Quality of life outcomes are equivalent after lobectomy in the elderly

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Objective: Prospective analyses of quality of life in elderly patients after lobectomy are limited, yet surgeons often recommend suboptimal therapy to these patients on the basis of the belief that lobectomy is poorly tolerated. Surgical decision making in elderly patients with lung cancer is better informed when the benefits to survival and quality of life after lobectomy are understood.

Methods: By using a validated quality of life instrument, 422 patients were prospectively assessed preoperatively and 3, 6, and 12 months after lobectomy. Outcomes were analyzed with respect to age (group 1: <70 years and group 2: ≥70 years). The outcome domains of physical functioning, role functioning, emotional functioning, cognitive functioning, social functioning, global health, and pain in the chest were analyzed using a mixed model. The trend in quality of life was determined according to age. The Kaplan–Meier method was used for analysis of overall survival.

Results: The mean age was 60.1 years in group 1 (N = 256) and 74.7 years in group 2 (N = 166). Baseline demographics and quality of life were similar except that group 2 had better emotional functioning scores and worse pain in the chest scores. Postoperatively, both groups demonstrated significant decreases in quality of life at 3 months. However, at 6 and 12 months, all domains had returned to baseline except physical functioning, which remained below baseline in group 2. Emotional functioning improved postoperatively for both groups. Overall survival at 5 years was not different between groups.

Conclusion: By using a validated quality of life assessment tool with measurements at baseline and serially after resection in a large patient population, this analysis quantifies the degree of impairment of quality of life after lobectomy and documents time to full recovery for both age groups.

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In patients with early-stage non-small cell lung cancer (NSCLC), lobectomy achieves the best long-term survival.¹ Yet, successful operations for stages I and II lung cancer are associated with a 5-year survival of only 40% to 70%.² Thus, treatment is often palliative rather than curative. Most studies published to date are concerned primarily with traditional outcomes, such as operative morbidity and mortality or long-term survival. The complex interplay among the treatment's benefits, risks, and the expectations held by patients with lung cancer serve to focus attention on the importance of health-related quality of life (QOL).

Information on QOL after operations for lung cancer surgery is sparse. Between 1994 and 2004, only 9 published articles were found that described QOL after lung

Abbreviations and Acronyms

EORTC QLQ	= European Organization for Research and Treatment of Cancer Quality of Life Questionnaire
NSCLC	= non-small cell lung cancer
QOL	= quality of life

cancer operations.³⁻¹¹ Of the 9 studies, only 3 included preoperative assessments, and although most used a validated QOL instrument, only 2 used a cancer-specific instrument.^{8,10} Clearly, a prospective, longitudinal study that follows a large patient population and that uses a cancer-specific instrument is needed to more accurately portray QOL after lung cancer operations.

Lung cancer disproportionately affects the elderly, with a median age at diagnosis of 70 years.¹² Prospective analyses of QOL in elderly patients after lobectomy are absent, yet surgeons may recommend operations with less proven oncologic efficacy to these patients on the basis of the belief that lobectomy is poorly tolerated. Surgical decision making in elderly patients with lung cancer is better informed when the benefits of lobectomy to survival and QOL are understood.

Materials and Methods

This is a retrospective review of prospectively collected data. The study was approved by the institutional review board at Duke University Medical Center.

Patients and Quality of Life Assessments

Patients with suspected lung cancer, who were seen in the Duke Thoracic Oncology Program, were asked to complete a QOL questionnaire preoperatively and then postoperatively at 3, 6, and 12 months. A trained clinical research assistant administered the questionnaire on a touch-screen computer, and attempts were made to administer the questionnaire before meeting with the clinician. Only patients who completed the baseline QOL assessment and at least 1 postoperative QOL assessment, and had undergone an anatomic lobectomy were included in the study. For purposes of analysis, patients in group 1 were defined as less than 70 years of age and patients in group 2 were defined as 70 years or older.

