Survival and quality of life at least 1 year after pneumonectomy

Ayesha S. Bryant, MD, Robert J. Cerfolio, MD, and Douglas J. Minnich, MD

Objective: Quality of life after pulmonary resection is becoming an increasingly important part of the conversation between patients and surgeons. Pneumonectomy is often called a *disease*. The objective of this study was to assess the physical and mental aspects of patients' quality of life at least 1 year after pneumonectomy.

Methods: Quality of life was ascertained using the Short Form-12 (SF-12) survey on a consecutive series of patients who were at least 1 year postoperative from a pneumonectomy. Both the physical and mental component scores of the quality-of-life survey were obtained and compared.

Results: There were 152 patients who underwent pneumonectomy between January 1997 and December 2010 by the same surgeon (104 for non-small cell lung cancer); 111 patients met the eligibility criteria. Mean survival was 3.4 years and the overall 5-year Kaplan-Meier survival was 38%. Responses to the quality-of-life survey were obtained in 108 of 111 patients (98%) who were at least 1 year postoperative. The overall quality-of-life score was comparable with that of the healthy population and patients with chronic diseases. The mean physical component score was significantly lower than that of the healthy population score ($P = .04$); the mental quality-of-life score was higher than those for patients with certain chronic diseases such as liver or kidney disease ($P = .05$). After multivariate analysis, only age remained a significant predictor of the physical component score.

Conclusions: Pneumonectomy is tolerated in carefully selected patients. The physical quality-of-life score 1 year after resection is significantly lower than the average population, yet the mental score in these patients is higher. Future studies on quality of life should be considered for all medical therapies, and stratification of the mental score from the physical score should be reported. (J Thorac Cardiovasc Surg 2012;144:1139-45)

Quality of life (QOL) is becoming an increasingly important part of the conversation between patients and physicians. Most patients are willing to accept the risks of immediate postoperative complications, yet not the risks of potential long-term functional disability after lung resection. Patients want reassurance that they will not be left physically or mentally handicapped and will be able to carry out activities of daily life after pulmonary resection.¹

Pneumonectomy is often referred to as a *disease*. Graham and Singer² reported the first successful pneumonectomy at the American Association of Thoracic Surgery annual meeting in 1933. Since that initial presentation, there remains much controversy surrounding this operation not only in terms of early postoperative mortality, but with

regard to the long-term detrimental impact on QOL.³⁻⁵ Many clinicians argue that patients who undergo pneumonectomy subsequently have a poor QOL, and therefore surgeons should only select it as a last option.^{6,7}

Few reports have evaluated the long-term (≥ 1 year postoperatively) mental and physical components of QOL in larger postpneumonectomy cohorts. The objective of this study was to assess the postoperative mental and physical QOL scores using the Short Form-12 (SF-12) survey in a consecutive series of patients who underwent pneumonectomy ≥ 1 year after pneumonectomy.

METHODS

This was a prospective cross-sectional study to evaluate the long-term impact on QOL of a consecutive series of patients who underwent pneumonectomy by the same general thoracic surgeon (R.J.C.). Pneumonectomy was performed on patients with non-small cell lung cancer only if sleeve resection of the bronchus or artery could not render a negative margin. We have reported previously our indication and workup for patients with non-small cell lung cancer and our technique for attempting sleeve resections of the artery and bronchus.^{8,9} No absolute threshold for a postoperative predicted percent diffusing capacity of the lung for carbon monoxide (DLCO%) or percent forced expiratory volume in 1 second (FEV₁%) was used below which pneumonectomy was denied; however, in general, a postoperative predicted DLCO of 30% and a postoperative predicted FEV₁ of 30% was used. Patients who were <19 years of age at the time of surgery were excluded from this study. In addition, pneumonectomy was sometimes performed for patients with benign disease with a destroyed lung. These patients were included in this study to elucidate more clearly the difference between cancer patients and those with inflammatory disease. The indications for

From the Division of Cardiothoracic Surgery, University of Alabama at Birmingham, Birmingham, Ala.

Disclosures: Robert J. Cerfolio is a speaker/consultant and has received grant support from Neomend and Precision, and is a speaker/consultant for Intuitive. Douglas J. Minnich is a consultant for superDimension. Ayesha S. Bryant has nothing to disclose with regard to commercial support.

