Elective Lung Resections in the Elderly: Where Do We Draw the Line?

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Abstract

Introduction The increasing longevity of the Western population means patients with a more advanced age are being diagnosed with resectable disease. With improvements in imaging and diagnostic capabilities, this trend is likely to develop further. As a unit operating on a higher proportion of older patients and with limited literature regarding the population of older than 85 years, we retrospectively compared the outcomes of patients older than 85 years in our unit treated with elective lung resection for non-small cell lung cancer (NSCLC) with those between the age of 80 and 84 years inclusive.

Methods All patients who underwent elective lung cancer resection between the years 2012 and 2015 were identified from the National Thoracic Surgical Database.

Results A total of 701 elective lung resections were performed during this time frame; 76 patients between the ages of 80 and 84 years and 18 patients older than 85 years. The follow-up period was 3 to 7 years. There was a significant increase in the Thoracic Surgery Scoring System (2.04; 2.96%, $p = 0.0015$) and a significant reduction in the transfer factor (94.7; 69.5%, $p = 0.0001$) between the younger and older groups. There were three (3.9%) in-hospital deaths in the 80 to 84 years age group and no in-hospital deaths in the 85 years and older age group.

Conclusion This study demonstrates that surgery for early NSCLC can be safely performed in 85 years and older population. This is a higher risk population and parenchymal-sparing procedures should be considered.

Keywords
- geriatric services
- thoracic surgery
- in-hospital mortality
- lung cancer

Introduction

Patients undergoing thoracic surgery often have multiple comorbidities and a strong smoking history that increases the risk of major surgery.[1] Furthermore, the increasing longevity of the Western population means patients with a more advanced age are being diagnosed with resectable disease and referred for surgery.[2] Improvements in imaging and diagnostic capabilities and with the possibility of lung cancer staging, this trend is likely to develop further.[3]

There is a paucity of evidence to guide surgical decision making in the elderly, particularly in thoracic surgery, due to underrepresentation in clinical trials. Historically, only 25% of the trials have been open to patients older than 65 years.[4] However, recent studies are demonstrating low levels of mortality when operating on this group of patients.[5,6] The ACOSOG Z0030 trial showed that there was no increase mortality risk when performing lobectomies in an older cohort.[7] Surgery has even been shown to demonstrate an

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increase in survival compared with radiotherapy in this cohort.[8]

Age itself is not a contraindication for surgery, nor should it be, although it is understood that it can be a marker of decreased physiological and mental compliance, often proportional to comorbidities.[9] Physiological decline, multimorbidity, and frailty are independent predictors that are associated with aging.[10–12] Age has been demonstrated to be a risk factor itself and is therefore used in the common risk stratification algorithms for thoracic surgery.[13] Despite this, patients can present with preserved physiology as measured by lung function testing and echocardiography yet are outside the normal range traditionally considered for major surgery on the basis of age.[14] This alongside the overall reduction in mortality associated with thoracic surgery in the current era, possibly due to advances in anesthetic and surgical techniques, and perioperative optimization and enhanced recovery, these patients are now being considered as surgical candidates.[15] Furthermore, collaboration with specialist geriatric liaison services has shown to further reduce postoperative complications in the elderly population undergoing surgery.[16]

The Getting It Right First Time (GIRFT) program produces a report of data obtained from units nationally to identify changes between centers with the aim to reduce unwanted variations.[17] As a unit that had been identified in the GIRFT report as an outlier for operating on an elderly population, our objective was to retrospectively assess the outcomes of patients older than 85 years in our unit who had been treated with elective lung resection for early-stage non-small cell lung cancer (NSCLC) and were older than 85 years at the time of surgery.[17]

Materials and Methods

We analyzed and compared all patients who underwent elective lung resection between the 4-year period of 2012 and 2015 who were aged between 80 and 84 years and 85 years and older at the time of surgery. These patients were identified from the National Thoracic Surgical Database. The electronic patient records were then used to obtain data for patient demographics, date of surgery, date of death, age at death, operation type, smoking history, and comorbidities (renal, cardiac, respiratory, and neurological). Death within 30 days of surgery within the same in-hospital episode was the definition of in-hospital mortality. Cause of death was determined as the significant pathological insult that was ultimately responsible for the patient's decline (i.e., hospital-acquired pneumonia). The Thoracic Surgery Scoring System (Thoracoscore) was used to estimate perioperative mortality based on these data.[13]

Results

A total of 701 elective lung resections were performed for NSCLC in this time frame by five different surgeons. Seventy-six patients were between the age of 80 and 84 years and 18 patients were older than 85 years. The follow-up period was 3 to 7 years.