Quality of Life Measures

QOL was assessed using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC-QLQ-C30). The QLQ-C30 is a validated instrument for measuring QOL in patients with cancer and consists of 5 functional scales, 3 symptom scales, and a global health status/QOL scale (sample questions can be seen at http://groups.eortc.be/qol/downloads/modules/specimen_20qlq_c30.pdf).¹³ In addition, 2 symptom scales for pain in the chest and pain in the arm/shoulder, as well as a dyspnea symptom scale, from the validated lung cancer module (QLQ-LC13), were used. Both questionnaires are designed for self-completion by the patient. For the functional scales (ie, those

TABLE 1. Baseline demographics

	Group 1 (N = 256)	Group 2 (N = 166)
Mean age, y (range)	60.1 (33–69)	74.8 (70–93)
Male (%)	44.1	52.4
Married (%)	69.1	63.9
Schooling (%)		
High school or less	56.2	56.6
Attended college	35.9	35.5
Graduate degree	7.8	7.8
Race (%)		
White	82.8	91.6
African American	14.4	8.4
Other	2.3	0
Diagnosis (%)		
NSCLC	91.0	94.5
Squamous	30.5	36.7
Adenocarcinoma	60.5	57.8
Stage 1 or 2	86.4	86.7
Surgery technique (%)		
Thoracoscopic	59.0	67.5
Thoracotomy	41.0	32.5

NSCLC, Non-small cell lung cancer.

exploring physical, role, emotional, cognitive, and social functioning) and global health status, a higher value corresponds to a higher level of function or high QOL. Conversely, a higher score in a symptom scale corresponds to a higher level of symptoms or problems.

Statistical Considerations

The baseline characteristics of group 1 and group 2 were compared using the Fisher's exact test for dichotomous outcomes, and a 2-tailed *t* test was used for continuous variables. QOL scores collected from the EORTC QLC-C30 were linearly transformed to a scale of 0 to 100 in accordance with the EORTC guidelines.¹⁴ The major objective of this study was to determine how QOL changed longitudinally and to compare differences between group 1 and group 2. This comparison was made by fitting a linear mixed model for repeated measures with restricted maximum likelihood estimation method for each EORTC functional scale, the global QOL scale, as well as 2 pain scales and the dyspnea scale (SAS PROC MIXED, SAS Institute Inc, Cary, NC). Effects modeled included the patient's age group, survey time (preoperatively, 3, 6, or 12 months), and interaction between age group and survey time. Of primary interest in these analyses was the interaction, a measure of whether the effect of time on outcomes was the same between the 2 groups.

Because 20% to 38% of data were missing, sensitivity analyses were conducted to examine the effect of missing data on inferences. The model was reanalyzed with data imputed to replace the missing data. A Monte Carlo Markov Chain approach to multiple imputations was used with SAS PROC MI. The correlation of the 4 assessments of each outcome, marital status, living situation, sex, stage, education, and video-assisted thoracic surgery use, were used in estimating 5 complete datasets or imputations. A mixed linear model

TABLE 2. Baseline quality of life, mean scores

	Group 1	Group 2	P value
Physical functioning	83.7	81.0	.2
Role functioning	82.2	82.4	.9
Emotional functioning	74.1	78.9	.02
Cognitive functioning	85.0	85.8	.6
Social functioning	85.8	86.7	.6
Global QOL	69.9	68.7	.6
Pain in chest	16.2	8.0	<.0001
Pain in arm/shoulder	18.8	16.8	.4
Dyspnea	27.1	25.0	.5

QOL, Quality of life.

(SAS PROC MIXED) was fit to each dataset with factors describing the effect of time, age group, and their interaction. The results for the interaction were combined across models using SAS PROC MIANALYZE.

The survival function was estimated using the Kaplan–Meier method. Overall survival was calculated from the date of surgery to the date of death from any cause or censored at June 1, 2006. Survival was expressed as a proportion, and survival curves were compared using the log-rank statistic. SAS version 9.1 (SAS Institute Inc) was used for all analyses.

Results

Patients

Between January 1, 1999, and September 25, 2005, 564 patients took an initial QOL survey and underwent lobectomy at Duke University Medical Center. A total of 142 patients (N = 82 group 1 and N = 60 group 2) took only 1 survey and were excluded from this analysis. Reasons for patients taking only 1 survey included death within 3 months of surgery (N = 8 group 1 and N = 12 group 2, *P* = .09), patients still within first 3 months of follow-up (N = 16 group 1 and N = 6 group 2, *P* = .16), and patients who were still alive but lost to follow-up (N = 58 group 1 and N = 42 group 2, *P* = 1.0).

A total of 422 patients completed at least 1 postoperative survey and were included in this study. Demographics from the eligible patients are listed in Table 1. As indicated, the majority of patients were white and married, and had stage 1 or 2 NSCLC. The 2 groups were well balanced with respect to patient characteristics.

