Original Article

Comparison of Postoperative Quality of Life and Pain with and without a Metal Rib Spreader in Patients Undergoing Lobectomy through Axillary Mini-Thoracotomy for Stage I Lung Cancer

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Purpose: To evaluate postoperative patient-reported quality of life (QOL) and pain with and without a metal rib spreader (MRS) in patients with stage I lung cancer who underwent lobectomy through axillary mini-thoracotomy (AMT).

Methods: This single-institution prospective observational study enrolled patients between January 2015 and April 2018. Their QOL and pain were evaluated using the EQ-5D and the European Organization for Research and Treatment of Cancer (EORTC) Quality of Life Questionnaire 30 items (QLQ-C30). The EQ-5D was completed preoperatively (Pre) and on days 1/3/5/7 (D1/3/5/7), at 1 month (M1), and at 1 year postoperatively (Y1). The EORTC QLQ-C30 was completed at Pre, M1, and Y1.

Results: The data of 140 patients were analyzed (video-assisted without MRS: VA/noMRS: 67, AMT with MRS: AMT/MRS: 73). Although the AMT/MRS group had more preoperative comorbidities, longer operative times, and more blood loss than the VA/noMRS group, the EQ-5D visual analog scale scores were not significantly different at any assessment point (Pre/D1/D3/D5/D7/M1/Y1) (VA/noMRS: 82/48/60/67/73/77/85, AMT/MRS: 80/46/60/66/73/76/85). Postoperative pain in the EQ-5D descriptive system and the EORTC QLQ-C30 was comparable between the groups.

Conclusion: VA/noMRS and AMT/MRS showed similar postoperative QOL and pain scores, indicating that MRS negligibly impacts the postoperative QOL and pain.

Keywords: lung cancer, mini-thoracotomy, metal rib spreader, quality of life, postoperative pain

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Introduction

For patients with early-stage lung cancer, lobectomy with mediastinal dissection remains the mainstay of treatment. As lung resection results in a high prevalence of postoperative pain, the major research focus was to establish less invasive and painful surgical approaches, such as muscle-sparing thoracotomy, thoracotomy techniques that avoid intercostal nerve damage,[1] mini-thoracotomy,[2–5] and video-assisted thoracic surgery (VATS).[6,7] More recently, robot-assisted thoracic surgery and single-port VATS were adopted in lobectomy for lung cancer.

Although there is a growing interest concerning the patient-reported health-related quality of life (QOL) in clinical oncology,[8,9] the studies that focused on the post-surgical QOL of patients with lung cancer remain limited. When comparing the postoperative QOL outcomes between VATS and the thoracotomy approach, some studies have shown results that were in favor for the VATS approach,[10–12] although other studies have reported different findings.[13–15] No study has yet reported the QOL outcomes of mini-thoracotomy for lung cancer surgery.

At our institution, we had developed and used axillary mini-thoracotomy (AMT) with a metal rib spreader (MRS) (AMT/MRS), as a less invasive approach for lobectomy in patients with lung cancer. Moreover, we recently introduced the video-assisted approach through AMT without using an MRS (VA/noMRS) to further reduce the invasiveness of the procedure.

This study aimed to evaluate and compare the QOL outcomes between the VA/noMRS and AMT/MRS approaches in patients with stage I lung cancer who underwent lobectomy. This study was planned as a part of our prospective single-institutional observational study to clarify the patient-reported QOL in surgical patients with lung cancer.[16,17]

Patients and Methods

Patients

In our prospective study, we recruited consecutive patients with lung cancer who underwent lung resection at the Hitachi General Hospital between January 2015 and April 2018 to examine the patient-reported QOL (UMIN Clinical Trials Registry: UMIN000017594). In total, 279 patients were enrolled in this cohort. The surgical approach was discussed and determined by surgeons at the preoperative conference based on tumor condition and patients' background. There were five conversions from the initially planned approach (four from VA/noMRS to AMT/MRS and one from AMT/MRS to open) (**Supplemental Fig. 1**, available Online). To evaluate the effect of the two surgical approaches, we analyzed the data obtained from the conducted approach, but not the planned approach. The conversion was performed because of palpation of the lesion for diagnostic wedge resection (n = 2) and pleural adhesion (n = 3). There were no conversions due to intraoperative complications, such as major hemorrhage. This study's protocol was approved by our institutional review board (No. 2015-4), and the need for written informed consent was waived because each questionnaire provided the respondent with an opportunity to refuse to answer. Moreover, the contact information for opting out was provided on our website.