Table 1 Summary of differences between the two groups

Age group	80–84 y	85+ y	
N (% of all resections)	76 (10.8%)	18 (2.6%)	
Mean age	81.8 (80–84)	87.5 (85–92)	
Male:female ratio	35:41	10:8	$p = 0.47$
Thoracoscore	2.04	2.96	$\boldsymbol{p = 0.0015}$
TLCO	94.7%	69.5%	$\boldsymbol{p = 0.00013}$
Number of in-hospital deaths	3 (3.94%)	0	$p = 0.8$
90 d mortality	4 (5.3%)	1 (5.6%)	$p = 0.96$
Deaths in follow-up period	25 (33%)	7 (39%)	$p = 0.63$
Number VATS procedure	45 (59.2%)	7 (39%)	$p = 0.12$
Number of wedge/ segmental resections	15 (19.7%)	6 (33.3%)	$p = 0.21$

Abbreviations: Thoracoscore, Thoracic Surgery Scoring System; TLCO, transfer factor of the lung for carbon monoxide; VATS, video-assisted thoracic surgery.
Note: Significant *p* values are in bold.

There was a significant increase in the Thoracoscore (2.04; 2.96%, $p = 0.0015$) and a significant reduction in the transfer factor (94.7; 69.5%, $p = 0.0001$) between the younger and older groups. The main differences between the two groups are summarized in ►**Table 1**.

In the 80 to 84 years age group, all 76 (100%) patients were smokers or ex-smokers and 17 (22.3%) patients had no previous medical history. Two (2.6%) patients had had previous lobectomies for NSCLC. Preoperatively, six (7.9%) patients had atrial fibrillation (AF), and seven (9.2%) were diabetic. Forty-nine (64.4%) lobectomies, 5 (6.6%) segmentectomies, 15 (19.7%) wedge resections, 2 (2.6%) lobectomies with wedge resections, 1 (1.3%) bilobectomy, 2 (2.6%) pneumonectomies, and 2 (2.6%) lobectomies with chest wall resection were performed. None of the 45 (59.2%) video-assisted thoracic surgery (VATS) procedures required conversion. Sixty-four (84.2%) patients were pathologically in stages 1 to 2 with 8 (10.5%) patients found to be in stage 3a (4 [5.3%] with N2 disease), and 4 (5.3%) patients with stage 3b disease. There were three (3.9%) in-hospital deaths (two [2.6%] from respiratory failure and one [1.3%] from stroke), three (3.9%) prolonged air leaks, two (2.6%) pulmonary emboli, five (6.6%) lower respiratory infections, and one (1.3%) upper gastrointestinal bleed. Four (5.3%) patients died within 90 days of surgery (three in-hospital deaths).

In the 85 years and older age group, all 18 (100%) patients were smokers or ex-smokers and 1 (5.6%) patient had no previous medical history. Two (11.1%) patients had had previous lobectomies for NSCLC. Preoperatively, six (33.3%) patients had AF, and three (16.7%) were diabetic. Nine (50%) lobectomies, 6 (33.3%) wedge resections, 2 (11.1%) lobectomies with wedge resections, and 1 (5.6%) lobectomy with chest wall resection were performed. None of the seven (38.9%) VATS procedures required conversion. Sixteen (88.9%) patients were pathologically in stages 1 to 2 with two (11.1%) patients found to be in stage 3a (N2 disease). One (5.6%) patient returned to

the operating room for bleeding, one (5.6%) patient required inotropes and intensive treatment unit stay for chest sepsis, and two (11.1%) patients had prolonged air leaks. There were no in-hospital deaths in this group and one (5.6%) death within 90 days of surgery.

The component that increased the Thoracoscore in the 85 years and older age group was the comorbidity score. The mean comorbidity score for the 85years and older age group was 2.6 compared with 1.3 for the 80 to 84 years age group. This difference was statistically significant ($p < 0.001$). There was no significant difference between sex, performance status, dyspnea score, and procedure type. All patients scored equally for disease type (malignant), age (older than 65 years), and priority of surgery (elective).