Quality of Life at Baseline

In compliance with entry criteria, all patients had preoperative QOL assessments. Table 2 summarizes the baseline QOL for each functional scale and symptom scale. The 2 groups were similar except that group 2 had higher emotional functioning and less pain in the chest at baseline.

Quality of Life Completion

All patients were asked to complete the QOL questionnaire at regularly scheduled follow-up appointments starting 3 months postoperatively. Subsequent completion rates varied between 62% and 80% for both groups (Table 3). Completion rates for each survey time point were similar between groups except at the 3-month survey, where 72% of group 1 and 62% of group 2 completed surveys (*P* = .39). The most common reason for not completing a survey was failure to show in the clinic. Because of the retrospective nature of the study, it was impossible to capture the patient’s specific reason for failing to show in the clinic at the proper survey time (eg, too sick, feeling too well, receiving cancer follow-up elsewhere).

Longitudinal Quality of Life

Subsequent QOL mean scores are listed in Table 4. Both groups 1 and 2 experienced significant reductions in physical functioning, role functioning, social functioning, and global QOL domains at the 3-month survey. Similarly, both groups had increased pain in their chests and arm, as well as increased dyspnea, at 3 months. By the 6-month survey, the QOL domains had returned to baseline for both groups. All domains except physical functioning remained not significantly different from baseline at the 12-month survey (Figure 1). Physical

TABLE 3. Quality of Life Questionnaire compliance

	Group 1								Group 2							
	Survey Time (mo)								Survey Time (mo)							
	Preop	3		6		12			Preop	3		6		12		
	No.	No.	%	No.	%	No.	%		No.	No.	%	No.	%	No.	%	
Assessments expected	256	256		254		247			166	166		164		156		
Patient deaths	0	0		2		7			0	0		2		8		
Assessments performed	256	184	72	203	80	178	72		166	103	62	132	80	112	72	
Reason missed																
Did not come to clinic		72	28	46	18	62	25			60	36	27	17	33	21	
Refused		0		1	0.4	2	0.8			0		0		3	2.0	
Institutional error		0		4	1.6	5	2.0			3	1.8	5	3.0	8	5.1	

TABLE 4. Quality of life scores at each assessment point

Assessment point	Group 1		Group 2	
	Mean score	SD	Mean score	SD
Preoperative survey				
Physical functioning	83.7	19.3	81.0	20.8
Role functioning	82.2	27.3	82.4	27.9
Emotional	74.1	21.5	78.9	19.6
Functioning	85.0	19.6	85.8	17.8
Cognitive	85.8	22.3	86.7	22.3
Functioning	69.9	21.5	68.9	24.2
Social functioning	16.2	25.1	8.0	17.6
Global QOL	18.3	22.8	16.8	25.7
Pain in chest	27.1	26.8	25.0	29.3
Pain in arm				
Dyspnea				
3-mo survey				
Physical functioning	77.9	18.4	73.9	24.6
Role functioning	65.3	30.1	63.9	32.5
Emotional	74.2	22.8	77.2	20.6
Functioning	81.4	21.3	84.8	18.0
Cognitive	76.8	25.9	77.2	28.2
Functioning	63.5	22.3	62.1	22.1
Social functioning	26.6	26.9	18.4	23.8
Global QOL	33.4	28.7	26.1	25.7
Pain in chest	41.7	27.6	40.5	30.5
Pain in arm				
Dyspnea				
6-mo survey				
Physical functioning	79.4	20.2	79.4	20.7
Role functioning	73.7	29.9	78.2	28.0
Emotional	76.6	20.2	82.4	18.0
Functioning	82.0	19.9	85.8	18.9
Cognitive	81.4	26.3	86.2	22.3
Functioning	68.3	21.9	69.7	20.9
Social functioning	18.4	24.5	10.9	19.0
Global QOL	23.8	25.7	23.2	26.4
Pain in chest	38.1	26.5	37.7	30.4
Pain in arm				
Dyspnea				
12-mo survey				
Physical functioning	81.9	19.1	78.0	22.8
Role functioning	79.0	27.0	80.4	29.0
Emotional	78.5	21.1	82.4	18.5
Functioning	83.4	19.8	83.6	18.9
Cognitive	82.6	24.4	87.8	23.2
Functioning	70.5	23.3	69.8	21.6
Social functioning	16.7	23.1	9.7	17.0
Global QOL	22.2	25.3	17.6	22.9
Pain in chest	33.0	25.7	32.7	30.8
Pain in arm				
Dyspnea				