Read at the 92nd Annual Meeting of The American Association for Thoracic Surgery, San Francisco, California, April 28-May 2, 2012.

Received for publication May 3, 2012; revisions received July 2, 2012; accepted for publication July 30, 2012.

Address for reprints: Ayesha S. Bryant, MD, Division of Cardiothoracic Surgery, University of Alabama at Birmingham, 703 19th St S, ZRB 739, Birmingham, AL 35294 (E-mail: abryant@uab.edu).

0022-5223/\$36.00

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<http://dx.doi.org/10.1016/j.jtcvs.2012.07.083>

Abbreviations and Acronyms

DLCO	= diffusing capacity of the lung for carbon monoxide
FEV ₁	= forced expiratory volume in 1 second
IRB	= institutional review board
QOL	= quality of life
PFT	= pulmonary function test
SF-12	= Short Form-12
SF-36	= Short Form-36

pneumonectomy for inflammatory diseases have been described previously.¹⁰ Prior to pneumonectomy, patients underwent pulmonary function tests (PFTs), computed tomographic scan, ventilation/perfusion scan, and echocardiogram, and were asked to assess their own performance status using the Eastern Cooperative Oncology Group performance status score.¹¹

Starting in 2003, the SF-12 survey was administered to all patients who had undergone a pneumonectomy since 1996. After 2003 the survey was administered prospectively to patients 1 year after they underwent a pneumonectomy. SF-12 is a shorter version of the standard Short Form 36 (SF-36), and it is also a validated tool used to assess the patient's QOL; it permits calculation of a physical component score and a mental component score.¹² Appendix 1 shows the SF-12 survey used in this study. Responses were stratified by the physical and mental components scores; these scores range from 0 (lowest level of health) to 100 (highest level of health). The national normalized value (as validated by Quality Metric Inc, Lincoln, RI) is 50.0 with a standard deviation of 10.¹³ Mental and physical component scores of these patients were compared with scores obtained for healthy patients; the general U.S. population; and patients with diabetes, hypertension, and liver or kidney diseases as reported by the National Survey of Functional Health Status.¹² A higher mental component score indicates a positive effect, absence of psychological distress, and limitations in usual social or role activities as a result of emotional problems; a higher physical score indicates fewer physical limitations, disabilities, or decrements in well-being as well as a high energy level.¹³

Major morbidity was defined as we have described previously.⁸ Operative mortality was defined as death within 30 days of the operation or prior to discharge. Information was obtained through hospital databases, medical records, and/or family reports. Data were exported from Excel (Microsoft Corp, Seattle, Wash) to SAS version 9.1 (SAS Institute, Cary, NC) software. Descriptive statistics were used to estimate the frequency of categorical and median of the continuous study variables. Subgroups analysis, which consisted of comparison of mental and physical scores stratified by age, gender, indication for operation, final pathologic stage, neo-adjuvant therapy, and comorbidity, were performed by means of the Mann-Whitney *U* test. Comparisons were done with paired, 2-tailed *t* tests for means of normally distributed continuous variables and Wilcoxon rank sum tests for skewed data. Either the χ^2 or the Fisher exact test was used to compare categorical data. A stepwise multivariate logistic regression model was used to assess for any correlation of QOL score with subgroups. The University of Alabama at Birmingham's institutional review board (IRB) approved this protocol (E100827024) as well as the prospective database (X030403013) used to collect information for this study. Individual consent was waived for inclusion in this study; however, it was required and obtained to enter patient data in the prospective database.

RESULTS

Between January 1997 and December 2011, 152 patients underwent a pneumonectomy. Of the 152 patients, 2

patients were excluded as a result of age <19 years, 11 patients died within 90 days of surgery, and 29 patients died within 1 year of surgery, thus leaving 111 patients eligible for this study. The characteristics of these 111 patients are shown in Table 1. A major postoperative morbidity occurred in 37 patients (23%), including the 10 patients (6.7%) who had an operative mortality. The mean survival was 3.4 years and the overall 5-year Kaplan-Meier survival was 37%.

