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Smoking cessation is challenging even for patients recovering from lung cancer surgery with curative intent

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Abstract

Background—Although it is recommended that smokers undergoing surgery for lung cancer quit smoking to reduce post-operative complications, few studies have examined patterns of smoking in the peri-operative period. The goals of this study were to determine: 1) patterns of smoking during post-operative recovery, 2) types of cessation strategies used to quit smoking, and 3) factors related to smoking after lung cancer surgery.

Methods—Data were collected from 94 patients through chart review, tobacco, health-status, and symptom questionnaires at 1, 2, and 4-months after surgery. Smoking status was assessed through self-report and urinary cotinine measurement.

Results—Eighty-four patients (89%) were ever-smokers and 35 (37%) reported smoking at diagnosis. Thirty-nine (46%) ever-smokers remained abstinent, 13 (16%) continued smoking at all

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time-points, and 32 (38%) relapsed. Ten (46%) of those who relapsed were former-smokers and had not smoked for at least 1-year. Sixteen (46%) of those who were smoking at diagnosis received cessation assistance with pharmacotherapy being the most common strategy. Factors associated with smoking during recovery were younger age and quitting smoking six-months before the diagnosis of lung cancer. Factors that were marginally significant were lower educational level, male gender, lower number of comorbidities, and the presence of pain

Conclusion—Only half of those who were smoking received assistance to quit prior to surgery. Some patients were unable to quit and relapse rates post-surgery were high even among those who quit more than 1-year prior. Innovative programs incorporating symptom management and relapse prevention may enhance smoking abstinence during post-operative care.

Keywords

lung cancer; thoracic surgery; smoking cessation; symptom management

INTRODUCTION

Evidence suggests that smoking cessation is associated with a better perceived health status, improved survival and decreased cancer recurrence among patients with early stage non-small cell lung cancer (NSCLC)¹⁻³. Therefore, patients with potentially curative lung cancer who are smoking at the time of diagnoses are advised to quit smoking pre-operatively in order to reduce post-operative complications⁴⁻⁶.

Although several studies have examined smoking behaviors in patients with varied stages of lung and head and neck cancer⁷⁻⁹, only two studies have examined smoking behaviors after surgical treatment for early stage lung cancer^{10, 11}. Gritz and colleagues followed 840 patients who underwent surgical resection for NSCLC for four-years and examined their smoking patterns. Sixty-percent of the patients reported smoking at the time of diagnosis. It took two-years for smoking cessation rates to stabilize after surgery. By then, approximately 40% of the patients who smoked at diagnosis quit smoking. Dresler and colleagues¹¹ followed 363 patients undergoing surgery for NSCLC to determine the patterns of smoking before and after surgery. Ninety-five percent of patients had a smoking history. Nineteen percent of patients reported smoking up until their surgery, 12% quit 2-weeks prior to surgery, 15% quit between 2-weeks and 3-months prior to surgery, 6% quit between 3-months and 1-year prior to surgery, 42% quit smoking at least 1-year prior to surgery, and the smoking status of 6% were unknown. Only 13% of smokers reported smoking within 1 year post-operatively.

A number of investigators have examined factors associated with smoking relapse among patients receiving surgery for NSCLC^{12, 13}. Walker and colleagues¹² followed patients with NSCLC who were smoking within 3-months of their surgery for 12-months after surgery to assess smoking status and predictors of smoking relapse. At some point after surgery, 43% of patients smoked; at 12-months after surgery, 37% were smoking. Sixty-percent of patients who relapsed did so within 2-months after surgery. Smoking at follow-up was associated with shorter quit duration before surgery, more intense cravings, lower income, and higher education. Among those who relapsed, greater delay before the relapse was associated with abstinence at 12-months. In a smaller study, Walker et al¹³ found that younger age and lower education were associated with smoking and shorter time to smoking relapse. Dresler and colleagues¹¹ noted that shorter quit duration before surgery was associated with continued smoking and return to smoking after surgery. Of the 13% who smoked after their surgery, the majority (61%) had never stopped smoking pre-operatively, only 3% of patients who quit smoking > 3-months before surgery returned to smoking.