Surgical procedure and postoperative pain management

In the AMT/MRS approach, we placed an arch-shaped skin incision of 10–14 cm (10–12 and 12–14 cm for female and male patients, respectively) on the mid-axillary line (**Fig. 1A** and **1B**) and made a mini-thoracotomy window using metal mini-rib spreaders (Mini-opener: Midorija Sugiura, Tokyo, Japan; HAIGHT rib spreader: B. Braun Aesculap, Tokyo, Japan) with three 12-mm surgical ports. Surgical manipulation was mostly performed under direct vision through a window with monitor vision assistance. The mini-thoracotomy window prohibited the surgeon from inserting his/her hands into the thorax for manipulation. For rib approximation, we placed intracostal sutures, as reported by Cerfolio et al.[1] In the VA/noMRS approach, we placed an arch-shaped skin incision of 6–8 cm on the mid-axillary line and made a utility window using a single-use plastic wound protector (Multi-flap gate: Sumitomo Bakelite Co., Ltd. Tokyo, Japan) with three 12-mm surgical ports (**Fig. 1B** and **1C**). Surgical manipulation was mostly performed under monitor vision. An intercostal suture was not used for rib approximation in the VA/noMRS approach. In both approaches, we spared the latissimus dorsi and serratus anterior muscles. Almost the entire length of the intercostal muscle was separated in both approaches (from the internal mammary artery at the ventral side to the dorsal edge of the subcostal muscle at the dorsal side). For lobectomy, we dissected all hilum structures and divided each structure (pulmonary artery, pulmonary vein, bronchus, and lung
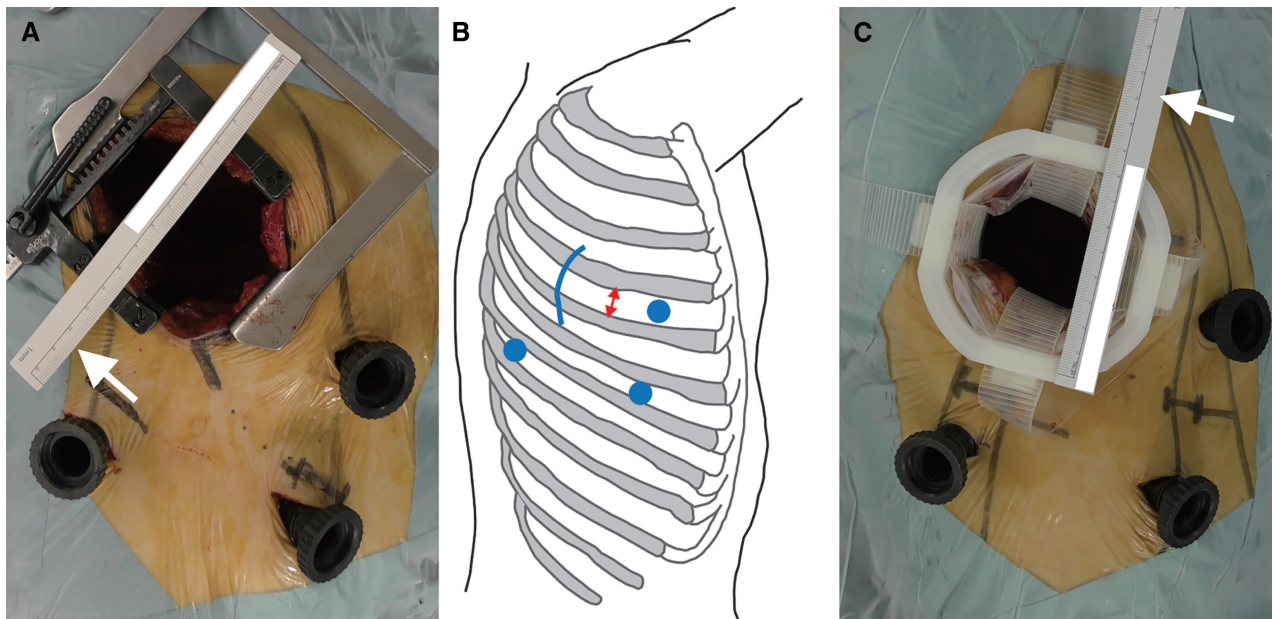
Fig. 1 Skin incision and port placement. (**A**) Photograph of the axillary mini-thoracotomy approach with a metal rib spreader (MRS). (**B**) Schema of skin incision and port placement. Double-headed arrow indicates the distance of rib spreading. (**C**) Photograph of the video-assisted approach through axillary mini-thoracotomy without an MRS. A paper scale is placed on the surgical window in (**A**) and (**C**) (arrow).

