ORIGINAL RESEARCH

Correlation Between Pain Intensity and Quality of Recovery After Video-Assisted Thoracic Surgery for Lung Cancer Resection

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Purpose: The Quality of Recovery-15 (QoR-15) questionnaire provides a multifaceted assessment of postoperative recovery, and the resulting score is recommended as an endpoint in clinical studies focused on postoperative pain. We aimed to investigate the correlation between the QoR-15 score and postoperative pain intensity in surgical patients.

Patients and Methods: Adult patients who underwent video-assisted thoracoscopic surgery (VATS) for lung cancer resection and were enrolled in a prospective registry or in a previous prospective study were included in this study. Baseline and perioperative data, including the results of assessment using the Korean version of the QoR-15 (QoR-15K) questionnaire at 48 hours postoperatively, were collected from the database. Correlations between the QoR-15K total score, questionnaire dimensions, and postoperative pain intensity at 48 hours postoperatively were determined using the Spearman correlation coefficient (ρ).

Results: We analyzed a total of 137 eligible patients. Significant negative correlations were noted between the QoR-15K total score and pain intensity at rest ($\rho = -0.45$, 95% confidence interval [CI]: $-0.57 - -0.31$, $P < 0.001$) and during coughing ($\rho = -0.55$, 95% CI: $-0.65 - -0.42$, $P < 0.001$) at 48 hours postoperatively. The pain dimension and pain intensity at 48 hours postoperatively showed significant correlations with physical comfort, emotional state, and physical independence dimensions. Multivariable logistic regression revealed a significant negative association between the pain score at 24 hours postoperatively and good or excellent postoperative recovery.

Conclusion: The results support the impact of postoperative pain on the overall postoperative quality of recovery in patients who underwent VATS for lung cancer resection. Moreover, the QoR-15K score may be considered as a primary endpoint in clinical studies on postoperative pain control.

Keywords: pain, postoperative, patient-reported outcome measures, perioperative care, perioperative medicine, thoracic surgery, video-assisted

Introduction

Improving postoperative recovery is a major goal for perioperative clinicians. Postoperative recovery has been traditionally evaluated based on physiological parameters, postoperative morbidity, length of hospital stay, and mortality. However, these indicators are not similar to those indicating postoperative recovery from the patients' perspective.[1] Further, with the advances in perioperative management, recognizing the substantial effects of new treatments with these conventional indicators is becoming difficult.[2]

Several assessment tools have been developed to quantitatively evaluate postoperative recovery, considering its multi-dimensional aspects.[3] Among them, the Quality of Recovery-15 (QoR-15) questionnaire, a short form of the QoR-40, can be used for a comprehensive assessment of postoperative recovery,[4] and its resulting scores have been recommended as

endpoints in clinical studies focused on patient comfort and pain.[5] Recently, it has been recommended as a standard outcome measure for evaluating postoperative recovery in clinical studies of surgical patients.[6,7] Against this backdrop, recently, the Korean version of the QoR-15 (QoR-15K) questionnaire was validated to assess the quality of recovery in Korean surgical patients.[2]

Postoperative pain is one of the physiological parameters that reflect postoperative recovery, and two among the 15 items of the QoR-15 questionnaire are directly associated with it.[4] Postoperative pain not only causes physical distress in surgical patients, but also affects various factors related to postoperative recovery.[8,9] Severe postoperative pain can significantly impair the achievement of "DrEaMing" (drinking, eating, and mobilizing) after surgery, which is one of the major goals of perioperative management.[10,11] In addition, analgesic methods can affect postoperative recovery through their side effects.[8] Further, severe acute postoperative pain can result in chronic postoperative pain, which can impair the long-term quality of life in surgical patients.[12] Therefore, postoperative pain management is a crucial component in the enhanced recovery after surgery program, which has recently become the standard for perioperative medicine.[13]

Only few studies have examined the relationship between postoperative pain and the quality of postoperative recovery. To the best of our knowledge, only one study has reported a significant negative correlation between postoperative pain intensity and quality of postoperative recovery, evaluated using the QoR questionnaire in the early postoperative period.[14] Since the quality of postoperative recovery has been considered an important endpoint in postoperative pain management,[15] we aimed to investigate their correlation in patients who underwent video-assisted thoracoscopic surgery (VATS) for lung cancer resection. In addition, we also aimed to investigate the correlation between postoperative pain intensity and other dimensions of the QoR-15K questionnaire, except the pain dimension.