Little information is available about smoking cessation strategies used by patients undergoing lung cancer surgery. Dresler and colleagues noted that only 59% of smokers reported that a physician told them to quit smoking pre-operatively¹¹. However, 89% of patients who continued smoking post-operatively reported physician advice to quit smoking¹¹. Recommended evidence-based methods for cessation include the use of pharmacotherapy (nicotine replacement medications, bupropion, or varenicline) and behavioral counseling¹⁴. Although counseling and medication are effective when used by themselves for treating tobacco dependence, the combination of counseling and medication is more effective than either alone and is the recommended standard by the Public Health Service Tobacco Dependence Treatment Guideline¹⁵. Several studies have demonstrated that the majority of smokers attempt to quit “cold turkey”, which is abruptly, on their own and without the use of proven cessation aides^{16, 17}. It is important to recognize that the use of proven cessation aides doubles the rate of success in maintaining smoking abstinence¹⁵.

In summary, the data that describe smoking behaviors and factors related to smoking after surgery for lung cancer, or cessation strategies used prior to surgery are limited and incomplete. This type of information is crucial to provide the basis for future development and testing of effective smoking cessation interventions. Our study extends previous studies by focusing specifically on patients recovering from curative surgery for lung cancer. Sanderson-Cox and colleagues¹⁸ note that the majority of studies examining smoking behavior in cancer patients have been conducted in heterogeneous groups of patients and that further research is needed to clarify to what degree smoking behavior may be related to a specific type of cancer, stage of disease and type of treatment. In addition, this study adds several unique variables such as the number of comorbidities and post-operative symptoms within the context of surgical recovery that haven’t been examined in previous studies as factors that may influence smoking relapse. The presence of these variables may influence cessation either positively or negatively. The purposes of our study are to determine: 1) patterns of smoking during post-operative recovery, 2) types of cessation strategies used to quit smoking, and 3) factors (demographic, tobacco-related, health status and post-operative symptoms) related to smoking after lung cancer surgery.

METHODS

Ninety-seven patients were recruited and gave written consent to participate in this Institutional Review Board-approved prospective clinical study. Entry criteria included: patients with stage I, II, IIIA NSCLC who underwent potentially curative surgical treatment, were 18 years of age, and able to read and understand English. Three patients were excluded from analysis because they did not meet study criteria. Ninety-four patients provided data at entry to the study (1-month after surgery); 92 at 2-months after surgery; and 86 at 4-months after surgery.

This study was part of a larger multi-site study that described symptom patterns during recovery from lung cancer surgery, which was an exploratory study conducted between 2002 and 2006 targeted to recruit 90 patients.¹⁹ A convenience sample was obtained from four data collection sites located in the western (University of California, Los Angeles), eastern (Dana-Farber/Brigham and Women’s Cancer Center and University at Buffalo, State University of New York), and southern US (Medical College of Georgia). Potential participants were recruited through letters sent from physicians and advertising through brochures and flyers. Because of restrictions imposed by the Institutional Review Board, patients were required to approach us; therefore, we cannot determine the exact number of participants who met the inclusion criteria and who were not interested in participating at each site. Participants were given a small stipend (\$25.00) for their time and efforts after each interview.

DATA COLLECTION

Demographic information was collected at baseline using a self-report questionnaire and included: age, gender, marital status, race, living situation, and level of education.

Tobacco variables—Tobacco use questions were based on items from the Behavioral Risk Factor Survey^{15, 20} and the Fagerstrom Test for Nicotine Dependence.²¹ These items included: age at initiation, number of years smoked, methods used for cessation, level of nicotine dependence, smoking status of household members, and exposure to environmental tobacco smoke (ETS). Methods used for cessation were defined as counseling, information, nicotine replacement, or other medication used for smoking cessation (i.e. bupropion, varenicline). Participants could select more than one method used for cessation. Time to smoke the first cigarette in the morning, an item on the Fagerstrom Test for Nicotine Dependence, was used as a measure of nicotine dependence in this study. High levels of nicotine dependence were defined as smoking the first cigarette in the morning within 30 minutes of awakening. This question has been found to be the best single item predictor of nicotine dependence²².

