Symptom recovery after thoracic surgery: Measuring patient-reported outcomes with the MD Anderson Symptom Inventory

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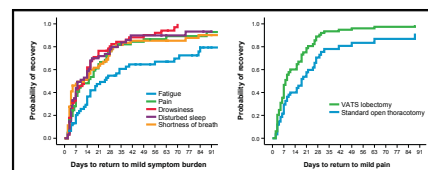
ABSTRACT

Objectives: Measuring patient-reported outcomes (PROs) has become increasingly important for assessing quality of care and guiding patient management. However, PROs have yet to be integrated with traditional clinical outcomes (such as length of hospital stay), to evaluate perioperative care. This study aimed to use longitudinal PRO assessments to define the postoperative symptom recovery trajectory in patients undergoing thoracic surgery for lung cancer.

Methods: Newly diagnosed patients (N = 60) with stage I or II non–small cell lung cancer who underwent either standard open thoracotomy or video-assisted thoracoscopic surgery lobectomy reported multiple symptoms from before surgery to 3 months after surgery, using the MD Anderson Symptom Inventory. We conducted Kaplan–Meier analyses to determine when symptoms returned to presurgical levels and to mild-severity levels during recovery.

Results: The most-severe postoperative symptoms were fatigue, pain, shortness of breath, disturbed sleep, and drowsiness. The median time to return to mild symptom severity for these 5 symptoms was shorter than the time to return to baseline severity, with fatigue taking longer. Recovery from pain occurred more quickly for patients who underwent lobectomy versus thoracotomy (8 vs 18 days, respectively; $P = .022$). Patients who had poor preoperative performance status or comorbidities reported higher postoperative pain (all $P < .05$).

Conclusions: Assessing symptoms from the patient's perspective throughout the postoperative recovery period is an effective strategy for evaluating perioperative care. This study demonstrates that the MD Anderson Symptom Inventory is a sensitive tool for detecting symptomatic recovery, with an expected relationship among surgery type, preoperative performance status, and comorbid conditions. (J Thorac Cardiovasc Surg 2015;■:1-7)

Time to recover to mild symptom severity after thoracic surgery (by symptom, surgery type).

Central Message

Using the MDASI to elicit patient-reported symptom burden is a simple, clinically relevant way to optimize care after thoracic surgery.

Perspective

We used the MD Anderson Symptom Inventory to elicit patient report of the worst symptoms experienced after thoracic surgery. Using a validated tool to gain patients' perspectives on symptom burden is a clinically relevant, user-friendly way to optimize perioperative care. Routine inclusion of symptom report to characterize recovery has the potential to improve standard practice.

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⟲ Supplemental material is available online.

Patients with non–small cell lung cancer (NSCLC) who undergo major surgery experience an acute, systemic, inflammatory, neuroendocrine, and metabolic stress response related to tissue injury and the medications used during the perioperative period. This response often encompasses a cluster of nonspecific symptoms (eg, fatigue, pain, and disturbed sleep) and organ-specific symptoms (eg, shortness of breath) that together cause considerable functional impairment. In addition, up to 25% of patients who undergo

surgery in the United States experience postsurgical complications,[1] which may exacerbate symptom severity and functional impairment, and prolong convalescence. Postoperative symptoms and their effects on functional recovery are critical determinants of patients' ability to return to planned cancer treatment, delays in which can negatively affect long-term clinical outcomes.[2,3]

Enhanced recovery programs (ERPs) incorporate Enhanced Recovery after Surgery[4] concepts, such as multimodal opioid-sparing analgesia and minimally invasive surgical techniques. ERPs generally lead to better postoperative outcomes, which are typically quantified using objective measures (ie, decreased mortality, fewer complications, shorter hospital stays).[4-8] Missing from these metrics is the voice of the patient, who is arguably the best source of information about what "recovery" from surgery means.[9,10]