parenchyma) separately using a stapler, ligation, or sealing device. Mediastinal lymph node dissection was performed identically in both approaches. A mini-thoracotomy or utility window was placed on the fourth intercostal space for upper and middle lobectomy and on the fifth intercostal space for lower lobectomy. The intercostal distances on the window (**Fig. 1**, double-headed arrow) were 2.5–4 and 6.5–8 cm in the VA/noMRS and AMT/MRS approaches, respectively. We placed an 18-Fr trocar catheter for men and a 16-Fr trocar catheter for women. Our standard pain management, which consisted of patient-controlled epidural analgesia and the oral administration of a non-steroidal anti-inflammatory drug (NSAID), was identical between the two groups. According to the patient's symptoms, the epidural catheter was removed on the day of or the day after the chest tube removal. When epidural analgesia was not indicated, patient-controlled intravenous analgesia was administered. NSAIDs were administered three times a day up to postoperative day 3, and taken when required on and after postoperative day 4. When the patient had intercostal neuralgia (the so-called post thoracotomy pain syndrome), pregabalin was administered. We used the standard clinical pathway for the different approaches (the predetermined postoperative duration for the VA/noMRS and AMT/MRS approaches were 7 and 10 days, respectively).

QOL and pain assessment

We recently reported on the QOL assessment in a prospective study.[16,17] We used the Japanese version of the EQ-5D-five-levels (EQ-5D-5L) questionnaire (Registration No. 7772) and the European Organization for Research and Treatment of Cancer (EORTC) Quality of Life Questionnaire Core 30 (QLQ-C30) as the QOL measures. We administered EQ-5D-5L preoperatively (Pre),[18] on postoperative day 1/3/5/7 (D1/D3/D5/D7), at 1 month after the surgery (M1), and at 1 year after the surgery (Y1). The EORTC QLQ C30 was administered at Pre, M1, and Y1.[19] The EQ-5D-5L consists of a descriptive system and a VAS (visual analog score). The descriptive system comprises the following five dimensions: mobility, self-care, usual activity, pain/discomfort, and anxiety/depression. Each dimension has five possible numerical responses from no problem [1] to extreme problems [5]. The VAS was used to determine the patient's self-reported general health status on a scale of 0–100. One hundred represents "The best health status I can imagine," whereas 0 represents "The worst health status I can imagine." The EORTC QLQ-C30 has 30 questions, including the global health status (GHS)/QOL and the pain score. The GHS and the pain scores were calculated according to the scoring manual. The responsible thoracic surgeon handed the printed QOL questionnaire directly to the patients. The patients were

hospitalized on the day before surgery, and an assessment at Pre was performed on the day of hospitalization. All M1 and Y1 assessments were performed in the outpatient clinic of the Department of Thoracic Surgery. The assessment at Y1 was conducted after the patients were informed that the results of their work-up at Y1 did not show any sign of relapse. At the time of pre-assessment, the patients were informed regarding this longitudinal QOL assessment study with documents stating the aim of the study and a request for their cooperation. At each assessment, the patients returned the accomplished questionnaire to any hospital staff.