Smoking status—Smoking status was determined through self-report and biochemical verification with urinary cotinine (Nic-alert, Jant Corporation). Current smokers were defined as patients who responded “yes” to smoking now or responded “no” to smoking now but had a urine positive for a cotinine level of ≥ 3 on the dipstick²³. If patients responded, “no” to smoking now and reported current use of nicotine replacement medications, they were classified as non-smokers. Smoking status was classified as current (at the time of the first interview), recent-quitter (quit < 1 year prior to diagnosis), former-quitter (quit ≥ 1 year prior to diagnosis), and never-smoker. Smoking status among the ever smokers was re-assessed at each subsequent time point as smoking or not smoking. Smoking status was assessed at 1, 2 and 4 months after surgery, this time period is consistent with recommendations from the Society for Research in Nicotine and Tobacco for short-term follow-up (≥ 3 months) of smoking abstinence^{24, 25}. The primary goal of this study was to understand smoking behaviors and factors associated with return to smoking after surgery for lung cancer in order to develop effective smoking cessation interventions in the future. Therefore, short-term follow-up of smoking status was the most appropriate outcome measure for use in this study. Longer-term follow-up such as 6 or 12 months is recommended as abstinence measures for smoking cessation intervention clinical trials²⁴.

Health status—The health status variables included comorbidities measured with the Charlson Comorbidity Index self-report²⁶. This instrument has been previously validated as reliable in lung cancer patients²⁷.

Post-operative symptoms—The post-operative symptoms including pain, dyspnea, fatigue, and depressed mood were assessed at each time period.

Post-operative pain was measured with the Brief Pain Inventory (BPI) short-form, which is a 9-item self-report questionnaire. It has been used extensively in patients with cancer²⁸. Two single items (pain presence and worst pain) and the two subscales (pain severity and interference with activities “during the last 24 hours”) were used in this analysis.

Post-operative dyspnea was measured with the American Thoracic Society Dyspnea Index²⁹. This is a five-item self-report questionnaire that describes breathlessness according to level of activity. Higher scores indicate more severe respiratory problems.

Post-operative fatigue was measured by the Schwartz Cancer Fatigue Scale^{30, 31}, a previously validated, six-item self-report questionnaire.

Depressed mood was measured by the Center for Epidemiological Studies— Depression scale³². This 20-item self-report questionnaire, with a score of >15 representing depressed mood, has been used extensively in adults with cancer.

Clinical variables were collected through a medical chart review and included histology, stage of cancer, type of resection, and receipt of adjuvant therapy. The American Joint Committee on Cancer Staging Manual was used to classify stage³³.

DATA ANALYSIS

Data analyses were performed using SAS 9.1.3. Distributions of certain characteristics are presented using frequencies and percents or means with standard deviations. Univariate logistic regressions were used to calculate the odds-ratios for predictors of smoking at any time after lung cancer surgery among participants who ever smoked prior to surgery. A stepwise multiple logistic regression model was used to identify which covariates remained significant when considered in combination.

RESULTS

Patient Cohort

As displayed in Table-1, the mean age of the patients was 63 years (s.d 9.9). Most were white, female, married and had a high school education or higher. The majority had Stage I or II adenocarcinoma and underwent a lobectomy.

Patterns of smoking during surgical recovery

Thirty-five patients (35/94) were smokers at the diagnosis of lung cancer making the frequency of smoking prevalence 37%. Eighty-four patients (89%) were ever-smokers and 10 (11%) were never-smokers. As Table-2 shows, among ever-smokers, most (n=47/84, 56%) had quit smoking prior to their diagnosis, 21/84 (25%) patients reported that they quit after their diagnosis, and 11/84 (13%) reported that they were smoking at 1-month after their surgery. However, 5 additional (total n=16/84; 19%) patients were identified as smokers at 1 month after surgery based on positive urine cotinine analysis. In addition, after they were diagnosed with lung cancer 18/69 (26%) patients had household members who continued to smoke. Forty-six/ninety-three (49%) patients reported exposure to environmental tobacco smoke (ETS) less than once a week, 14/93 (15%) reported exposure to ETS several times a week and 33/93 (36%) reported exposure to ETS everyday.

The mean time interval between quitting and cancer diagnosis was 8 years (sd 12). Smokers who continued smoking post-operatively were highly nicotine-dependent as 9/11 (86%) current-smokers reported smoking within 30 minutes of waking up in the morning (Table 2).

Of the 84 ever-smokers, only 46% (39/84) did not smoke at all throughout the study. Patterns of smoking showed that by 1-month after surgery, 18% (16/84) of ever-smokers had relapsed back to smoking, by two-months after surgery, 33.3% (28/84) relapsed back to smoking and at 4-months 42% (34/84) had relapsed back to smoking (see Figure 1).