For example, the minimally invasive, video-assisted, thoracoscopic surgery (VATS) lobectomy is well known to be associated with fewer complications and more-rapid recovery than is standard open thoracotomy.[11,12] However, to our knowledge, no empirical, patient-reported outcome (PRO) data characterize the time course and developmental trajectory of postoperative symptoms, especially during the time frame spanning from hospital discharge to return of normal functioning.[6] Lack of research on how to define and measure symptomatic and functional recovery after major cancer surgery from the patents' perspective is an important gap in comprehensive postoperative care; additionally, this lack compromises any comparison of ERP innovations against standard care.[9,10,13]

Capturing patients' perspectives on how well and how quickly they are recovering, in terms of symptom severity and persistence, functional impairment, and ability to resume planned oncology treatment, requires a validated PRO measure that is sensitive to differences related to type of surgery and variations in perioperative care. Although PROs have been widely accepted in clinical research,[14,15] the use of subjective outcomes in current perioperative practice is relatively novel, despite recent recognition of their potential benefits.[9] Inclusion of PROs in an ERP pathway would challenge the current paradigm of standard perioperative care and its reliance on objective metrics that do not reflect the patient perspective on the effectiveness of cancer therapy and symptom control.[9]

We therefore conducted a PRO-based longitudinal investigation to: (1) examine whether a validated PRO measure, the MD Anderson Symptom Inventory (MDASI),[16] could be used to identify the most-severe symptoms experienced by patients with NSCLC beginning before thoracic surgery and continuing to 3 months postsurgery; (2) identify risk factors for high levels of postoperative symptoms; and (3) characterize postsurgical recovery in terms of symptom trajectories.

METHODS
Patients

We prospectively recruited newly diagnosed patients with stage I or II NSCLC who were scheduled for thoracic surgery at The University of Texas MD Anderson Cancer Center (Houston, Tex), between 2004 and 2008. Eligible patients were: aged ≥18 years; naïve to any cancer treatment; able to understand English and the study requirements; and willing and able to respond to a repeated, computerized telephone interactive-voice-response–administered symptom rating scale, after they were discharged from the hospital. The study was approved by the MD Anderson Institutional Review Board. All participants gave written informed consent.

Study Design and Outcome Measures

Symptoms were assessed using the MDASI, a brief measure of the severity of 13 common, cancer-related symptoms experienced by the patient during the previous 24 hours. Each symptom is rated on an 11-point scale, with 0 being "not present," and 10 being "as bad as you can imagine."[16]

Patients completed a paper and pencil version of the MDASI at the time of enrollment (presurgery baseline), and while in the hospital on days 3 and 5 after surgery. Before discharge, patients were given a demonstration of the computerized voice-response system and rehearsed using the system until they were comfortable with it. Patients were given options about which days of the week to receive calls from the system, and specified their preferred time of day for calls. Patients were called by the system 1 week after discharge, and weekly thereafter until 3 months after surgery. In addition, demographic characteristics, postoperative complications, and other clinical variables were recorded.

Statistical Analysis

All patients included in this analysis provided MDASI data at baseline and on day 3, at a minimum. We used the average of all available scores for each symptom, to identify the 5 most-severe symptoms and construct symptom-development trajectories. Cumulative, logit, mixed-effect models were used for longitudinal analysis. Random intercepts were included in all models. In models comparing symptom scores at specific time points (day 3, day 5, week 1, and month 3 after surgery) with preoperative symptom levels, we treated time as a categoric variable. In models identifying risk factors for longitudinal symptom burden, we treated time (days from surgery) as a continuous variable, with 2 segments separated by day 3.

Age, gender, race, marital status, baseline Eastern Cooperative Oncology Group performance status, comorbid conditions, surgery type, interaction between time and surgery type, length of hospitalization, estimated blood loss, pulmonary complications, and cardiovascular complications were included in the models. SAS 9.3 (SAS Institute, Inc, Cary, NC) was used to conduct all analyses. All statistical tests were 2-sided.

We defined "postoperative recovery" as either: (1) symptom recovery to baseline level: after surgery, the patient reported 2 contiguous symptom

levels at or below the preoperative (baseline) level (patients whose symptoms were >3 at baseline were excluded); or (2) symptom recovery to the mild level: after surgery, the patient reported MDASI symptom scores ≤3 (none or mild) at 2 contiguous measurements. Characterizing recovery as the attainment of symptoms rated 0 to 3 on the 0 to 10 scale is based on the cutpoints used in multiple clinical practice guidelines, such as the National Comprehensive Cancer Network fatigue and pain guidelines.[17,18] Empirical work has consistently demonstrated that substantial functional impairment occurs when symptoms reach moderate to severe levels.[19,20] Median and mean recovery days and 95% confidence intervals (CIs) were estimated using Kaplan–Meier analysis.