Statistical analysis

We determined the sample size by hypothesizing that the minimally important difference (MID) in the EQ-5D VAS score between the VA/noMRS and AMT/MRS groups would be 10 (VA/noMRS would have a higher VAS score).[20] To detect a 10-point increase in the VA/noMRS group, 52 cases were required for each group (104 cases in total), which was calculated using a standard deviation of the VAS score of 18, 80% power to detect the difference, and a two-sided alpha level of 0.05. Considering a withdrawal or missing data rate of 5%, we planned to enroll at least 55 patients with stage I lung cancer who underwent lobectomy in each approach (110 cases in total). The results were presented as means ± standard deviations or medians [quantile 1, quantile 3] for continuous variables. Categorical and ordinal variables were presented as number (proportion) of patients. To compare continuous variables, Student's t-tests or Wilcoxon's rank sum test were applied. To compare the categorical and ordinal variables, Fisher's exact and Wilcoxon's rank sum tests were used, respectively. Statistical analyses were performed using SPSS version 25 (IBM Corp., Armonk, NY, USA). Statistical significance was set at $p < 0.05$.

Results

Patient characteristics

We analyzed 140 cases (VA/noMRS, 67; AMT/MRS, 73) (**Supplemental Fig. 1**). The preoperative clinical characteristics are summarized in **Table 1**. Three patients in the AMT/MRS group simultaneously underwent additional lung resection to lobectomy. Two patients underwent additional wedge resection for another ground-glass nodule. Moreover, one patient underwent additional lobectomy for right middle-lobe hypoplasia. Age, sex,

albumin level, neutrophil–lymphocyte ratio, preoperative respiratory function, tumor location, and clinical T factor were not different between the two groups. The smoking index tended to be larger in the AMT/MRS than in the VA/noMRS group. The proportion of patients who lived alone tended to be higher in the AMT/MRS than in the VA/noMRS group. Those in the AMT/MRS group had significantly higher C-reactive protein (CRP) levels and Charlson comorbidity index (CCI) scores than those in the VA/noMRS group. Among comorbidities, the prevalence of interstitial pneumonia was higher in the AMT/MRS than in the VA/noMRS group.

Intraoperative and postoperative outcomes

Regarding the intraoperative outcomes (**Table 2**), blood loss was greater in the AMT/MRS than in the VA/noMRS group (46 cc vs. 17 cc, respectively, $p < 0.003$). There was no bronchopleural fistula nor grade 5 adverse event in this cohort. Differences in the postoperative stay were attributed to the different clinical pathways applied to each group. The pathological examination revealed that non-adenocarcinoma was more frequent in the AMT/MRS than in the VA/noMRS group. The frequency of upstaging was comparable between the two groups. The number of resected segments and pathologically evaluated lymph nodes, postoperative pulmonary function, and the frequency of adjuvant chemotherapy and protocol termination were similar between the two groups. The number of patients with postoperative adverse events of grade 3 or higher was higher in the VA/noMRS than in the AMT/MRS group ($p = 0.083$). There was no postoperative intercostal neuralgia requiring pregabalin in both groups. One patient in the AMT/MRS group required pregabalin for upper extremity pain because of the surgical position. There were more missing data in the EQ-5D questionnaire in the AMT/MRS group than in the VA/noMRS group ($p = 0.055$).