Responses to the SF-12 QOL survey were obtained in 108 of the 111 patients (98%) who were alive at least 1 year postoperatively. Table 2¹³ shows that the mean physical component score in our cohort was significantly lower than that of the average U.S. population's score ($P = .02$), whereas the mental QOL score was significantly higher ($P = .03$).

Univariate analysis of patient characteristics showed that mental QOL differed significantly by: gender (females had a higher mental component score than males, $P < .001$), indication for surgery (patients who underwent resection for malignancy had a higher mental score, $P < .001$), and disease recurrence (patients who had a recurrence had lower mental scores). There was no significant difference observed based on age, preoperative PFTs, neo-adjuvant therapy, final pathologic stage, smoking status, or comorbidity. On multivariate analysis, none of these factors remained significantly associated with the mental QOL score. Univariate analysis showed that physical QOL differed significantly by age (older patients had a lower physical component score, $P = .01$), FEV1% score (patients with a higher FEV1% had a higher physical component score, $P < .001$), and indication for surgery (patients undergoing surgery for malignancy had a higher physical score, $P = .05$). There were no significant differences observed based on gender, DLCO%, neo-adjuvant therapy, final pathologic stage, smoking status, comorbidity, or recurrence. On multivariate analysis, only age remained significantly associated with the physical component score ($P = .02$).

DISCUSSION

General thoracic surgeons try to avoid pneumonectomy in patients with lung cancer because of the reported poor QOL, increased morbidity and mortality, and the impression that a pneumonectomy is, in and of itself, a disease. However, sometimes a pneumonectomy is the only way to achieve an R0 resection. In general, it should be reserved for patients who are N2 lymph node negative, have acceptable pulmonary and cardiac function, and suitable performance status. Interestingly, pneumonectomy is often not offered for patients who have a metastatic lesion to the lung because of the opinion that it offers only local control and it has an associated poor QOL. The perception that a patient postpneumonectomy has a poor QOL secondary to physiologic impairment was the impetus for this study.

TABLE 1. Patient characteristics (preoperative) of the 111 patients eligible for the study

Characteristic	Value
Age, y (range)	58 (19-73)
Male, n (%)	54 (49)
Current smoker (quit <1 mo prior to surgery), n (%)	23 (21)
Preoperative PFTs	
FEV ₁ % (SD)	76 (12)
DLCO% (SD)	72 (14)
Pao ₂ , mm Hg (range)	72 (66-88)
Paco ₂ , mm Hg (range)	42 (39-45)
Preoperative ECOG status (range)	1 (0-2)
Neo-adjuvant treatment, n (%)	32 (29)
Indication for surgery, n (%)	
Malignant lesion	97 (87)
Benign (infection)	14 (13)
Side of pneumonectomy, n (%)	
Right	58 (52)
Left	53 (48)
Pneumonectomy type, n (%)	
Completion	29 (27)
Radical	10 (6)
Standard	72 (67)

PFT, Pulmonary function test; FEV₁, forced expiratory volume in 1 second; SD, standard deviation; DLCO, diffusing capacity of the lung for carbon monoxide; Pao₂, partial pressure of oxygen in blood; Paco₂, partial pressure of carbon dioxide in blood; ECOG, electrocorticogram.

There are few data in the literature that evaluate QOL in patients postpneumonectomy, and none that evaluate the long-term mental and physical QOL scores ≥ 1 year after pneumonectomy.

Leo and colleagues,¹⁴ in 2010, evaluated QOL using a Quality of Life Component 30 survey pre- and 6 months postoperatively in 41 patients who had a pneumonectomy. They found that 1 of 4 patients reported a significantly decreased QOL 6 months postoperatively. Similar to our results, they also reported that patients who were >70 years of age at the time of surgery had a significantly poorer QOL.

Deslauriers and associates,⁴ in 2011, evaluated QOL of 100 patients that were ≥ 5 years postpneumonectomy. They used physiologic studies as a surrogate for QOL

and showed that most patients were able to adjust to living a “near-normal life” after pneumonectomy. Their conclusions were derived from an evaluation of physiologic parameters, which included FEV₁%, DLCO%, maximal oxygen uptake, 6-minute walk test, chest roentgenogram, ipsilateral diaphragmatic motion, phrenic nerve conduction, and echocardiography. Their findings provided unique physiologic information; however, QOL was not assessed in this study.