RESULTS

Sample

Of the 119 patients scheduled for thoracic surgery for NSCLC who were screened for participation in the study, 42 were excluded because they did not meet inclusion criteria (34 had stage III or IV cancer; 8 had received previous treatment). Of the 77 patients enrolled, 17 did not supply baseline and day-3 data and thus were excluded from analysis, resulting in a final sample size of 60 patients (Figure E1). Among these 60 patients, 5 completed 2 postoperative MDASI assessments; all others completed ≥3 postoperative MDASI assessments. The random missing data rate was 22%.

Table 1 shows baseline demographic and clinical characteristics for the sample. Approximately 48% of patients were treated with a minimally invasive surgical procedure (VATS lobectomy); no significant difference was found in the percentages of patients with stage I cancer versus stage II cancer, by type of surgery ($P = .152$). Other than surgery type, no specific ERP-based management strategies were utilized.[4-8]

Major Postoperative Symptoms

The 5 most-severe postoperative symptoms were pain, fatigue, drowsiness, shortness of breath, and disturbed sleep. Mixed modeling showed that mean fatigue peaked on day 5 after surgery, whereas the other 4 symptoms had already peaked by day 3 after surgery (the first observation point after surgery). Before surgery, approximately 13% of patients reported moderate to severe symptoms (≥4 on the 0-10 scale), the most severe of which were fatigue and disturbed sleep. At day 3 after surgery, the prevalence of moderate to severe symptoms was 51.6% for pain, 59.7% for fatigue, 54.8% for drowsiness, 33.9% for shortness of breath, and 56.5% for disturbed sleep. By 4 weeks after surgery, the only symptoms still more severe than they were at baseline were fatigue (mean: 2.92 [SD 2.45] vs 1.47 [SD 2.17], respectively; $P = .003$), and pain (mean: 1.55 [SD 1.97] vs 0.80 [SD 1.96], respectively; $P = .0002$), with the other 3 symptoms having returned to preoperative levels. By the end of month 3, all symptoms had improved to better than preoperative levels (Figure 1 and Table E1).

TABLE 1. Demographic and clinical characteristics

Characteristic	n	%
Age (y)		
M (SD): 66.2 (10.5)		
Median (range): 67 (32-89)		
<60	16	26.7
≥60	44	73.3
Gender		
Male	30	50.0
Female	30	50.0
Race		
Non-Hispanic white	53	88.3
Other	7	11.7
Marital status		
Married	40	66.7
All others	20	33.3
Type of surgery		
Open thoracotomy	31	51.7
VATS lobectomy	29	48.3
Length of hospital stay (d)		
M (SD): 6.1 (3.1)		
Median (range): 6 (2-20)		
≤6	41	68.3
≥7	19	31.7
Estimated blood loss (mL)		
M (SD): 333.9 (659.2)		
Median (range): 150 (0-3450)		
≤150	34	56.7
>150	26	43.3
Preoperative ECOG PS		
Good (0-1)	51	85.0
Poor (2-4)	9	15.0
Pulmonary complications		
No	46	76.7
Yes	14	23.3
Cardiovascular complications		
No	50	83.3
Yes	10	16.7
Smoked 100 cigarettes in your lifetime		
No	9	15.0
Yes	51	85.0
Comorbid conditions		
No	5	8.3
Yes	55	91.7
Day-3 pain rating (scale: 0-10)		
0-6	38	63.3
7-10	22	36.7

N = 60. *VATS*, Video-assisted thoracoscopic surgery; *ECOG PS*, Eastern Cooperative Oncology Group performance status; *M*, mean; *SD*, standard deviation.