Preoperative and postoperative QOL

The preoperative and postoperative mean EQ-5D VAS scores at each time point were shown in **Fig. 2**. The VAS scores at each assessment point were not significantly different between the two groups. In addition to the EQ-5D VAS, we compared the global health status/QOL score (GHS score) in the EORTC QLQ C30. The GHS scores were almost identical between the two groups. The GHS scores at Pre/M1/Y1 were 74 ± 18/63 ± 19/80 ± 16 in the VA/noMRS approach and 72 ± 21/64 ± 21/78 ± 16

Table 1 Patient characteristics

	VA/noMRS (n = 67)	AMT/MRS (n = 73)	p
Age (mean, range)	69 (29–89)	69 (48–85)	0.962
Sex (male: female)	39 (58): 28 (42)	46 (63): 27 (37)	0.561
Albumin (g/dL)	4.3 ± 0.4	4.3 ± 0.3	0.942
CRP (mg/dL) (median, interquartile range)	0.07 (0.04–0.16)	0.13 (0.07–0.23)	0.003
NLR	2.3 ± 1 .0	2.7 ± 2.9	0.263
PS			
0	56 (84)	63 (86)	0.923
1	9 (13)	8 (11)	
2	2 (3)	2 (3)	
Smoking index	437 ± 574	600 ± 533	0.082
VC (L)	3.3 ± 0.8	3.2 ± 0.8	0.53
FEV1 (L)	2.4 ± 0.6	2.3 ± 0.6	0.427
CCI			
0	38 (57)	14 (19)	<0.001
1	14 (21)	24 (33)	
≥2	15 (22)	35 (48)	
Comorbidity			
Hypertension	23 (34)	29 (40)	0.509
IHD	2 (3)	5 (7)	0.257
IP	3 (4)	11 (15)	0.037
Stroke	8 (12)	8 (11)	0.855
DM	8 (12)	10 (14)	0.756
Living alone	3 (4)	10 (14)	0.06
Tumor location			
RU	26 (39)	27 (37)	0.901
RM	5 (7)	7 (10)	
RL	16 (24)	15 (21)	
LU	11 (16)	16 (22)	
LL	9 (13)	8 (11)	
cT factor			
1a	23 (34)	25 (34)	0.668
1b	13 (19)	10 (14)	
2a	31 (46)	38 (52)	

AMT/MRS: axillary mini-thoracotomy with a metal rib spreader; CCI: Charlson comorbidity index; CRP: C-reactive protein; DM: diabetes mellitus; FEV1: forced expiratory volume in 1 s; IHD: ischemic heart disease; IP: interstitial pneumonitis; LL: left lower; LU: left upper; NLR: neutrophil-to-lymphocyte ratio; PS: performance status; RL: right lower; RM: right middle; RU: right upper; VA/noMRS: video-assisted approach through axillary mini-thoracotomy without a metal rib spreader; VC: vital capacity

in the AMT/MRS approach (p = 0.919, 0.586, and 0.635, respectively).

Preoperative and postoperative pain

Figure 3 shows the frequency of preoperative and postoperative pain reported as moderate or higher, according to the "Pain/discomfort" scale in the EQ-5D descriptive system. Three patients graded the preoperative pain as moderate or higher (two [3%] and one [1%] in the VA/noMRS and AMT/MRS groups, respectively). The proportion of patients with pain increased at D1 and decreased over time. There were more patients with pain at 1 year after the surgery in the VA/noMRS than in the AMT/MRS group (five and zero patients, respectively). In addition to the EQ-5D descriptive system, we compared the pain scores in the EORTC QLQ C30 between the two groups. The pain scores at each assessment point (Pre/M1/Y1) in the VA/noMRS and AMT/MRS groups were as follows: VA/noMRS = 8 ± 15/28 ± 20/12 ± 18 and AMT/MRS = 10 ± 17/26 ± 17/10 ± 12, respectively. There were no significant differences at each time point (p = 0.776, 0.461, and 0.907, respectively).