Brunelli and coworkers,¹⁵ in 2007, showed there was little correlation between QOL measurements and the physiologic tests physicians often order to assess QOL. They administered the SF-36 survey to 156 patients who underwent pulmonary resection, 12 of whom had a pneumonectomy. They surveyed patients preoperatively and at 1 and 3 months after resection. Similar to our findings, they showed in their patients postpneumonectomy that their physical component scores were decreased significantly and yet their mental component scores were unchanged.

Our results show that 1 year after pneumonectomy, patients have comparable mental scores with that of the general population; the mean mental score was actually higher than patients with other chronic diseases. This difference persisted even in patients who had both a pneumonectomy and a chronic illness such as diabetes mellitus or heart disease, or who received neo-adjuvant therapy. This higher mental score may be attributed to the fact that most patients in our series had a malignancy; cancer patients who have been completely resected often report a higher mental score.

When we compared the patients who had a pneumonectomy for cancer with those who had a pneumonectomy for benign disease, the mental score and physical score were both significantly higher in the patients who had the pneumonectomy performed for malignancy. This further supports the theory that patients who have cancer who undergo resection report higher mental scores. In this study, we also found that women reported a higher mental score than men, and relatively similar physical scores. These findings are in contrast to Ilonen and colleagues,¹⁶ who reported a significantly lower QOL in women who underwent pneumonectomy. There was no significant difference in the mental score based on age. However, not surprisingly, the physical scores of the younger cohort were significantly higher than those of older patients.

The strengths of our study include the large number of patients followed over a long time period; all procedures were performed by the same surgeon who used similar pre-, intra-, and postoperative protocols; the large sample size of patients postpneumonectomy only; high response rate to the surveys (98%); and the fact that the SF-12 is a validated, standardized survey.

Limitations of this study include the inherent subjectivity of any study on QOL. Other limitations include the fact

TABLE 2. Mental and physical component scores of postpneumonectomy patients compared with general US populations, including healthy adults and those with chronic diseases¹³

	Mental component score, pt (±SD)	Physical component score, pt (±SD)
Healthy adults	52.3 (7.9)	54.3 (6.2)
General U.S. population	49.4 (9.8)	49.6 (9.9)
Hypertension	49.1 (9.5)	43.7 (10.3)
Diabetes mellitus	47.3 (10.7)	41.5 (11.1)
Kidney disease	45.2 (10.1)	37.9 (11.2)
Liver disease	44.1 (12.9)	42.0 (12.1)
Postpneumonectomy patients	52.1 (10.7)	35.8 (8.9)

SD, Standard deviation.

that the SF-12 survey has been shown to yield less reproducible and precise scores compared with its longer SF-36 counterpart. However, we opted to use the SF-12 survey in lieu of its longer counterpart or other QOL surveys that may yield additional information as a tradeoff for a higher response rate. In our experience, patients are less likely to complete and return longer surveys; they are more accurate when they use shorter ones. In addition, the survey was only administered 1 year postoperatively; consequently, our results do not reflect QOL of patients who died prior to that. These patients may have had the lowest QOL scores as well as lower PFT scores, which could explain why pulmonary function was not associated significantly with QOL outcome in this study. We did not administer the survey both pre- and postoperatively, and thus we were unable to evaluate changes from baseline values or temporal changes. Our study is different from other studies because 27% of our patients underwent completion pneumonectomy. These operations are often more difficult and this could have skewed our results and increased morbidity and mortality. In addition, patients who have pneumonectomy for benign disease often have a lower QOL preoperatively than those with cancer, and this, too, may have skewed our results and lowered the QOL data falsely.

Thus, whether the old adage that “pneumonectomy is a disease” is true depends on the definition of the word *disease*. In this study, we tried to define what a disease is by using QOL information for patients with common diseases such as diabetes mellitus, kidney disease, and hypertension. We found that patients postpneumonectomy have similar QOL scores, and thus pneumonectomy is a disease. Our results were surprising to us and showed the relatively marginal QOL these patients have 1 year after pneumonectomy and the high 1-year mortality rate. However, like many other diseases, pneumonectomy can be well tolerated.