Risk Factors for Higher Levels of Postoperative Symptoms

Mixed modeling with ordinal regression analysis was used to examine multiple factors that contributed to the development of the 5 most-severe postoperative symptoms (Table 2). Those with poorer preoperative Eastern Cooperative Oncology Group performance status
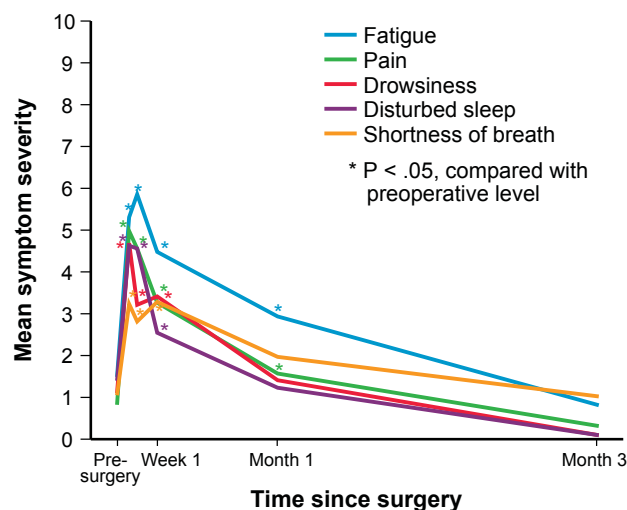
FIGURE 1. Severity levels over time for the 5 most-severe symptoms after thoracic surgery.

(2-4 vs 0-1) experienced more-severe postoperative pain ($P = .03$). Patients who reported any comorbid condition before surgery reported higher levels of pain ($P = .04$). Cardiovascular postoperative complications were related to a higher drowsiness score ($P = .004$).

Significant interactions between surgery type and time were found. Compared with patients who underwent VATS lobectomy, patients who underwent standard open thoracotomy reported a more-rapid increase in the first 3 days after surgery, and a slower decrease after 3 days for 4 symptoms: fatigue, pain, drowsiness, and shortness of breath.

Defining the Postoperative Recovery Time Course Using Symptom Outcomes

Figure 2, A presents Kaplan–Meier curves of time to recover to a mild-severity level of symptoms, during the 3-month period immediately after surgery, for the 5 most-severe symptoms. Patients who underwent VATS lobectomy showed a faster recovery for pain than did patients who underwent standard open thoracotomy (8 days vs 18 days, $P = .022$) (Figure 2, B). Tables E2 and E3 show additional data related to Figure 2, A and B, respectively, on the number of patients with moderate to severe symptoms (≥ 4 on the 0-10 scale) and the probability of recovery at given time points during the study.

Table 3 presents the median time course of recovery to mild symptom ratings (≤ 3 on a 0-10 scale) by Kaplan–Meier analysis. Fatigue showed a slower recovery to mild severity than did the other 4 symptoms (median: 22 days vs 10-15 days). Generally, symptoms took longer to return to baseline levels than to mild symptom ratings. The median number of days for recovery to baseline symptom ratings was higher for fatigue than for the other 4 most-severe symptoms.

TABLE 2. Risk factors for higher symptom burden within 3 months of surgery, by ordinal regression analysis

Symptom	Estimate*	SE	P value
Fatigue			
Days from surgery (≤ 3)	0.23	0.04	<.0001
Surgery type by days from surgery (≤ 3), open thoracotomy vs VATS	0.22	0.09	.01
Days from surgery (4-100)	−0.28	0.04	<.0001
Surgery type by days from surgery (4-100), open thoracotomy vs VATS	−0.19	0.09	.03
Pain			
Days from surgery (≤ 3)	0.21	0.04	<.0001
Surgery type by days from surgery (≤ 3), open thoracotomy vs VATS	0.44	0.11	.0001
Days from surgery (4-100)	−0.26	0.05	<.0001
Surgery type by days from surgery (4-100), open thoracotomy vs VATS	−0.43	0.12	.0002
ECOG PS 2-4 vs 0-1 at baseline	1.14	0.52	.03
Comorbid conditions (yes vs no)	1.33	0.66	.04
Drowsiness			
Days from surgery (≤ 3)	0.14	0.04	.0003
Surgery type by days from surgery (≤ 3), open thoracotomy vs VATS	0.18	0.08	.03
Days from surgery (4-100)	−0.18	0.04	<.0001
Surgery type by days from surgery (4-100), open thoracotomy vs VATS	−0.17	0.08	.04
Cardiovascular complications (yes vs no)	1.33	0.46	.004
Disturbed sleep			
Days from surgery (≤ 3)	0.11	0.03	.001
Days from surgery (4-100)	−0.14	0.03	<.0001
Shortness of breath			
Days from surgery (≤ 3)	0.27	0.05	<.0001
Surgery type by days from surgery (≤ 3), open thoracotomy vs VATS	0.24	0.10	.02
Days from surgery (4-100)	−0.30	0.05	<.0001
Surgery type by days from surgery (4-100), open thoracotomy vs VATS	−0.23	0.10	.03