SD, Standard deviation; QOL, quality of life.

functioning decreased below baseline in group 2 at the 12-month survey. Emotional functioning did not change at the 3-month survey but then significantly increased at both the 6 and 12-month surveys for both groups. Cognitive functioning did not differ from baseline at any of the subsequent survey times. The symptom scales for pain returned to preoperative values by 6 months and remained similar to baseline at 12 months. The dyspnea symptom scale recovered some but remained above baseline for the 6 and 12-month surveys. The linear mixed model examining the overall effect of the interaction between survey time and group was not significant for any domain or symptom scale. This suggests that although both groups experienced changes in QOL over the year, they did not differ from each other. The *P* values for the overall interaction were as follows: physical functioning = .08, role functioning = .33, emotional functioning = .20, cognitive functioning = .24, social functioning = .08, global QOL = .54, pain in chest = .98, pain in arm = .39, and dyspnea = .89. The sensitivity analysis with multiply imputed data sets confirmed that there was no evidence of a statistically significant interaction. The resulting *P* values were physical functioning = .36, role functioning = .65, emotional functioning = .40, cognitive functioning = .35, social functioning = .38, and global QOL = .85.

Survival

Survival for the 2 groups is depicted in Figure 2. Median follow-up for the whole cohort was 28.3 months. Median survival was calculated to be 73.1 months for group 1 and 56.7 months for group 2. There was no significant difference between survival curves by log-rank test (*P* = .72).

Discussion

Health-related QOL is being increasingly recognized as an important issue in cancer care and research. Yet, information on QOL after lung cancer operations is limited. This study compared preoperative and postoperative QOL after lobectomy in 422 patients and specifically analyzed these changes with respect to age. A clinically validated, cancer-specific instrument was used to measure QOL in patients who underwent lobectomy predominantly for early-stage NSCLC. To our knowledge, this study represents the largest prospective, longitudinal, evaluation of QOL in patients undergoing operations for lung cancer to date.

The multidimensional nature of the QOL assessment raises some important issues of interpretation. Multiplicity of comparisons and interdependency of responses at successive times make it necessary to focus on the whole pattern of results. The exclusive use of patients with complete data provides unbiased, albeit inefficient, results, if the data that are missing occurs completely at random. Alternatively, it provides biased results, if data that are missing occurs not completely at random (the more common form of missingness). In this study we used a linear mixed-effect model to analyze

Figure 1. QOL after lobectomy. Mean QOL domain scores plotted as a function of survey time.

all available data and to reconcile the fact that intrasubject QOL measurements are not independent (repeated measures).¹⁵ On the basis of this analysis, both groups demonstrated significant reductions in physical, role, social, and global QOL domains, as well as increased pain involving the chest and arm/shoulder, and increased dyspnea at 3 months postoperatively. All parameters, except dyspnea, had recovered to baseline values by 6 months. Both groups demonstrated a similar decrement in QOL with a parallel return to baseline. The one notable exception was in the domain of physical functioning, which had returned to baseline by 6 months and decreased below its preoperative value in pa-

tients 70 years or older by 12 months. It is unclear whether physical functioning remained reset at this lower level or continued to deteriorate over time in these patients.

Patients aged 70 years or more had less impairment in emotional functioning preoperatively. This domain remained at its baseline value in both groups through the first 3 months after operation, but then demonstrated a significant increase by 6 months. This trend persisted through the end of the study. This reduction in emotional functioning preoperatively may be explained in part by the psychologic impact related to the recent cancer diagnosis. Not surprisingly, worsened emotional functioning seems to affect younger patients more than the older patients. In a similar pattern, older patients seem to perceive pain as being less severe both at baseline and postoperatively when compared with younger patients.