We conclude that, in carefully selected patients, a pneumonectomy is an acceptable operation. However, pneumonectomy reduces significantly a patient's physical score on the QOL survey, particularly in elderly patients. Given the higher mental QOL scores in our cohort, the notion that this operation leaves a patient in an unfit state is not supported by the patient's perception of their own functional status. The improved mental QOL score may be attributed to the fact that the majority of patients in our series had cancer, and studies have shown that patients who have been completely resected are more optimistic overall. However, the depressed physical QOL scores should be related to patients prior to surgery. QOL measurement is becoming an increasingly important aspect of all types of medical therapies. Prospective multicenter studies that evaluate both physiologic and QOL scores pre- and then postoperatively every 6 months for at least 5 years after pneumonectomy are needed.

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APPENDIX 1. SF-12 PATIENT QUESTIONNAIRE

1. In general, would you say your health is:

☐ Excellent
☐ Very Good
☐ Good
☐ Fair
☐ Poor

The following two questions are about activities you might do during a typical day. Does YOUR HEALTH NOW LIMIT YOU in these activities? If so, how much?

2. MODERATE ACTIVITIES, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf:

☐ Yes, limited a lot
☐ Yes, limited a little
☐ No, not limited at all

Climbing several flights of stairs:

- ☐ Yes, limited a lot
- ☐ Yes, limited a little
- ☐ No, not limited at all

During the PAST 4 WEEKS have you had any of the following problems with your work or other regular activities AS A RESULT OF YOUR PHYSICAL HEALTH?

3. Accomplished less than you would like:

- ☐ Yes
- ☐ No

4. Were limited in the KIND of work or other activities:

- ☐ Yes
- ☐ No

During the PAST 4 WEEKS, were you limited in the kind of work you do or other regular activities AS A RESULT OF ANY EMOTIONAL PROBLEMS (such as feeling depressed or anxious)?

5. ACCOMPLISHED LESS than you would like:

- ☐ Yes
- ☐ No

6. Didn't do work or other activities as CAREFULLY as usual:

- ☐ Yes
- ☐ No

7. During the PAST 4 WEEKS, how much did PAIN interfere with your normal work (including both work outside the home and housework)?

- ☐ Not at all
- ☐ A little bit
- ☐ Moderately
- ☐ Quite a bit
- ☐ Extremely

The next three questions are about how you feel and how things have been DURING THE PAST 4 WEEKS. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the PAST 4 WEEKS

8. Have you felt calm and peaceful?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time

- ☐ A little bit of the time
- ☐ None of the time

9. Did you have a lot of energy?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little bit of the time
- ☐ None of the time

10. Have you felt downhearted and blue?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little bit of the time
- ☐ None of the time

11. During the PAST 4 WEEKS, how much of the time has your PHYSICAL HEALTH OR EMOTIONAL PROBLEMS interfered with your social activities (like visiting with friends, relatives, etc.)?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little bit of the time
- ☐ None of the time

Discussion

Dr Gary W. Chmielewski (*Chicago, Ill*). I would like to congratulate Dr Bryant on a good presentation and I would like to thank the authors for getting the manuscript to Dr Liptay and I before the meeting. Dr Liptay and I would like to thank the Association for the chance to review this and discuss.

As surgeons, we have 2 goals in performing a pulmonary resection. One is to get rid of the cancer and the other is to get patients back to their lives. The authors are to be congratulated on looking at the second part of the equation, which most often is overlooked.

In this paper, the authors look at postoperative QOL scores in patients undergoing pneumonectomy. They report on 111 patients operated on during a 13-year period. Five-year survivals were 37%, with QOL scores obtained in 98% of these patients who were out 1 year from surgery. In summary, the mental quality of life scores were better compared with to the average population whereas the physical component score was significantly worse than the average population. As was pointed out here, in their article the authors state that it's a misnomer to call a pneumonectomy a disease, and they also emphasized the need to use separate

mental and physical parameters to assess the impact of our surgery on our patients' quality of life. Although I agree with the authors that the QOL scores are important in looking at our overall surgical results, it does appear from your data that we are inducing somewhat of a chronic disease state on these patients, because they do have QOL scores physically that are worse than patients with heart disease, renal disease, and diabetes mellitus.

That said, I have 3 questions. The first 2 are: Now that your institution is armed with these data, do your surgeons plan to give a preoperative QOL questionnaire and, if there are surgeons in the audience who are inclined to go ahead and use these questionnaires in their postoperative care, what interval do you suggest that we query our patients on?