Table 2 Intraoperative and postoperative outcomes using two different axillary mini-thoracotomy approaches

	VA/noMRS (n = 67)	AMT/MRS (n = 73)	p
Operation time (min)	242 ± 53	263 ± 64	0.033
Blood loss (cc)	17 ± 39	46 ± 71	0.003
Chest tube placement (day)	4 ± 3	4 ± 2	0.123
Postoperative stay (day)	8 ± 3	11 ± 3	<0.001
Epidural analgesia, absent	4 (6)	2 (3)	0.3
Histological type			
AD	60 (90)	56 (77)	0.026
SQ	4 (6)	14 (19)	
Other	3 (4)	3 (4)	
Pathological stage			
0	4 (6)	3 (4)	0.905
I	50 (75)	56 (77)	
≥II	13 (19)	14 (19)	
No. of resected segment	3.8 ± 1.0	3.9 ± 1.1	0.591
No. of dissected lymph nodes	16 ± 7	16 ± 8	0.981
Postoperative adverse events			
All grades	26 (39)	25 (34)	0.602
≥Grade 3	14 (21)	8 (11)	0.083
Intercostal neuralgia	0	0	
Adjuvant chemotherapy	14 (21)	18 (25)	0.688
Postoperative VC at Y1 (L)	2.7 ± 0.8	2.7 ± 0.8	0.683
Postoperative FEV1 at Y1 (L)	2.0 ± 0.6	1.9 ± 0.5	0.347
Missing data, present	6 (9)	15 (21)	0.055
Protocol termination by Y1	6 (9)	12 (16)	0.186
Relapse	3	5	
Multiple lung cancers	2	0	
Death due to other diseases	0	3	
Others	1	4	

AD: adenocarcinoma; AMT/MRS: axillary mini-thoracotomy with a metal rib spreader; FEV1: forced expiratory volume in 1 s; SQ: squamous cell carcinoma; VA/noMRS: video-assisted approach through axillary mini-thoracotomy without a metal rib spreader; VC: vital capacity; Y1: 1 year after the surgery
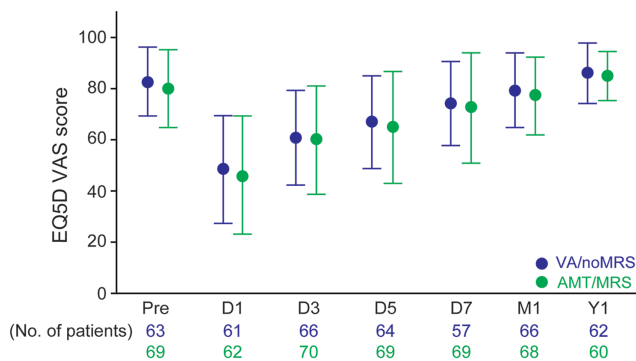

Fig. 2 Patient-reported quality of life measured by using the EQ-5D visual analog scale of the two surgical approaches in patients with stage I lung cancer who underwent lobectomy. Error bars indicate the standard deviation. No. of Patients indicates the number of patients whose data were collected. AMT/MRS: axillary mini-thoracotomy with a metal rib spreader; VA/noMRS: video-assisted approach through axillary mini-thoracotomy without a metal rib spreader

Discussion

This is the first prospective study to compare the patient-reported QOL according to the EQ-5D VAS and EORTC GHS scores between two different mini-thoracotomy approaches. Our main finding was that the postoperative QOLs in the VA/noMRS and AMT/MRS groups were comparable, indicating that the impact of the MRS was negligible in our setting with a modest rib spreading. Moreover, the prevalence of postoperative pain was comparable between the two groups. As we performed lung resection with the AMT/MRS approach as a less invasive approach, this result is readily acceptable. In contrast, since we introduced VA/noMRS to further reduce the invasiveness of the surgical approach, this result indicates that our VA/noMRS procedure can be further improved in the future. Additionally, it was
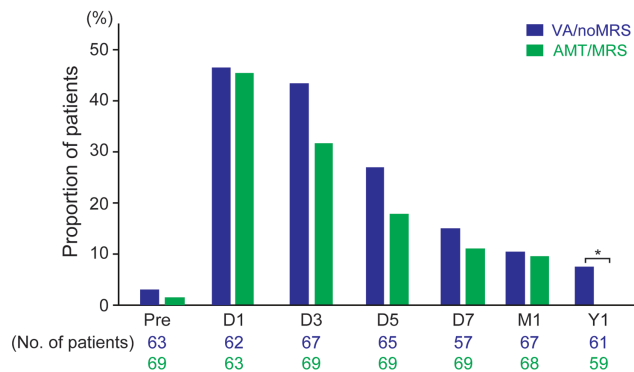
Fig. 3 Bar plots showing the percentage of postoperative pain reported as moderate or more according to "Pain/discomfort" of the EQ-5D descriptive system. *p <0.05. AMT/MRS: axillary mini-thoracotomy with a metal rib spreader; VA/noMRS: video-assisted approach through axillary mini-thoracotomy without a metal rib spreader