The observation that QOL decreases over the first 3 to 6 months postoperatively and then returns to its preoperative level has been reported by others. Dales and colleagues⁹ reported on 117 patients who underwent thoracotomy for presumed lung cancer (NSCLC in 91, other pathology in 26). QOL was measured with the Sickness Impact Profile (SIP) and Spitzer QL-Index preoperatively and at 1, 3, 6, and 9 months postoperatively. Dales and colleagues found that QOL and dyspnea significantly worsened at 1 and 3 months postoperatively but returned to baseline at 6 and 9 months. Zieren and colleagues¹⁰ reported similar findings using the Spitzer QL-Index and an earlier version of the EORTC QLQ (QLQ-CLC36). They examined 2 cohorts of patients who had undergone curative operations for lung cancer; 1 cohort completed a single QOL survey 12 months postoperatively (N = 52) and another was surveyed preoperatively and then again at discharge (median 11 days) and 3, 6, 9, and 12 months postoperatively (N = 20). In the latter cohort,

Figure 2. Overall survival via the Kaplan-Meier method. Survival was compared with the log-rank statistic.

patients demonstrated significant decreases in physical, role, and global domains of QOL, and increases in disease symptoms, such as dyspnea, at discharge. These differences, however, had disappeared at the 3-month survey.

Handy and colleagues⁶ reported on 139 patients undergoing lung resections who were evaluated with the short-form health survey [36 items] and the Powers' QOL index before operation and then again at 6 months after operation. Preoperative QOL in patients undergoing operation for lung cancer was significantly worse than in healthy controls. Handy and colleagues found that at 6 months, subscales for physical functioning, role-physical, bodily pain, and mental health on the short-form health survey [36 items] were significantly worse than baseline. Because the data collected were truncated at 6 months, however, it is uncertain whether these findings persisted at 12 months. In addition, Handy and colleagues found that emotional functioning, although not significantly worsened, failed to improve with time. An unanswered question is whether the difference in their findings compared with those of the present study can be attributed to a different patient population or differences in QOL instruments.

Compliance with the QOL assessment, defined as the number of assessments actually completed as a proportion of those expected, ranged from 62% to 80%.¹⁶ The most commonly missed survey time point was the 3-month survey with 28% of group 1 and 38% of group 2 missing this time point. Missing data were rarely the result of patient refusal or neglect, because a trained clinical research nurse guided each patient through their surveys. A more common reason was a failure of the patient to return for clinic follow-up within the prescribed time frame. Compliance with the QOL assessment is important because the failure to return for clinic follow-up may be influenced by the patient's QOL at that particular time point.¹⁷ Because of the retrospective nature of this study, it is not possible to determine whether a patient missed the assessment because of postoperative disability, with associated poor QOL, or because he or she was recovering exceptionally well and chose to skip a clinic visit. Moreover, because of our large referral area, some patients may have chosen to receive part of their cancer care with their local area physician. Certainly, the larger percentage of group 2 patients who missed their 3-month survey could introduce significant bias if these patients did so because of increased postoperative disability.

Missing data are common in QOL studies, and they are usually not missing completely at random.¹⁸ Thus, to account for missing data, appropriate statistical modeling (linear mixed model) was used. Sensitivity analysis was performed by replacing the missing data with multiply imputed values that were generated from individual baseline characteristics and previous QOL values.¹⁹ Furthermore, the same linear mixed model was used to analyze each of the 5 imputed datasets, and SAS PROC MIANALYZE was applied to combine the results across models. Although it is impossible for any model to completely remove all possible bias, the findings

from this analysis confirmed the original results; no difference in QOL was observed between groups.

Overall survival for the 2 groups was not different, whereas median survival time for the 2 groups appeared different because of a separation in survival curves at approximately 60 months. The median survival was 73 months for group 1 and 56.7 months for group 2.

The most important limitation to the generalizability of this study's findings is the selection bias inherent in its retrospective design. The study cohort represented patients who were motivated and willing to complete QOL surveys, preoperatively and postoperatively. This study delineated the time course of change in QOL after lobectomy, but its conclusions obviously do not help a surgeon choose which particular elderly patient will survive a major lung cancer operation. Indeed, although not statistically significant, more patients in group 2 died within 90 days of completing the preoperative survey than in group 1 (12 patients in group 2 vs 8 patients in group 1). Another limitation to this study's generalizability is the relatively high percentage of women who were enrolled (55.9% in group 1 and 47.6% in group 2). This proportion is slightly higher than the general pool of patients with lung cancer and may indicate that women generally are more willing to complete QOL surveys.

To summarize the main findings, this study delineates the magnitude of the change in QOL experienced by younger and older patients undergoing anatomic lobectomy and shows that they have similar decrements to 3 months. This study also documents that the time course to recovery of QOL in both groups is generally less than 6 months.