Materials and Methods
Study Design and Population
The present study was approved by the institutional review board (IRB) of Seoul National University Hospital, Seoul, Korea (No. 2209-077-1358) and executed in compliance with the Declaration of Helsinki. The need for informed consent was waived in this study due to its retrospective design that involved using prospectively collected anonymized registry data or previously collected prospective anonymized data on VATS for lung cancer resection.[16] The prospective registry used in this study was approved by the IRB of Seoul National University Hospital, Seoul, Korea (No. 2205-059-1322) and consecutive adult patients undergoing VATS for lung cancer resection have been enrolled in this registry since June 2022. The previous randomized controlled trial (RCT) targeted patients who were scheduled for elective VATS for lung cancer resection, and patient recruitment took place from July 2020 to August 2021.[16] Under the monitoring of our institution's Institutional Review Board (IRB), we have complied with all relevant data protection and privacy regulations throughout the duration of this study.

Adult patients (≥ 19 years of age) who underwent VATS for lung cancer resection and enrolled in either the aforementioned registry from June 2022 to August 2022 or the aforementioned RCT[16] were included in the present study. Patients who underwent surgery in areas other than the lungs at the same surgical time, in who unplanned conversion to thoracotomy was performed, or who were not followed-up at 48 hours postoperatively were excluded. Considering a previous study,[2] the Spearman correlation coefficient between postoperative pain intensity and the total score of the QoR-15K questionnaire performed 48 hours postoperatively was assumed to be 0.4. In the planning stage of the study, a sample size of 61 was considered as sufficient to achieve 90% power to detect this level of correlation between the variables, with a two-sided alpha of 0.05. By August 2022, a total of 95 patients who underwent VATS for lung cancer resection were enrolled in the registry, and we judged that the number of patients included in this study should exceed 61, assuming a dropout rate of 30%. However, during the data analysis phase, we decided to include patients from our previous RCT,[16] who had undergone the same surgery, to conduct additional analyses on significant predictors of postoperative recovery evaluated with the QoR-15K questionnaire 48 hours postoperatively. The revised protocol was re-approved by our hospital's IRB.

Perioperative Management
For all patients registered in the prospective registry data, anesthesia induction was performed with the use of propofol, fentanyl, and rocuronium, while sevoflurane was used for anesthesia maintenance. A continuous infusion of remifentanil

was administered selectively according to the attending anesthesiologists. All patients included in the RCT data received total intravenous anesthesia with a target-controlled infusion of propofol and remifentanil.[16] During anesthesia induction, 5 mg of dexamethasone and 0.075 mg of palonosetron were administered intravenously to prevent postoperative nausea and vomiting (PONV) unless contraindicated.

At the end of the surgery, 30 mg of ketorolac or 1 g of acetaminophen, and 50 μg of fentanyl was administered intravenously, and a fentanyl-based intravenous patient-controlled analgesia (IV-PCA) was initiated to the patient. The IV-PCA consisted of fentanyl (20 μg/mL) at a bolus of 1 mL with a lockout interval of 10 minutes and no continuous infusion.[17] Sugammadex was used for the reversal of neuromuscular blockade. After extubation, patients were transferred to the post-anesthesia care unit, where 50 μg of fentanyl was administered intravenously as a rescue analgesic. In the patients enrolled in the RCT, those belonging to the nefopam group received a total of 80 mg of nefopam administered during 24 hours perioperatively.[16]

Ward ambulation and oral intake were permitted after 6 hours postoperatively, and a tramadol/acetaminophen combination tablet (tramadol 75 mg/acetaminophen 650 mg every 12 hours or tramadol 37.5 mg/acetaminophen 325 mg every 6 hours) was routinely administered from the time of resumption of oral intake. During postoperative fasting in the ward, 1 g acetaminophen or 50 mg tramadol was administered intravenously as a rescue analgesic. After oral intake was resumed, 200 mg ibuprofen was administered orally as a first-line rescue analgesic and 5 mg oxycodone as a second-line rescue analgesic. Rescue analgesics were administered according to the attending surgeons' decision.