Discussion

Lung cancer is a disease that affects older population.[4] Currently, there is evidence that despite an aging population, patients older than 75 years have almost a fourfold chance of being turned down for surgery compared with those younger than 65 years despite having earlier stage tumors.[18] This is an understandable trend as these elderly patients have been shown to have longer inpatient stays and are associated with increased mortality risk.[19]

With increasing evidence that surgery may be appropriate in the elderly, but paucity of specific evidence and lack of well-validated risk scores, the challenge lies in deciding who is an appropriate candidate for surgery. Conventional risk models are not accurately calibrated to predict outcomes in the elderly and do not include frailty parameters.[13]

Frailty scores have been shown to correlate with negative outcomes across all surgery types. Greater mortality at 30 days, 90 days, and 1 year, along with increased postoperative complications and lengths of stay, has been observed (20). Several studies agree that increase in risk of mortality with increased frailty is around twofold.[20–22] There are many plausible mechanisms for this that include reduced physiological reserve, which increases the risk of deterioration, and reduced cognitive function, which increases the risk of delirium.[23]

Among the limited thoracic surgery-specific data, there is some suggestion that frailty may be even more strongly associated with adverse outcomes than in other specialties, with a four- to sevenfold increase in mortality risk reported, and therefore, risk models incorporating frailty scores have been developed, such as FORECAST (Frailty predicts death One year after Elective Cardiac Surgery Test); however, they need more thorough validation.[24] It has been highlighted that a single frailty measure alone does not predict an increase in morbidity and mortality, but a combination of several measures may be able to.[25]

Despite its limitations, the Thoracoscore demonstrated that there was a significant increase in risk difference between the two groups in this study. It is therefore imperative that risk reduction strategies are employed to decrease the morbidity and mortality burden. Specialized geriatric services have been developed to try and achieve this with good results. These results have been demonstrated in vascular surgery where preoperative thorough assessment has shown to diagnose and predict cognitive impairment, frailty, and postoperative delirium.[26,27] It is therefore essential that these services continue to develop and extend into thoracic surgery.

Lobectomy has been the treatment of choice in lung cancer surgery in the suitable patients for its benefit in terms of reduced recurrence rates; however, the evidence for this is now dated.[28] However, there is now a growing body of evidence that demonstrates equivalence in smaller, suitable tumors in terms of oncological outcomes.[29] Therefore, it is understandable that these parenchymal-sparing procedures are being utilized more frequently, as in this study, in the higher risk, elderly patient.

A surprise finding in this study was the high proportion of elderly patient undergoing thoracotomy and lung resection compared with the use of VATS. VATS has been shown to reduce surgical stress, impact on chest wall mechanics, morbidity and mortality, pain, and postoperative delirium.[30] This finding is not statistically significant and it is difficult to explain the cause. The failure to reach significance may be as a result of the small population size, especially of the 85 years and older age group, or be a chance finding. If the former is true, a potential explanation may be the reluctance to perform VATS in patients who are perceived by the surgeons to be higher risk due to age. A thoracotomy in this setting may have been felt to have been the safer option.

Much of the work in the literature is directed at the 80 years and older age group; however, this study highlights that it is safe to operate in the group that lie beyond this, the 85 years and older age group. This is despite knowing that they are both measurably, using the Thoracoscore, and immeasurably, due to frailty and physiological decline, at higher risk of morbidity and mortality.

Limitations of the Study

This study only analyzed patients who underwent surgery at our institution. Further work is required to analyze all the patients in these age groups who presented with operable lung cancer and determine the reasons that surgery was not performed.

There has been no analysis of specific oncological outcomes such as recurrence or disease-free survival in the study. However, due to there being no significant difference between the groups in terms of approach or extent of resection, the authors did not feel that this was necessary.

This study is a retrospective review and therefore subject to observational bias.

Conclusion

This study demonstrates that surgery for early NSCLC can be safely performed in 85 years and older population. This must occur in the knowledge that this is a higher risk population due to increased comorbidities as demonstrated in this study and parenchymal-sparing procedures should be considered. Further work is required to incorporate old age physiology and frailty into risk assessment models to aid with

perioperative decision making. Input from specialist geriatric teams may prove to be helpful in managing these patients.

Disclosures
There are no sources of funding for the work to declare.

Conflict of Interest
There are no conflicts of interest to declare.

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