We also examined patterns of smoking for those who had quit before their diagnosis and those who were smoking at their diagnosis (see Figures 2 and 3). The majority of ever-smokers (n= 49/84, 58%) had quit smoking prior to their diagnosis. However, ten of those who quit smoking before their diagnosis (n=10/49, 20%) relapsed to smoking after their

surgery (see Figure 2). Surprisingly, eight ($n=8/10$, 80%) of those who relapsed had quit 1 year prior to their diagnosis. In fact, their mean time since quitting was 8.5 ($sd=6.5$) years.

Thirty-five ($n=35/84$, 42%) ever-smokers were smoking at the time of cancer diagnosis. Although the majority of those who were smoking at diagnosis attempted to quit smoking, only ten ($n=10/35$, 29%) smokers were able to maintain cessation throughout the study (Figure 3). Some patients returned to smoking as early as 1-month after surgery, however, most patients who ultimately returned to smoking did so within 2-months after their surgery. A substantial portion of smokers ($n=13/35$, 37%) who were smoking at the time of diagnosis continued to smoke at each time point throughout the study period.

Strategies used to assist in cessation

Among patients who were smoking at the time of their diagnosis, 16 (46%) received assistance with cessation. Treatment with medication (nicotine replacement or bupropion) was the most commonly used strategy (Table 4). Medications were given alone, in combination with other tobacco dependence medications or in combination with smoking cessation information. In this cohort, only 1 (6%) lung cancer patient received combined treatment with counseling and pharmacotherapy.

Factors (demographic, tobacco-related, health status and post-operative symptoms) correlated with smoking during surgical recovery

Potential factors related to smoking during surgical recovery were examined at entry to the study using logistic regression (Table-4 and Table-5). Age, education, time since smoking cessation and pain were significant in the univariate models. Younger patients were more likely to have smoked after surgery as compared with older patients, those with less than a high school education were more likely to smoke after surgery as compared to those with a high school or higher education, those who quit smoking within 6-months prior to diagnosis were more likely to smoke after surgery as compared with those who had quit for a longer period of time, and those who had significant pain were more likely to smoke after surgery as compared to those who didn't have pain. The presence of post-operative pain was significantly correlated with smoking after surgery across three different variables. Patients who reported the presence of pain, worse pain during the last 24 hours and increased severity of pain were more likely to smoke after surgery compared to those without pain (see Table-4).

Factors associated with smoking during recovery in a multiple logistic model were younger age and quitting smoking less than six months before the diagnosis of lung cancer. Factors that showed a trend toward significant difference were lower educational level, male gender, lower number of comorbidities, and the presence of pain (see Table-5).

DISCUSSION

The most recent smoking prevalence rates among US adults showed a decline in smoking from 24.7% in 1997 to 18.6% in early 2007³⁴. For both sexes combined, the percentage of smoking adults was lower among those 65 years and over (7.5%) than among those in the 18–44 (20.6%) and 45–64 (20.9%) age groups. Our study provides current information about smoking patterns after surgery for patients who underwent surgery for NSCLC. We discovered that 37% of patients in this study were smoking at the time of their diagnosis. In addition, 26% of household members continued to smoke after their family member was diagnosed with lung cancer. Thus, the frequency of smoking prevalence for both patients and their family members in our study were much higher than the general population even when compared by age group. However, when compared with previous studies of patients

with newly diagnosed surgical lung cancer, our study's frequency of smoking prevalence are lower than the 60% reported by Gritz and colleagues¹⁰ and higher than the 19% reported by Dresler and colleagues¹¹. Reasons for differences in frequency of smoking prevalence may be related to a time lag between the various studies and use of different methodologies to assess smoking status (i.e. self-report versus use of self-report and biochemical verification).

In this study, 51% of lung cancer patients were exposed to ETS after their surgery. Of these patients, 15% were exposed to ETS several times a week while more than one-third (36%) of patients were exposed to ETS every day. The frequency of ETS exposure in this patient cohort (51%) is higher than other samples of early stage lung cancer patients reported in the literature (28% and 45%)^{35, 36}. Exposure to ETS in early stage NSCLC patients has been associated with a threefold increase in respiratory symptoms and worse survival, especially for ETS at work^{35, 36}. Given the high rates of ETS exposure within this cohort, future studies are needed which seek to understand the location and duration of exposure to ETS so that interventions can be developed to decrease exposure.