Data Collection

Demographic, comorbidity, and perioperative data were collected from the registry or RCT database. The QoR-15K questionnaire administration was conducted by research nurses on the day before surgery and 48 hours postoperatively. The score of each dimension of the questionnaire was calculated as the sum of the scores of the following items in parentheses: physical comfort (1st, 2nd, 3rd, 4th, and 13th items), physical independence (5th and 8th items), psychological support (6th and 7th items), emotional state (9th, 10th, 14th and 15th items), and pain (11th and 12th items).[4] In addition, postoperative pain intensity measured by an 11-point numeric rating scale at rest and during coughing at 24 and 48 hours postoperatively, IV-PCA fentanyl consumption during the first 24 hours and 24–48 hours postoperatively, the occurrence of PONV during the first 24 hours and 24–48 hours postoperatively, and administration of rescue analgesics during the first 24 hours and 24–48 hours postoperatively were investigated by the research nurses. Data regarding the occurrence of postoperative complications, graded according to the Clavien–Dindo classification,[18] during hospitalization and the length of hospital stay were also collected.

Statistical Analysis

Descriptive statistical analysis was performed to reveal the demographic and perioperative characteristics. Categorical data are expressed as numbers (percentages) and continuous data as mean (standard deviation) or median (interquartile range [IQR]) values, according to the normality evaluated by the Shapiro–Wilk test. The Hodges–Lehmann method was used to estimate the median differences and their 95% confidence interval (CI) between the pre and postoperative QoR-15K scores. The primary outcome was the correlation between the QoR-15K total score and postoperative pain score at 48 hours postoperatively. The secondary outcomes were the correlations between the scores in each dimension of the QoR-15K and postoperative pain score at 48 hours postoperatively. The Spearman correlation coefficient (ρ) was used to estimate the correlations between the QoR-15K total or dimension's score and postoperative pain score at 48 hours postoperatively. Additionally, we conducted a multivariable binary logistic regression analysis with backward stepwise elimination to assess good or excellent postoperative recovery at 48 hours after surgery. Good or excellent postoperative recovery was defined as a QoR-15K total score of 122 or higher, assessed at 48 hours postoperatively.[19] The analyses included the following variables: female (versus male), age $\geq$ 65 years, American Society of Anesthesiologists physical status 3 (versus 1 or 2), body mass index $\geq$ 25 kg/m^2, current smoker, preoperative QoR-15K < 136, total intravenous anesthesia (versus sevoflurane anesthesia), duration of anesthesia $\geq$ 3 hours, pain score during coughing at 24 hours postoperatively, and PONV during the first 24 hours postoperatively. We arbitrarily defined a poor preoperative state evaluated by the preoperative QoR-15K as a score of less than 136. Considering that movement-evoked pain has a greater impact on postoperative functional recovery than pain at rest,[20] we included the pain score during coughing as

a variable instead of the pain score at rest. Variables with a p-value < 0.2 in the univariable logistic regression analyses were included in the multivariable analyses.

P values less than 0.05 were considered statistically significant, and analyses were conducted using R software version 3.6.1 (R Foundation for Statistical Computing, Vienna, Austria).

Results

Among 94 patients enrolled in the prospective registry from June to August 2022, 69 patients met the inclusion criteria. The remaining 25 patients were excluded as they were discharged before 48 hours postoperatively (n = 16), not present even after several visits for follow-up assessment (n = 5), or underwent thoracotomy (n = 3) or VATS lobectomy with en-bloc chest wall resection (n = 1). Among 90 patients registered in the previous RCT data, a total of 68 patients completed the QoR-15K questionnaire at 48 hours postoperatively and were included in the study. Therefore, a total of 137 patients were included in this study for analyses. Demographics and perioperative characteristics are presented in Table 1. Table 2 presents the postoperative outcomes related to postoperative recovery. There were 11 patients for whom IV-PCA was