Conclusions

This study examined the longitudinal QOL in a large cohort of patients with lung cancer undergoing lobectomy, using a clinically validated, cancer-specific instrument. Postoperative QOL was reduced transiently and to a similar degree in patients aged less than 70 years and in patients aged 70 years or more. Further, the 5-year survival between groups was equivalent. These data support the use of lobectomy in selected elderly patients with lung cancer.

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Discussion

Dr Francis C. Nichols (Rochester, Minnesota). Dr Burfeind and colleagues have pointed out that surgical morbidity, mortality, and long-term survival have been our traditional reported outcome parameters. However, with multimodality diagnostic and treatment options now becoming routine in patients with certain diseases, particularly lung cancer, an ever-increasing amount of time has to be spent by patients in investigating, treating, and hopefully regaining their personal health. This has resulted in a growing appreciation about health-related QOL for these patients. Specifically regarding our patients with lung cancer, who are indeed oftentimes middle-age, as you said, or older, it would seem that knowledge of QOL would provide useful information, in fact, essential information for the patients, their families, primary care providers, and other specialists, namely, our referrers. In broad terms, QOL is a concept that is easy to intuitively grasp but difficult to reliably measure. It's a dynamic concept varying over time. The authors are to be commended on the prospective nature of this study dating back to 1999, which involved a large cohort of patients, 422, which to my knowledge represents the largest number of patients thus reported on. As a clinician, I worry about missing data. Although many of us in the room

aren't statisticians, I and perhaps others get nervous when 20% to 38% of the data are missing. I would have thought that with a dedicated clinical research assistant administering the questionnaire and use of a computer that missing data elements could have been less or caught earlier. If the missing data were due to patients not keeping their scheduled clinic appointments, is there any process now in place for avoiding that in the future? Could you please comment on this 20% to 38% missing data and the validity of imputing data?

Dr Burfeind. As you know, missing data is a common problem in QOL research, and it's important because the reason it's missing can often be related to a patient's QOL. That being said, if they don't come to the clinic, there are numerous reasons why that may happen. It may be that their QOL is so poor that they don't come to the clinic. Alternatively, in some instances it could be that they're feeling so well that they skip a clinic appointment or that they receive part of their care elsewhere, and at a large referral center, such as Mayo or Duke, many people will get referrals from elsewhere and some of the patient's postoperative care may be assumed closer to home. I think those are some of the reasons explaining the missing data. As you may have noticed, it was almost never missing because of a patient coming to the clinic and then either refusing to take the survey or us just forgetting to administer it. It was almost always because the patient didn't show up in the clinic. As far as the imputation method, I think we used the most up-to-date method to do that; that is, it took into effect the patient's other QOL scores as well as the preoperative variables that I had said earlier. So we tried to use all available data to impute rather than either throwing out all the patients who didn't have complete data or using the last value forward or mean value methods. Although no method of imputation is perfect, we tried to use a method that would introduce the least amount of bias.

Dr Nichols. My second question relates to the respondents. As you said, the majority of the respondents were women and 82% of the respondents were both white and married. Initially, 564 patients were given the survey and underwent lobectomy. Do you have any idea how many patients never participated in the initial survey process and still underwent lobectomy at Duke, and would their demographics have altered the characteristics of your cohort?

Dr Burfeind. It's possible, and that's certainly a bias. We do not collect the information prospectively on who decides to participate and who doesn't. I do know that we perform approximately 300 anatomic lobectomies per year, so that would be approximately one third of the patients are participating in this study.

Dr Nichols. My final question relates to your conclusion that QOL domains after lobectomy are similar and usually transient in these 2 groups, and because the 5-year survival data between the groups is no different, your data therefore support lobectomy in the elderly. What I don't think has been addressed is the clinical decision-making process that qualified these patients for lobectomy in the first place. I think I, my colleagues, and others here in this room, with a reasonable degree of comfort, can predict who we can get through operations and ultimately out of the hospital. What I haven't mastered is which patients will have their QOL devastated. Was there a difference between the 2 groups in terms of operative mortality, or, for that matter, morbidity, and did this have any relationship with your preoperative QOL scores?