Of the patients who were still smoking at the time of their diagnosis, 16 (46%) received smoking cessation interventions consisting of counseling, information, and/or pharmacotherapy. This finding is similar to that of Schnoll and colleagues who assessed the smoking cessation interventions that cancer patients in a smoking cessation program used in their previous quit attempts³⁷. Many patients quit "cold turkey" and didn't use any cessation aides in their quit attempt. Similar to our study, Schnoll and colleagues found that a-third to half of patients used proven cessation aides such as nicotine replacement or bupropion. An additional finding from our study is that only one (6%) smoker received combined treatment with counseling and medication, the recommended intervention for tobacco dependence treatment. Thus, we find in our study that the vast majority of lung cancer patients did not receive optimum treatment for nicotine dependence¹⁴.

The majority of smokers in our study made a quit attempt at the time of their diagnosis and approximately 50% were able to quit and not return to smoking during the 4-months after surgery. Twardella and colleagues³⁸ examined the relationship between the diagnosis of a smoking-related disease and smoking cessation among older adults (aged 50–74 years) in a primary care setting and found that when individuals experience the personal health effects, many permanently quit; in the year of the diagnosis of cancer, the rate of cessation increased five-fold. It is important to recognize, however, that quitting smoking is a difficult process for most smokers and often requires repeated attempts in order to be successful¹⁵. Smoking relapse can occur even after a lengthy period of abstinence. In our study, ten out of forty-nine (20%) former smokers who had quit 1-year prior to their diagnosis experienced smoking relapse after their diagnosis. This finding is similar to that from a study by Krall et al who examined rates of late smoking relapse among aging men who were followed in the VA Normative Aging Study³⁹. Among this cohort, smokers who had been abstinent for two-years were followed for twenty additional years. Approximately 20% relapsed after two-years. Most of the smoking relapse was in years 3–10. After 10-years of abstinence, however, smoking relapse rates were less than 1% per year. In another study, Gilpin and colleagues estimated the probability of future smoking relapse for different durations of abstinence at baseline but they weren't able to find any one duration of abstinence after which former smokers had no risk of smoking relapse⁴⁰. However, if three-years was used as a criterion, 97% of participants remained abstinent. Thus, even former-smokers require ongoing support to maintain cessation.

Despite the diagnosis of lung cancer, a sizable proportion (n=13/35, 37%) of smokers enrolled in our trial continued smoking at all time points. Emery and colleagues defined individuals who are heavy smokers, have a weak quitting history and may never quit

smoking as “hard core” smokers⁴¹. This subgroup of smokers requires innovative approaches to enhance cessation. A growing body of evidence suggests that genetic factors influence smoking initiation, progression to nicotine dependence and persistent smoking¹⁷. Thus, a promising direction for future smoking cessation treatments is the use of pharmacogenetic approaches to individualize treatments. Pharmacogenetics research can potentially improve treatment by identifying genetic variants that are predictive of therapeutic response. In turn, the selection of treatment can be optimized by matching treatment modality to genetic profile⁴². Further study is needed to determine if people with tobacco-related cancers have these genetic variants.

We also found that a shorter time since quit appeared to be a risk factor for smoking after surgery. Similar to other studies, our study identified that shorter time since quit was associated with smoking after surgery^{11, 13}. Smokers who quit smoking six-months before the diagnosis of lung cancer were nine-times more likely to return to smoking as compared to those who quit smoking > then six-months before diagnosis. Given that most smokers find it difficult to quit and remain abstinent, more innovative therapies may be needed to address tobacco dependence, especially in patients with lung cancer who are often highly dependent smokers. Steinberg and colleagues⁴³ have recently suggested that tobacco dependence should be treated as a chronic disease. The optimal duration of therapy is not known and some smokers may require extended therapy given as long as is necessary to enhance successful outcomes⁴³.

Male gender, lower educational level, lower number of comorbidities and presence of pain were marginally associated with smoking during recovery. Gritz and colleagues also found that women were more likely to quit smoking and stay quit after lung cancer surgery⁴⁴. Studies that have examined gender differences in the general population have had mixed results^{45–47}. Some studies have shown that women have a more difficult time quitting smoking, whereas other have found no differences exist. Few studies have examined gender differences in smoking cessation among medically ill populations. It is not clear whether there is an interaction between gender, illness, and smoking cessation. Further studies are needed to clarify whether gender differences in smoking cessation exist among those with medical conditions.