Table 1 Patient Demographics and Clinical Characteristics

	N = 137
Female	63 (46.0)
Age, years	66 (60–73)
Height, cm s	161.1 ± 7.7
Weight, kg	62.6 ± 11.1
Body mass index, kg/m²	24.0 (21.9–25.9)
ASA physical status, I/II/III	37 (27.0)/91 (66.4)/3 (6.6)
ECOG performance status scale, 0/1	123 (89.8)/14 (10.2)
Current smoker	23 (16.8)
Type of surgery	
VATS wedge resection	20 (14.6)
VATS segmentectomy	25 (18.2)
VATS lobectomy	92 (67.2)
Propofol-based total intravenous anesthesia	67 (48.9)
Preemptive intercostal nerve block	109 (79.6)
Intraoperative dexamethasone use	136 (99.3)
Intraoperative palonosetron use	136 (99.3)
Intraoperative remifentanil use	79 (57.7)
Intraoperative ketorolac use	123 (89.8)
Intraoperative acetaminophen use	4 (2.9)
Perioperative continuous infusion of nefopam	38 (27.7)
Duration of anesthesia, min	155 (130–175)

Note: Data are presented as the mean ± standard deviation or median (interquartile range) or number (%).
Abbreviations: ASA, American Society of Anesthesiologists; ECOG, Eastern Cooperative Oncology Group; VATS, video-assisted thoracic surgery.

Table 2 Postoperative Outcomes Related to Postoperative Recovery

	N = 137
Pain score at rest, NRS (0–10)	
24 h	3 (2–5)
48 h	2 (1–4)
Pain score during coughing, NRS (0–10)	
24 h	6 (4–8)
48 h	5 (3–6)
Postoperative fentanyl consumption via IV-PCA during the first 48 h, mcg	500 (200–790)
Rescue analgesic use	
0–24 h	46 (33.6)
24–48 h	29 (21.2)
Nausea	
0–24 h	53 (38.7)
24–48 h	32 (23.4)
Vomiting	
0–24 h	18 (13.1)
24–48 h	10 (7.3)
Length of hospital stay, days	7 (5–9)
Postoperative complications, Clavien–Dindo classification, I/II/III or higher	102 (74.5)/18 (13.1)/17 (12.4)

Note: Data are presented as the mean ± standard deviation or median (interquartile range) or number (%).
Abbreviations: NRS, numeric rating scale; IV-PCA, intravenous patient-controlled analgesia.

discontinued due to opioid-related side effects (n = 9) or patient's refusal (n = 2) within 24 hours postoperatively, and in an additional 12 patients, IV-PCA was discontinued for 24–48 hours postoperatively. In addition, one patient underwent emergency re-operation during the hospitalization period due to postoperative bleeding, and one patient died during the hospitalization period due to postoperative acute respiratory distress syndrome. Six patients had unplanned readmission within 30 days postoperatively (wound problem, n = 4; unknown fever, n = 1; and voiding problem, n = 1).

Changes in the QoR-15K total score and in each item before and 48 hours after surgery are summarized in Table 3. The median total QoR-15K score decreased from 148 (IQR: 142–150) before surgery to 123 (IQR: 108–135) at 48 hours postoperatively (median difference: −23, 95% CI: −26 – −20, $P < 0.001$; Table 3). Among all items of the postoperative QoR-15K questionnaire, the 11th item (moderate pain) showed the lowest median score and highest median difference between pre- and postoperative scores (median difference: 5, 95% CI: −5 – −4). Changes in the dimensions of the QoR-15K score before and 48 hours after surgery are summarized in Table 4.

The inter-dimension correlations of the postoperative QoR-15K score and postoperative pain severity at 48 hours postoperatively are presented in Table 5. The QoR-15K score showed significant negative correlations with pain intensity at rest (ρ = −0.45, 95% CI: −0.57 – −0.31, $P < 0.001$) and during coughing at 48 hours postoperatively (ρ = −0.55, 95% CI: −0.65 – −0.42, $P < 0.001$). The pain dimension of the QoR-15K showed a significant correlation with the emotional state, physical comfort, and physical independence dimensions of the QoR-15K as well as pain intensity at rest and during coughing at 48 hours postoperatively.