Dr Burfeind. That's a very good point, and I think that's the most important limitation to this study. This is taking that group

of people who 4 thoracic surgeons all thought they could get through a lobectomy, and, in fact, did get through the lobectomy. Because you had to take a preoperative and at least 1 postoperative QOL assessment, that means you survived at least 90 days. I think what it does say, though, is that in that group of patients who you think you can get through the operation, their QOL isn't usually devastated, on average, or as it would be measured here, but in fact they will have a transient decrease, but it should come back to baseline. The more important question that you had was can we do something to help predict which patients are going to survive, and I am actually looking at that information now and trying to see whether baseline QOL can predict 30-day mortality. It has been shown in some other types of cancer and it may here. It's just that I need some more time to make sure it's not confounded by things like performance status and forced expiratory volume in 1 second and make sure that it shakes out in a multivariable model that way.

Dr Nichols. You and your colleagues are to be commended on trying to move us forward in our quest of furthering our understanding of QOL.

Dr Scott J. Swanson (*New York, New York*). Obviously I'm going to ask you one question. Did you look at video-assisted thoracic surgery as a separate category and did that have any effect? If we're going to do one at a time, I'll have one other question.

Dr Burfeind. Being from Duke, I definitely looked at that. This dataset was not ideally set up to answer that question. The short answer is there was no difference between QOL in those 2 groups. I think the main problem was that by using 3 months as your first postoperative QOL time point, you're missing the boat. The main advantages to video-assisted thoracic surgery lobectomy may have been most significant at 1, 2, or 6 weeks, even 2 months. The 3-month time point was the one that had the most missing data. So it makes it really hard to draw firm conclusions.

Dr Swanson. The second question, 70 years of age is getting to be sort of younger for us as we go on here. Did you look at sort of extreme ages, maybe more than 80 or 85 years, and see if that was different?

Dr Burfeind. I didn't, and I think that's a great point, Scott. I picked 70 years because it was the median age of patients diagnosed with lung cancer in the United States. Most previous studies had used a cutoff of 65 years to describe elderly patients. We're glad when somebody is 65 years. That's one of the young patients. But I also didn't keep age as a continuous variable and try to find some cut point above which QOL seemed to suffer more. I could go back and do that, but it makes the statistical model quite complex. So actually I don't have the answer.

Dr Swanson. Do you know how many patients aged more than 80 years are in that group?

Dr Burfeind. Seventeen of the 166 patients were 80 years or older, so the majority of patients in group 2 were between 70 and 80 years.

Dr Michael T. Jaklitsch (*Boston, Massachusetts*). Thank you for this study. I think it's a very important contribution. If for no other reason, suggesting that whatever nadir there is that may have separated the 2 groups is resolved by 3 months, that in and of itself is extremely valuable data. There are 2 other variables that I would ask you to look at within this dataset. What was the incidence of people going to rehabilitation facilities? In particular, that 3-month mark may be that they have gotten out of rehabilitation and they're not quite strong enough to make the trip back down to Durham. So that becomes an important variable. And then also, because respiratory reserve declines as a function of age, if you look at which lobe was taken, you may pick up a signal there on the lower lobes, because if you take a lower lobe in an 80-year-old patient, that's a much bigger hit than if you took the upper lobe.

Dr Burfeind. I agree. I will look at those things. The retrospective nature of this made it difficult to try and parse out why somebody didn't come back to the clinic. You know, if this had been in a randomized trial and we were very closely monitoring that, we probably would have called to find out why they didn't come back, and that is a very important limitation and a source of important bias in this study.

Dr Thomas W. Rice (*Cleveland, Ohio*). Age is a continuous variable, and by dichotomizing your data, you've lost a lot. So you would do us a big service by looking at the continuum and telling us if there is a certain age we should be worried about. And most of us aren't concerned about the 70-year-old. We're concerned about the 80-year-old. So please do it as a continuous variable.

Dr Burfeind. Thank you, Dr Rice.

Dr Neri M. Cohen (*Baltimore, Maryland*). What number of patients go on to get adjuvant therapy? Because that nadir in the 3 months is when the 1B's and the II's are going to be in the midst of their chemotherapy, and I can't tell you how many times they come back and tell me at 3 months, "The surgery was a breeze. The chemo is killing me."

Dr Burfeind. That's a very good point, and I didn't look at that.

Dr Douglas E. Wood (*Seattle, Washington*). I'll make one other point about your conclusions. I guess I'll be even more optimistic than some of the other discussants and say that your conclusions said that one can consider resection in selected elderly patients. I guess I would be even more bold just to say that the default position would be that we would consider resection in all elderly patients and that one has to have a compelling reason not to offer it rather than the other way around.

Dr Burfeind. Thank you, and I think that is the approach we typically take, exactly.