SE, Standard error; *VATS*, video-assisted thoracoscopic surgery; *ECOG PS*, Eastern Cooperative Oncology Group performance status. *Multinomial logit mixed modeling: N = 60,651 observations.

DISCUSSION

The current study demonstrates the utility of the MDASI, a PRO assessment tool, for evaluating symptom severity in patients who have undergone surgery for NSCLC, and detecting expected fine differences in symptom report by type of procedure (VATS lobectomy vs standard open thoracotomy) and patient characteristics. To our knowledge, this longitudinal study is the first to use PROs to define a postoperative recovery course.

In this cohort of newly diagnosed, treatment-naïve patients with early-stage NSCLC, a cluster of symptoms peaked immediately after surgery, with one third of patients experiencing severe pain on day 3, which was the first time symptoms were measured after surgery. Pain, fatigue, and shortness of breath were highly prevalent in the first week after surgery, representing a combined effect from surgical
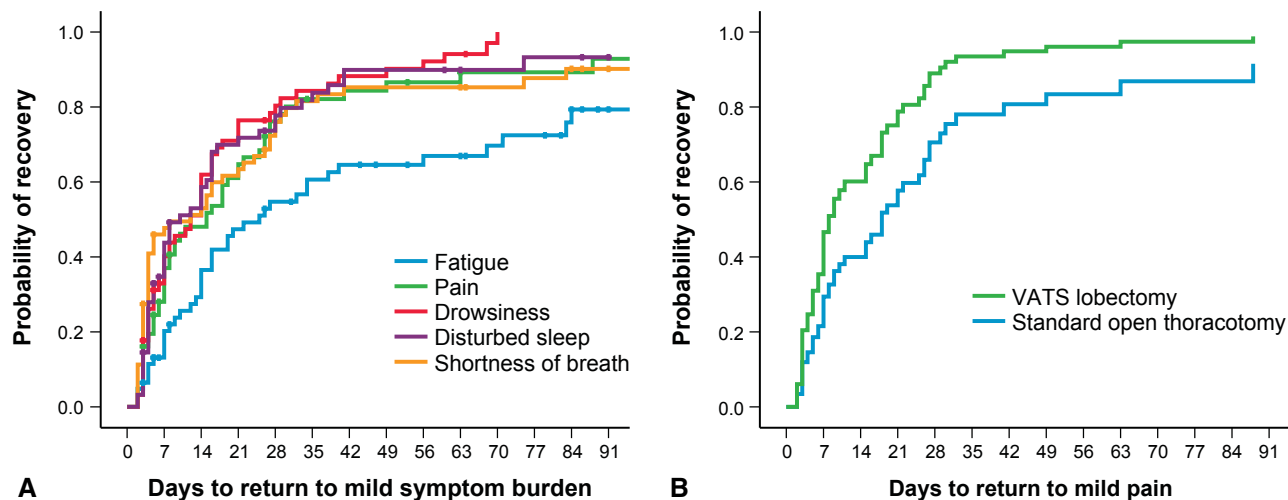
FIGURE 2. Time to symptom recovery to mild severity after thoracic surgery. A, Kaplan–Meier curves for the 5 most-severe symptoms overall. B, Kaplan–Meier curves for difference in pain recovery between standard open thoracotomy and VATS lobectomy ($P = .022$). "Return to mild pain" was defined as a report of MDASI pain scores ≤3 (none or mild) at 2 contiguous measurements. Tables E2 and E3 provide additional data related to Figure 2, A and B, respectively, on the number of patients with moderate to severe symptoms and the probability of recovery at given time points during the study. *VATS*, Video-assisted thoracoscopic surgery.

insult and perioperative care. The mean ratings for most symptoms (except for fatigue) had returned to preoperative levels by the end of the first month.