Table 3 Changes in the Korean Version of the Quality of Recovery-15 (QoR-15K) Questionnaire Scores Before and 48 Hours After Surgery

QoR-15K Items	Preoperative	Postoperative	Median Difference (95% CI)
Total	148 (142–150)	123 (108–135)	−23 (−26 − −20)
1. Able to breathe easy	10 (10–10)	9 (7–10)	−1 (−1 − 0)
2. Been able to enjoy food	10 (10–10)	10 (8–10)	0 (−1 − 0)
3. Feeling rested	10 (10–10)	9 (7–10)	−1 (−1 − 0)
4. Have had a good sleep	10 (10–10)	9 (7–10)	−1 (−1 − 0)
5. Able to look after personal toilet and hygiene unaided	10 (10–10)	10 (8–10)	0 (0–0)
6. Able to communicate with family or friends	10 (10–10)	10 (10–10)	0 (0–0)
7. Getting support from hospital doctors and nurse	10 (10–10)	10 (10–10)	0 (0–0)
8. Able to return to work or usual home activities	10 (10–10)	7 (5–10)	−3 (−4 − −2)
9. Feeling comfortable and in control	10 (10–10)	9 (8–10)	−1 (−2 − 0)
10. Having a feeling of general well-being	10 (10–10)	8 (6–10)	−2 (−3 − −2)
11. Moderate pain	10 (10–10)	5 (3–7)	−5 (−5 − −4)
12. Severe pain	10 (10–10)	8 (5–9)	−2 (−3 − −1)
13. Nausea or vomiting	10 (10–10)	10 (8–10)	0 (−1 − 0)
14. Feeling worried or anxious	10 (8–10)	10 (7–10)	0 (0–0)
15. Feeling sad or depressed	10 (8–10)	10 (8–10)	0 (0–0)

Notes: Data are presented as the median (interquartile range) or median difference (95% CI). Adapted from Stark PA, Myles PS, Burke JA. Development and psychometric evaluation of a postoperative quality of recovery score: the QoR-15. Anesthesiology. 2013;118:1332–1340. Available from: https://pubs.asahq.org/anesthesiology/article/118/6/1332/11456/Development-and-Psychometric-Evaluation-of-a.[21]

Table 4 Changes in the Dimensions of the Korean Version of Quality of Recovery-15 (QoR-15K) Before and 48 Hours After Surgery

QoR-15K Items	Preoperative	Postoperative	Median Difference (95% CI)
Physical comfort (0–50)	50 (48–50)	41 (35–46)	−8 (−9 − −7)
Emotional state (0–40)	40 (35–40)	36 (30–38)	−3 (−4 − −2)
Psychological support (0–20)	20 (20–20)	20 (18–10)	0 (0–0)
Physical independence (0–20)	20 (20–20)	16 (12–19)	−4 (−5 − −3)
Pain (0–20)	20 (20–20)	13 (9–15)	−6 (−7 − −6)

Note: Data are presented as the median (interquartile range) or median difference (95% CI).

Table 6 presents the results of the multivariable logistic regression analyses of good or excellent postoperative recovery at 48 hours postoperatively. Multivariable logistic regression analyses revealed that a preoperative QoR-15K score lower than 136 (OR [odds ratio]: 0.28, 95% CI: 0.09–0.83, $P = 0.022$), pain score during coughing at 24 hours postoperatively (OR: 0.82, 95% CI: 0.69–0.96, $P = 0.016$), and PONV during the first 24 hours postoperatively (OR: 0.35, 95% CI: 0.16–0.73, $P = 0.005$) were negatively associated with a good or excellent postoperative recovery.

Table 5 Inter-Dimension Correlations of Postoperative Pain Intensity and Postoperative QoR-15K Scores

		Total Score	Physical Comfort	Emotional State	Psychological Support	Physical Independence	Pain
QoR-15K dimension	Physical comfort	**0.75 (0.66–0.81)**	-				
	Emotional state	**0.81 (0.74–0.86)**	**0.53 (0.40–0.64)**	-			
	Psychological support	**0.51 (0.37–0.62)**	**0.33 (0.17–0.47)**	**0.38 (0.22–0.51)**	-		
	Physical independence	**0.65 (0.55–0.74)**	**0.43 (0.28–0.56)**	**0.34 (0.19–0.48)**	**0.25 (0.09–0.40)**	-	
	Pain	**0.57 (0.45–0.67)**	**0.29 (0.14–0.44)**	**0.33 (0.17–0.47)**	0.29 (−0.08 – 0.25)	**0.26 (0.10–0.41)**	-
Pain score at rest at 48 h, NRS		**−0.45 (−0.57 – −0.31)**	**−0.26 (−0.41 – −0.10)**	**−0.33 (−0.47 – −0.17)**	**−0.24 (−0.39 – 0.81)**	**−0.28 (−0.43 – −0.12)**	**−0.37 (−0.50 – −0.21)**
Pain score during coughing at 48 h, NRS		**−0.55 (−0.65 – −0.42)**	**−0.38 (−0.51 – −0.23)**	**−0.39 (−0.52 – −0.24)**	**−0.18 (−0.33 – −0.01)**	**−0.31 (−0.45 – −0.15)**	**−0.56 (−0.66 – −0.44)**