noted that the QOL and postoperative pain outcomes were mostly comparable between the two groups throughout the hospitalization period, shortly after discharge (M1), and in the long term (Y1).

Regarding the definition of surgical approaches, although each definition for VATS and mini-thoracotomy varied among reports, we basically adapted the definition of the national clinical database (NCD) registry in Japan.[21] According to this registry, all approaches with skin incision <8 cm regardless of the presence or absence of a rib spreader are registered as VATS. Moreover, the VATS cases in the NCD registry were divided into complete VATS (surgical manipulation under only monitor vision) and VATS+mini-thoracotomy (surgical manipulation under combined use of monitor and direct vision). Namely, our VA/noMRS approach would be classified as VATS+mini-thoracotomy under NCD registry definition. Moreover, there is no gold standard definition regarding mini-thoracotomy. We defined surgical approach with thoracotomy widow that did not allow the surgeon to insert his/her hand into the thorax for surgical manipulation, as mini-thoracotomy, and distinguished from open approaches including posterolateral, anterolateral, antero-axillary, and median sternotomy. In our previous report, open approaches had significantly lower EQ-5D VAS scores at Y1 compared to less invasive approaches (AMT/MRS and VA/noMRS).

When we established the protocol in 2015, there were no studies available on postoperative QOL according to the EQ-5D VAS score. Therefore, we referred to a study involving patients with advanced lung cancer using EQ-5D and hypothesized that VA/noMRS would score 10 points higher than AMT/MRS.[20] However, our findings showed a different outcome. Bendixen et al.[11] performed a randomized-controlled trial comparing the QOL and postoperative pain between patients who underwent VATS and anterolateral thoracotomy in 2016. They used the EQ-5D VAS score to assess the QOL. Interestingly, our EQ-5D VAS scores in the VA/noMRS (Pre, M1, and Y11: 82, 77, and 85, respectively) and AMT/MRS (Pre, M1, and Y1: 80, 76, and 85, respectively) groups were comparable to those of the VATS group in Bendixen et al.'s study (preoperative [Pre], 4 weeks [M1], and 52 weeks [Y1]: 76.8, 78.1, and 86.7, respectively). In contrast, the VATS group in the aforementioned study seemed to show an earlier restoration at M1 compared to our cohort. This might be attributable to their VATS technique, in which they used the four-port technique, including a 4-cm utility incision and one 10-mm port with a trocar for the thoracoscope, and two 10- to 15-mm incisions without trocars. Compared with their technique, we used larger window and more plastic surgical ports and divided the intercostal muscle on the window. Additionally, we noted another similarity with Bendixen's results. Namely, the mean difference in the VAS score between VATS and anterolateral thoracotomy in their study was 6.1 at 1 year after the surgery. In our cohort, the VAS score of the less invasive approach (VA/noMRS and AMT/MRS) was 7 points superior to the open approach.[16] This might support our interpretation of this study that both the VA/noMRS and AMT/MRS approaches are less invasive.

