Plateau airway pressure, cmH_2O	1.16 (0.93–1.46)	0.19		
Average tidal volume, mL	1.01 (1.00–1.02)	0.25		
C-reactive protein, mg/dL	1.08 (1.01–1.17)	0.02	1.01 (0.93–1.10)	0.78
SpO_2/FiO_2 ratio	0.99 (0.99–1.00)	0.006	0.99 (0.99–1.00)	0.08
Long-course corticosteroid treatment	10.91 (1.37–86.70)	0.02	9.03 (0.96–84.90)	0.054

[†], includes current and former smokers. OR, odds ratio; CI, confidence interval; PPO, predicted postoperative; FEV_1, forced expiratory volume in 1 s; DL_{CO}, diffusing capacity for carbon monoxide; SpO_2, oxygen saturation; FiO_2, fraction of inspired oxygen.

reached statistical significance after adjusting for potential confounding factors. This may represent the complex interplay of diverse clinical variables, along with the effect of corticosteroid duration. A standardized corticosteroid treatment regimen for postoperative ALI has not been established. While various regimens have been proposed and used (11), including a common approach of 1–2 mg/kg intravenous methylprednisolone for 14 days followed by a 2-week taper, the optimal duration of treatment remains unclear (32,33). However, the optimal corticosteroid treatment duration is uncertain and has not been subjected to controlled trials. Recent studies suggest that a shorter 10-day course of dexamethasone may reduce mechanical ventilation time and overall mortality in patients with moderate-to-severe ARDS (34). This is the first study to show the clinical benefit of a short course of corticosteroid treatment for postoperative ALI. Patients in this study were treated according to the standardized corticosteroid

protocol (15); however, the total treatment duration was determined at the discretion of the attending physician. This made comparing the efficacy and safety of short and long courses of treatment possible. In our study, as the cumulative dose of corticosteroids in the first 7 days was similar, the primary difference between the treatments was the corticosteroid tapering schedule, that is duration and total cumulative dosage of corticosteroid treatment. Our findings suggest that high-dose corticosteroids can be tapered over a shorter period of 10 days, as indicated by a previous study (34). Nevertheless, further prospective studies are needed to confirm these findings.

To fully appreciate our results, however, the limitations of this study should be acknowledged. First, considering the observational nature of this study, selection bias may have influenced the significance of our findings. Moreover, the baseline characteristics were not evenly distributed between short and long course treatment groups, although adjusted multivariate analysis was used to address this. However, the retrospective nature of the study inherently limits our ability to fully account for reverse causality. Given the case-by-case nature of decision on steroid therapy, clinicians' inclination to administer prolonged steroid therapy to patients with more severe clinical conditions may have contributed to a higher rate of postoperative complications, regardless of the duration of steroid treatment. However, considering the rarity and severe, often fatal outcomes associated with postoperative ALI, a retrospective approach may be the most reasonable approach to investigate postoperative ALI. Second, we were unable to confirm that all patients who developed acute hypoxemic respiratory distress within 1 week following lung resection surgery were screened for the postoperative ALI. Patients with more severe illness may have been excluded from chest CT scans, even if ALI was highly suspected. Additionally, data on the number of patients who refused further evaluation for suspected ALI was not available from medical records during the study period. Third, the classical definition of ALI, that is, an impaired PaO_2/FiO_2 ratio of <300 mmHg by arterial blood gas analysis, was not used in this study. This resulted in the inclusion of less severe cases than in previous studies. However, as much as postoperative ALI is a fatal complication following lung resection surgery that requires careful attention from clinicians and should be immediately managed, we believe that including these cases would be clinically meaningful. Fourth, despite a large sample size of over 7,000 patients, the low incidence of postoperative ALI limited our statistical power, requiring future multicenter approach with larger sample sizes to further investigate the factors associated with this condition. Finally, this study was conducted at a single, high-volume lung cancer surgery center in Korea, which may limit the generalizability of our findings to other institutions with different patient populations and resource availability.

In addition to further identifying the benefit of corticosteroid treatment for postoperative ALI following lung resection surgery, this study suggests corticosteroid treatment duration should be shortened to reduce surgical site complications. However, to confirm these observations, further evaluation with a prospective randomized controlled study is required.

Conclusions

Short-course corticosteroid therapy demonstrated benefit in postoperative ALI patients, indicating a need to reduce the total duration of corticosteroid treatment by carefully weighing the benefits and risks of this therapy.

Acknowledgments

The abstract has been presented at the 26th Congress of the Asian Pacific Society of Respirology Above and Beyond (17–20 November 2022, Seoul, Korea) as a poster.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1295/rc

Data Sharing Statement: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1295/dss

Peer Review File: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1295/prf

Funding: This work was supported by a Samsung Medical Center grant (No. OTA2202901).

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1295/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all

aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The institutional review board of Samsung Medical Center approved the review and publication of information obtained from the patients' records (SMC 2021-06-038). Informed consent was waived owing to the retrospective observational nature of the study.

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Cite this article as: Zo S, Lee J, Jeon YJ, Kim HK, Jeon K. Impact of the duration of corticosteroid treatment for postoperative acute lung injury following lung cancer surgery. J Thorac Dis 2025;17(1):220-230. doi: 10.21037/jtd-24-1295