Notes: Data are presented as the Spearman correlation coefficient (95% confidence interval). Bold values are for $P < 0.05$.
Abbreviations: QoR-15K, Korean version of Quality of Recovery-15; NRS, Numeric rating scale.

Table 6 Logistic Regression Analyses for Good or Excellent Postoperative Recovery at 48 Hours Postoperatively

	Univariable		Multivariable	
	OR (95% CI)	*P*-value	OR (95% CI)	*P*-value
Female (versus male)	0.52 (0.26–1.02)	0.057		
Age ≥ 65 years	1.12 (0.57–2.21)	0.738		
ASA class 3 (versus 1 or 2)	1.10 (0.28–4.30)	0.888		
Body mass index ≥ 25 kg/m^2	0.91 (0.46–1.81)	0.786		
Current smoker	0.95 (0.39–2.33)	0.907		
Preoperative QoR-15K < 136	0.32 (0.12–0.89)	0.029	0.28 (0.09–0.83)	0.022
Total intravenous anesthesia (versus inhalation anesthesia)	0.57 (0.29–1.13)	0.109		
Duration of anesthesia ≥ 3 hours	0.78 (0.34–1.76)	0.543		
Pain score during coughing at 24 hours postoperatively, NRS (0–10)	0.81 (0.69–0.94)	0.007	0.82 (0.69–0.96)	0.016
PONV during the first 24 hours postoperatively	0.33 (0.16–0.68)	0.002	0.35 (0.16–0.73)	0.005

Abbreviations: ASA, American Society of Anesthesiologists; CI, confidence interval; NRS, Numeric rating scale; OR, odds ratio; PONV, postoperative nausea or vomiting; QoR-15K, Korean version of Quality of Recovery-15.

Discussion

In the present study, a significant negative correlation was found between pain intensity and quality of postoperative recovery, evaluated using the QoR-15K questionnaire at 48 hours postoperatively in patients who underwent VATS for lung cancer resection. The pain dimension of the QoR-15K assessment and postoperative pain score showed significant negative correlations with the other dimensions of the QoR-15K assessment, except for the psychological support dimension, which suggested that postoperative pain affected various aspects of postoperative recovery. Among all

items of the QoR-15K questionnaire, the item with the lowest median score at 48 hours postoperatively was the 11th item (moderate pain). In addition, the pain score during coughing at 24 hours postoperatively showed a significant association with poor postoperative recovery, along with PONV and a low preoperative QoR-15K score. Therefore, in these patients, postoperative pain management appeared to be the most important perioperative component in improving postoperative recovery.

The major goal of postoperative pain management is not to eliminate pain, but to improve postoperative recovery by providing physical comfort that will not interfere with postoperative rehabilitation, such as ambulation. From this point of view, the quality of postoperative recovery would be more appropriate than pain intensity as the primary outcome in clinical studies on postoperative pain intervention. The assessment of the postoperative quality of recovery can evaluate not only the effect of analgesic interventions on postoperative pain intensity but also the overall improvement in postoperative recovery, including improvements in physical and psychosocial functions. Therefore, recently, several studies that used quality of postoperative recovery, rather than pain intensity, as the primary outcome have been reported.[22–28] As the importance of using patient-reported outcome assessments such as the QoR-15 questionnaire in surgical patients is emphasized,[29,30] the number of clinical studies on postoperative pain using the QoR-15 score as the primary endpoint is increasing.[31]