Fatigue remained the most persistent symptom during the 3-month study. Postoperative fatigue had a somewhat different pattern of recovery compared with the other major symptom outcomes in this study, peaking 2 days later (at day 5) than the other symptoms (Figure 1; Table E1) and recovering more slowly. The leading role of fatigue in the postoperative setting is similar to that induced by other major cancer therapies, such as chemoradiation and stem-cell transplantation,[21,22] and it reflects the fact that no effective management strategy is currently available for this symptom. Among all MDASI data collected for a total of 13 symptoms, we identified the 5 most-severe

symptoms, which represent a profile of the worst symptom burden for this postsurgery patient cohort.

Our finding of differences in pain severity between VATS lobectomy and standard open thoracotomy mirrors previously reported clinical benefits from thoracoscopic lobectomy for early-stage NSCLC.[11,23] This finding demonstrates that the MDASI is sufficiently sensitive to differentiate postoperative symptoms by type of procedure. The acute pain experienced by patients after open thoracotomy surgery,[12,24] which is pain caused by a combination of insults such as retraction, resection, or fracture of ribs; dislocation of costovertebral joints; injury of intercostal nerves; and further irritation of the pleura by chest tubes,[25] is considered to be more severe than the pain produced by VATS lobectomy.

TABLE 3. Postoperative symptom recovery to mild or baseline severity, by Kaplan–Meier analysis

Symptom	n	Recovered, n (%)	Median recovery time (d) (95% CI)	Mean recovery time (d) (95% CI)
Recovery to mild symptom severity*				
Pain	60	49 (81.7)	15 (7-23)	23 (15-30)
Fatigue	60	41 (68.3)	22 (11-33)	39 (29-48)
Drowsiness	60	53 (89.3)	12 (7-17)	18 (13-23)
Shortness of breath	60	51 (85.0)	12 (2-22)	22 (15-29)
Disturbed sleep	60	49 (81.7)	10 (4-16)	20 (13-26)
Recovery to preoperative (baseline) severity†				
Pain	60	35 (58.3)	54 (44-64)	56 (47-65)
Fatigue	60	29 (48.3)	75 (61-89)	62 (52-72)
Drowsiness	60	42 (70.0)	27 (17-37)	41 (32-51)
Shortness of breath	60	35 (58.3)	69 (23-115)	54 (43-64)
Disturbed sleep	60	46 (76.7)	16 (5-34)	34 (25-43)

CI, Confidence interval. *"Recovery to mild severity" was defined as a report of symptom scores ≤3 (none or mild, on the MDASI 0-10 scale) at 2 contiguous measurements. †"Recovery to preoperative (baseline) severity" was defined as a report of MDASI symptom levels at or below the preoperative (baseline) level at 2 contiguous measurements.

Assessing PROs allows researchers and health professionals to identify who is at greater risk for high levels of postoperative symptoms. In addition, both the Charlson Comorbidities Index[26] and the American Society of Anesthesiologists physical status classification score, currently used as important routine measures of comorbidity for predicting major complications,[27-29] are predictive of risk for high symptom burden from postoperative pain. This finding is in accord with prior work in other cancer populations demonstrating the detrimental impact of comorbidities on PROs. The impact of comorbidities may be additive or even synergistic—an important area for future investigation.

This work additionally defined the time course of postoperative recovery after thoracic surgery, using a PRO-based approach. The late phase of recovery has been described as the time ''from hospital discharge to return to usual function and activities,''[6] yet agreement is lacking in contemporary clinical practice as to how to define and measure recovery after major cancer surgery, and what constitutes optimal care during recovery.[30] We defined ''recovery'' using a 2-pronged approach: symptom return to baseline, or symptom return to a mild severity level. Because two thirds of the patients in this study sample reported having no symptoms (rated 0 on a 0-10 scale) at baseline, the fact that the time to return to mild symptom levels (ratings 0-3) was much shorter than that to return to baseline symptom levels is not surprising.