Concerning the postoperative pain, the proportion of patients who answered that they had moderate pain/discomfort or more was not significantly different, except for the results at Y1. Contrary to general expectations, while pain scores in the EORTC QLQ-C30 of both groups at Y1 were not significantly different, the AMT/MRS group had a lower proportion of patients with pain and discomfort than the VA/noMRS group at Y1. Regarding pain sensitivity, hypertension, male sex, and never smoker were reported as factors associated with less pain sensitivity (hypoalgesia). Female sex, chronic inflammation, and current smoker were reported as factors associated with more pain sensitivity (hyperalgesia).[22,23] The AMT/MRS group had more male patients, higher smoking index, CRP level, and CCI scores than the VA/noMRS group. The prevalence of hypertension was not significantly different between the two groups. As factors associated with hypoalgesia and hyperalgesia were mixed in both groups, interpreting

this result is challenging at the moment; thus, more research involving a larger sample size or randomized studies would be needed. Moreover, our data did not show that VA/noMRS was painless than AMT/MRS.

While a large number of reports have compared the perioperative or long-term oncological outcomes between VATS and thoracotomy,[6,7,24] studies comparing VATS and mini-thoracotomy remain limited.[25–29] Among these studies, they reported that VATS is less painful,[27,29] introduces less acute surgical stress,[26,28] and retains more pulmonary function than mini-thoracotomy,[25] which contradicted our results. This could be attributed to our VA/noMRS procedure, which included intercostal muscle separation and minimal rib spreading. However, perioperative and postoperative outcomes, such as operative time and blood loss, were favorable for the VA/noMRS group. The number of dissected lymph nodes and postoperative pulmonary function were comparable between the two groups. These results indicated that our VA/noMRS approach retains an acceptable safety and quality. As our versatile approach was AMT/MRS, we applied AMT/MRS to heavier smokers or patients with comorbidities, as they were more likely to have longer operative times and greater blood loss. To further improve the patient-reported outcomes, we recently introduced robotic-assisted lobectomy for lung cancer and started a new prospective study to evaluate the postoperative QOL and pain in the robotic approach (UMIN000037873).

There were some limitations to this study. First, this study was conducted at a single institution, specifically a regional tertiary hospital with an academic educational center. Most operations were performed by a clinical trainee under the guidance of a responsible thoracic surgeon, resulting in relatively longer operative times. Second, the sample size was calculated based on data of patients with advanced lung cancer.[20] Although a randomized-controlled trial showed that the EQ-5D VAS score is superior with VATS compared to thoracotomy by 6–7 points,[11] no report has described the MID in patients who have undergone surgery for lung cancer. Therefore, we initiated a new prospective study to determine the MID in these patients (UMIN000037864). Third, the distribution mode of the questionnaire, timing of QOL assessment, and exclusion criteria might have affected the patient's responses, thus resulting in a QOL estimation that was better than the patients' actual condition. Fourth, we used "Pain/discomfort" in the EQ-5D descriptive system and the pain score of the EORTC QLQ C30 for pain assessment. Therefore, information on the pain's location is missing, and the five levels of questions in the EQ-5D might result in a lower proportion of patients with postoperative pain compared to that of Bendixen et al.'s study, which used the 11-point numeric rating scale. Fifth, we did not have data regarding the actual oral dose of NSAIDs after postoperative day 4. Although the requirement of pregabalin and clinical impression concerning the NSAID usage was identical in both groups, a more detailed data collection should be considered in the protocol.

Conclusions

In this prospective study, our VA/noMRS and AMT/MRS approaches yielded comparative postoperative QOL and pain outcomes. Although the setting of VATS and mini-thoracotomy varied at each institution, this indicated that an MRS with modest rib spreading has a negligible impact on the patients' postoperative QOL and pain.

Author Contributions

Hideo Ichimura: Conceptualization, methodology, formal analysis, and writing—original draft. Keisuke Kobayashi: Investigation and writing—review and editing. Masahiko Gosho: Formal analysis and writing—review and editing. Kojiro Nakaoka: Investigation and writing—review and editing. Takahiro Yanagihara: Investigation and writing—review and editing. Yusuke Saeki: Investigation and writing—review and editing. Yukio Sato: Writing—review and editing and supervision.

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Disclosure Statement

None declared.

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