Postoperative recovery evaluated using the QoR questionnaire can provide more meaningful clinical information than that obtained using pain intensity scoring. In recent studies regarding the effect of regional analgesia on quality of recovery after breast cancer surgery, despite no significant group difference in pain scores at 24 hours postoperatively, the intervention group showed a higher QoR-15 score than that of the control group at 24 hours postoperatively.[23,25] The following points may explain the results. First, the pain-related items of the QoR-15 questionnaire assess the condition over the past 24 hours, not the pain intensity at a specific time point. In the present study, the QoR-15K score showed a significant correlation with postoperative pain intensity, but it was only of a mild to moderate degree. Second, the decrease in opioid-induced side effects due to a decrease in postoperative opioid consumption over the previous 24 hours would have contributed to improvement in the overall quality of recovery. Last, the decrease in pain intensity over the previous 24 hours might have affected other dimensions as well as the pain dimension in the QoR-15 questionnaire assessment. In the present study, both the pain dimension of the QoR-15K questionnaire and pain score showed significant correlations with the emotional state, physical comfort, and physical independence dimensions of the QoR-15K questionnaire. Similarly, in a study regarding the effect of regional analgesia on quality of recovery after thoracic surgery, the significant decrease in pain scores up to eight hours postoperatively correlated with a significant difference in postoperative recovery at 48 hours postoperatively.[24] This result can suggest that pain control during the immediate postoperative period is important for overall postoperative recovery during hospitalization.

Despite their significant correlation, the significance degree of correlation between pain intensity and QoR-15K score was moderate. This result might be because the quality of postoperative recovery was influenced by various factors, including postoperative pain. More specifically, in the present study, the emotional dimension of the QoR-15K questionnaire showed a strong correlation with the total score and pain dimension of the QoR-15K questionnaire, which was similar to the result of a previous study.[32] In addition, in the present study, despite administration of dual prophylaxis for PONV in most patients, PONV occurred in a significant number of patients, which would have affected the QoR-15K total score, as well as the physical comfort dimension. Therefore, in clinical studies regarding the effect of pain intervention on postoperative recovery in a sample of modest size, control of these confounding variables should be considered.

Caution should be employed when interpreting the results of this study for the following reasons. First, this study has limited generalizability due to its retrospective design, which included a small number of patients who underwent a single type of surgery at a single institution. Differences in perioperative management depending on the type of surgery or institution may affect the primary outcome. Additionally, the degree of pain can vary depending on the type of surgery; therefore, the contribution of postoperative pain to overall postoperative recovery may also differ. Second, no gold standard for evaluating the quality of postoperative recovery exists. In the previous study on the validity of the QoR-15K questionnaire, the correlation between the QoR-15K score and QoR visual analog scale score was of a moderate to strong degree (r = 0.61; 95% CI, 0.51–0.69; $P < 0.0001$).[2] However, the QoR-15 questionnaire assessment was the first

patient-reported outcome measurement in surgical patients, the validity of which was verified according to a strict statistical process.[6] Third, we routinely conducted the QoR-15K questionnaire only at 48 hours postoperatively due to the lack of personnel to conduct more assessments. Changes in the QoR-15 score over time after surgery may provide more valuable information on postoperative recovery.[28] Lastly, we have not investigated the quality of postoperative recovery after discharge. The association between acute and chronic postoperative pain is well known,[33] but so far, the impact of acute postoperative pain on the overall quality of postoperative recovery after discharge has not been reported. Especially in thoracic surgery, chronic postoperative pain occurs relatively frequently, and this can impair the long-term quality of life after surgery. Therefore, further research is needed regarding the impact of acute pain on the quality of both early and long-term recovery after surgery.

Conclusion

In conclusion, the QoR-15K score at 48 hours postoperatively showed a significant negative correlation with pain intensity at 48 hours postoperatively in patients who underwent VATS for lung cancer resection. In addition, both pain intensity and the pain dimension of the QoR-15K questionnaire showed significant correlations with other dimensions of the QoR-15K questionnaire in these patients. These results further demonstrate the impact of postoperative pain on overall postoperative recovery in patients who underwent VATS for lung cancer resection. Considering the significant correlation between the postoperative pain intensity and QoR-15K score, the QoR-15K score may be regarded as a primary endpoint in clinical studies on postoperative pain control. However, our study had several limitations that hinder the generalization of our conclusions, and further research will be needed on this subject, with a more diverse range of surgeries and a larger patient population.

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Disclosure

The authors declare that they have no competing interests in this work.

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