This study has several limitations. First, the sample was a homogenous group of patients who had early-stage lung cancer. Future studies with more diversity are warranted, to identify major symptoms and define the trajectory of postoperative recovery with more generalizability. Second, the MDASI assesses a core set of 13 symptoms that are common to patients with cancer; an MDASI version that is specifically geared to perioperative care after thoracic surgery has not yet been created, tested, or psychometrically validated.

Third, we did not collect symptom scores on days 1 and 2 after surgery, and we did not assess objective measures affecting duration of hospital stay, such as fluid status, pain medicine usage, infection, or chest drainage. The symptomatic differences between VATS lobectomy and open thoracotomy that were observed clinically may have been even more striking if these data had been included. Finally, this study occurred before our institution's ERP program was established. The recovery period, symptom profiles, and specific risk factors for impaired recovery could vary after implementation of an ERP pathway for patients undergoing various types of thoracic surgery.[9,31]

In sum, the current study is among the first to describe the nature of the worst symptoms reported by patients with NSCLC, during the 3 months after thoracic surgery. The establishment of an ERP pathway may be an important part of perioperative management after cancer surgery, because ERPs can be expected to provide meaningful improvements in recovery that should hasten a patient's return to planned chemotherapy or other cancer treatment when indicated. Using a straightforward, concise tool, like the MDASI, to obtain the patients' perspectives on how well they are recovering, is a clinically relevant and user-friendly method for optimizing perioperative care.[9] Routine inclusion of an easy method, such as the MDASI, to characterize recovery via symptom report would be a novel PRO application in perioperative care that has the potential to improve standard practice.

Conflict of Interest Statement
The authors report no conflicts of interest in this work.

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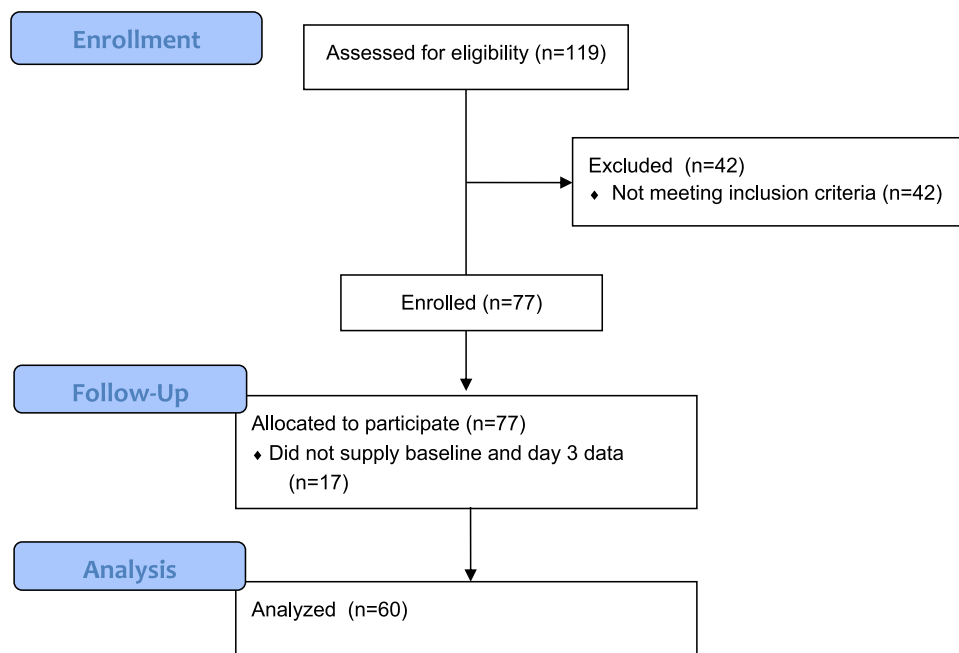
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FIGURE E1. Flow of participants into the study.