Dr Bryant. Based on these data, we do plan to implement not only just the QOL survey but physiologic measurements as well, such as PFTs and a 6-minute walk test. I think a 6-month interval for the first few years postoperatively would be ideal, and then yearly for the remainder of the patient's life, or as far as possible.

Dr Chmielewski. This is an uncommon circumstance, but did you see any dramatic differences in the QOL scores in the rare patient who required a right pneumonectomy who also received neo-adjuvant therapy compared with the rest of the group?

Dr Bryant. In our patient cohort we did not see any differences.

Dr Chmielewski. My final question is: Have your data resulted in the surgeons at your institution selecting patients differently for pneumonectomy or, I guess I'd like to ask Cerf, do you plan to manage any of these preoperative or postoperative parameters differently so that we can improve on our patients' QOL?

Dr Cerfolio. This is the one that Cam should be getting up and giving me the business on, not the other one. This paper was really Dr Bryant's idea, not mine—QOL. I said, you know, QOL, really, I'm a surgeon. But these are great data. And when she collected the data, I was really depressed to see several things: That 40 patients out of 150 are dead at a year. That's embarrassing, but that's my own data. They were all R0 resections and they all were N2 negative on mediastinoscopy, endobronchial ultrasound, or frozen at the time of surgery. I think 6 or 7 ended up having N2 positive on final pathology. But I thought I picked the best of the best, and 1 in 3 are dead at a year. That's not very good.

Dr Shrager. Most of them were stage IB, right? That would be better than the published data for stage IB.

Dr Cerfolio. Well, I appreciate you saying that, but I'm not happy with the results. And then to find out that the two thirds who are alive aren't really very happy with their QOL, especially if they're old. So I have gotten less aggressive. So now it looks like the only way to get an R0 resection is to do a pneumonectomy. I am having a different conversation since Dr Bryant has presented me with this data, to be honest. My initial thing when I wrote the abstract was, oh, pneumonectomy is a disease really is a misnomer; it's not a disease, but it depends how you define disease, and if you define hypertension and diabetes mellitus and chronic liver disease as a disease, and I guess we should, then a pneumonectomy is a disease, and so I'm wrong. What else new?

Dr Todd L. Demmy (Buffalo, NY). The SF-12 is an abbreviated form of the SF-36. The 2 dimensions on these studies that people get a major effect after lung resection tend to be dyspnea and pain. Is the ability to measure those dimensions reduced on the SF-12?

Dr Bryant. On the SF-12, the questions that are asked are more about are you able to perform your activities of daily life. Indirectly, it's asking about their functional status. We actually added a few questions in our survey that address specifically those issues, pain, but we did not find any correlations.

Dr Demmy. It's interesting to study that interaction because with more lung resected there is more muscle use, probably aggravating the chronic pain mechanism. So I think you should look at that. The other data point that tends to categorize the QOL on these surveys is diffusing capacity rather than FEV₁. Did you break out your scores based on the DLCO?

Dr Bryant. We did. We looked at both FEV₁ and DLCO. We did not find a correlation with DLCO. It may be that the patients with the poorest PFT status may have expired within that first year.

Dr Demmy. Usually as you approach 40% DLCO, that's a group that does much worse with QOL. So you should analyze based on those levels of residual diffusing capacity.

Dr Rafael S. Andrade (Minneapolis, Minn). I'm very impressed with compliance of 98% in answering the surveys, which I think would be good for a clinical trial. How did you actually do that? In Minnesota, the IRB is very insistent that you can contact patients maybe up to 3 times by letter, but you can't be hammering them. And some of these patients are 12 years out. They have no reason to come back. How did you get 98% compliance?

Dr Bryant. We primarily mailed the surveys and then followed up with a phone call. Our IRB did not make a stipulation of how many times we could contact them. Every patient that Dr Cerfolio has operated on since 1996, we have obtained permission to include their data in his prospective database, and we tell them up front that this may be used for research. I think that's one of the reasons that the IRB gave us permission and allowed us to waive consent. But it was very aggressive mail-outs and phone calls to get that 98% response.