TABLE E1. Most-severe symptoms related to thoracic surgery, as reported by patients on the MD Anderson Symptom Inventory

Symptom	Before surgery (n = 60)	Day 3 (n = 60)	Day 5 (n = 20)	Week 1 (n = 51)	Month 1 (n = 44)	Month 3 (n = 16)
Fatigue	1.47 (2.17)	5.30* (2.90)	5.85* (2.76)	4.47* (2.74)	2.92† (2.45)	0.79 (1.31)
Pain	0.80 (1.96)	4.97* (3.16)	4.55* (2.70)	3.25* (2.84)	1.55† (1.97)	0.29 (0.83)
Drowsiness	1.08 (1.86)	4.68* (3.12)	3.20† (2.65)	3.40* (2.73)	1.39 (1.94)	0.07 (0.27)
Disturbed sleep	1.38 (2.19)	4.62* (3.61)	4.55* (3.28)	2.53 (3.08)	1.21 (1.68)	0.07 (0.27)
Shortness of breath	1.03 (2.07)	3.22* (2.99)	2.80* (2.57)	3.27* (2.96)	1.95 (1.89)	1.00 (1.57)

Values are M (SD). Differences in severity between the time point and baseline (presurgery) were statistically significant as shown. *$P < .0001$ by mixed modeling. †$P < .01$ by mixed modeling.

TABLE E2. Supplemental data for Figure 2, *A*: number of patients with moderate to severe symptoms, and probability of recovery

Symptom	Day	n (moderate to severe)	Probability of recovery	
			Estimate	95% CI
Fatigue	0	60		
	7	49	0.30	0.18-0.42
	14	39	0.48	0.34-0.62
	28	24	0.61	0.47-0.75
	56	15	0.67	0.55-0.79
	84	7	0.82	0.68-0.96
Pain	0	60		
	7	40	0.48	0.34-0.62
	14	28	0.61	0.47-0.75
	28	12	0.83	0.73-0.93
	56	5	0.87	0.77-0.97
	84	3	0.95	0.87-1.03
Drowsiness	0	60		
	7	37	0.52	0.38-0.66
	14	27	0.71	0.59-0.83
	28	11	0.85	0.75-0.95
	56	5	0.94	0.88-1.00
	84	—	—	—
Disturbed sleep	0	60		
	7	36	0.54	0.40-0.68
	14	25	0.70	0.58-0.82
	28	13	0.82	0.72-0.92
	56	5	0.90	0.82-0.98
	84	2	0.93	0.85-1.01
Shortness of breath	0	60		
	7	31	0.51	0.39-0.63
	14	28	0.62	0.50-0.74
	28	15	0.82	0.72-0.92
	56	8	0.85	0.75-0.95
	84	4	0.90	0.82-0.98

CI, Confidence interval.

TABLE E3. Supplemental data for Figure 2, *B*: number of patients with moderate to severe pain, and probability of recovery

Procedure	Day	n (moderate to severe)	Probability of recovery	
			Estimate	95% CI
VATS	0	29		
	7	16	0.68	0.52-0.84
	14	7	0.68	0.52-0.84
	28	3	0.94	0.86-1.02
	56	1	0.94	0.86-1.02
	84	1	1.00	1.00-1.00
Open thoracotomy	0	31		
	7	22	0.36	0.22-0.50
	14	19	0.60	0.46-0.74
	28	8	0.77	0.64-0.90
	56	3	0.85	0.74-0.96
	84	1	0.91	0.81-1.01

CI, Confidence interval; *VATS*, video-assisted thoracoscopic surgery.

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000   **Symptom recovery after thoracic surgery: Measuring patient-reported
        outcomes with the MD Anderson Symptom Inventory**
        *Christopher P. Fagundes, PhD, Qiuling Shi, PhD, Ara A. Vaporciyan, MD, David C. Rice, MD,
        Keyuri U. Popat, MD, Charles S. Cleeland, PhD, and Xin Shelley Wang, MD, MPH, Houston, Tex*

        Using the MDASI to elicit patient-reported symptom burden is a simple, clinically relevant way to
        optimize care after thoracic surgery.

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