Dr Betty C. Tong (Durham, NC). I have 2 questions. First, how do you think your data might be different or more robust if you had longitudinal data?

Dr Bryant. I think it would help with assessing temporal changes.

Dr Tong. Second, would you discuss a little bit how you chose the SF-12 as your measure of QOL rather than another validated measure, such as the European Organization for Research and Treatment of Cancer (EORTC) Quality of Life Component 30 with the LC13 module, which is geared specifically toward patients with lung cancer.

Dr Bryant. We chose the SF-12 primarily because it's a shorter version of the survey and we were trading off compliance and patient response. With the longer surveys we found that patients often didn't respond or the survey was incomplete. With the SF-12, we found that they are more likely to respond and complete the survey.

Dr Tong. I think that the EORTC Quality of Life Component 30 with the LC13 module, although longer, would address some of the things that Dr Demmy had highlighted with regard to pain, shortness of breath, and other symptoms.

Dr Cerfolio. I would like to add one response to that. We tried that before and failed. Patients in Alabama, and maybe it's Alabama, but people who come to see me, they're not going to spend time filling out more forms than they already have to just

for the hospital and insurance company, and now answering more questions for research stuff. So we did that before and we had a low compliance. This is much higher with the 12 instead of the 36.

Dr David J. Sugarbaker (*Boston, Mass*). I just wanted to congratulate Dr Cerfolio and the group on a really carefully done study. I think it really highlights that when you say the word *pneumonectomy*, it means different things to different people, and if you select your patients well and the operation goes well, those patients can live a very happy, relatively normal life. So when you hear people talk about pneumonectomy, or even extrapleural pneumonectomy, it means different things to different people, but I think what these data show is that it can mean good things for our patients. Congratulations.

Dr Gail Darling (*Toronto, Ontario, Canada*). I would just like to follow along on the previous question about the instrument that was chosen. I congratulate you for addressing QOL in our patients, but I think, as surgeons, we should remember that QOL is not just physical symptoms and debility and that sort of thing. There are many other components to QOL. It's not just their FEV₁ or their pain scores. I think some of the other instruments, the EORTC instrument, the FACT, measure some of these other dimensions of QOL, including things like emotional well-being, social well-being, functional well-being, which are not really captured by the SF-12 or SF-36.

Dr Bryant. Thank you.

Dr Gaetano Rocco (*Naples, Italy*). I would like to ask a question, Cerf. Could confounding factors in the analysis of the results be the age threshold that you chose of 58 and the fact that more than 10% of these patients were completion pneumonectomies?

Dr Cerfolio. I appreciate you trying to make me feel better. Yes. Some of these were completion pneumonectomies and some of these were destroyed lungs and difficult operations—not just

cancer patients—but I have to also look in the mirror and be honest and reflective about the poor reflection that is not very appealing, and say that a 9-out-of-150 operative mortality and then an 11-out-of-150 90-day mortality is not so good, and another 29 died within a year. That's pretty ugly. I think they were a sick group of patients, I agree, but I think everybody in this room operates on a group of sick patients. How would they have done if they had never met me is the other question we need more data on.

Dr Mohamed Khoreba (*Montreal, Quebec, Canada*). You compared your QOL with hypertension and patients with renal disease. What kind of renal disease exactly? Is it terminal renal disease or just a patient with a different creatinine? What kind of liver disease? A patient with severely debilitating liver disease or not? If we are comparing pneumonectomy with a patient with just working hypertension who has better control with 1 or 2 medications, it's not a disease as we would call it.

Dr Bryant. That's an excellent question and a comment. I think that's one of the limitations of our study. The definitions of those diseases were not clear. The reason that we used these data to show as comparison data is that it's really actually one of the few data points that we found that is comparable, and it's also released by the same company that makes the SF-12. So we felt that it was comparable, but perhaps not the ideal.

Dr Khoreba. I would suggest maybe you can compare them with terminal renal disease, with very severe chronic obstructive pulmonary disease, with patients after pneumonectomy with some debilitating disease with a patient who has a very morbid procedure like pneumonectomy.

Dr Joseph B. Shrager (*Stanford, Calif*). In most studies that have looked at this, the control group is lobectomy patients. I don't know if you have the data, but you probably really want to compare pneumonectomy patients with lobectomy patients.