Lower education was associated with return to smoking after surgery. This finding is similar to other studies in the general population that have found education to be one of the most potent sociodemographic predictors of cessation. Less educated persons have higher smoking prevalence rates and lower rates for cessation. Although it is not clear how or why educational level influences smoking cessation outcomes^{48, 49} contextual factors such as having a greater prevalence and acceptance of smoking as a social norm among those who are less educated may influence the dynamics of smoking⁵⁰.

A lower number of comorbidities were marginally associated with smoking during recovery. This finding suggests that healthier smokers may not be compelled to quit in the same way that those smokers who are symptomatic. Thus, they may have a more difficult time quitting and staying quit. Further studies to replicate this finding are needed since even smoking cessation at the time of diagnosis is associated with improved clinical outcomes.

The presence of significant pain was marginally associated with smoking during recovery. To our knowledge, no other studies have reported the relationship between post-operative pain and smoking after surgery. Another study examined changes in symptom burden in smokers with AIDS/HIV who enrolled in a smoking trial⁵¹. Results from Vidrine et al's study identified that increased days of smoking abstinence were associated with a decrease

in HIV-related symptom burden; this finding underscores the importance of maintaining smoking abstinence in a medically ill population⁵¹.

The findings from our study provide direction for future smoking cessation interventions. Smoking relapse rates are high after lung cancer surgery even among those who quit 1-year prior. Similar to Walker et al's findings, our study found that most smokers had relapsed by 2-months after their surgery^{12, 13}. Smokers were highly dependent and many didn't receive optimal smoking cessation interventions. Although the diagnosis of lung cancer provides a window of opportunity to promote cessation, many challenges exist for patients and health care providers. First, patients undergoing lung cancer surgery have little time to adequately prepare for their cessation attempt. In addition, the diagnosis of lung cancer and subsequent treatment is often accompanied by cancer or treatment-related symptoms. Moreover, patients may be reluctant to disclose their smoking behaviors because of the stigma and embarrassment of continued smoking after a cancer diagnosis⁵². As a result, clinicians may not be aware of relapse issues. Smoking cessation interventions need to be tailored to this population. Ideally, smoking cessation interventions (medications and behavioral counseling) should begin prior to surgery and continue for at least 2-months after surgery. A longer duration of treatment may be needed, however, to enhance success rates⁴³. Given that former-smokers are at high risk for smoking relapse, they should be included in smoking cessation interventions that incorporate the opportunity for repeat tobacco dependence treatment if needed, adequate symptom management and smoking relapse prevention⁵³.

There were several limitations of the study that must be considered in interpreting the findings, including the use of convenience sampling and the relatively small sample size. This study did not include pre-operative data collection, a challenging time because of the short window from diagnosis to surgery in many situations. Future studies are needed that include a baseline assessment as well as a longer follow-up period to follow relapse. The strengths of the study are that we used biochemical verification to confirm self-report smoking status.

In summary, it is essential to promote smoking cessation both before and after lung cancer surgery in order to improve clinical outcomes. Only half of smokers received an appropriate smoking cessation intervention prior to surgery. Further study is needed to understand patient interest in participating in smoking cessation interventions and what type of programs they prefer so that programs can be tailored to meet their needs. Despite a diagnosis of potentially curable lung cancer, some patients were unable to quit prior to surgery and relapse rates post-surgery were high even among those who quit more than 1-year prior. Innovative cessation programs incorporating symptom management and relapse prevention are needed to enhance quitting prior to surgery and to maintain abstinence during post-operative care.

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Figure 1.
Pattern of SR over time

Figure 2.
Pattern of SR: Quit before surgery

Figure 3.
Pattern of SR: Smoking at diagnosis (n=35)

Table 1

Demographic and Clinical Characteristics of the Sample at 1-month after surgery (n=94)

Characteristic	N	(%)	Mean Value (SD)
Age			63.3 years (9.9)
Gender			
Male	40	(42.5%)	
Female	54	(57.5%)	
Race			
White	84	(89%)	
Black	9	(10%)	
Asian	1	(1%)	
Education			
Less than High School	24	(26%)	
High School	35	(37%)	
Greater than High School	35	(37%)	
Marital Status			
Married/partnered	57	(61%)	
Live alone	37	(39%)	
Stage at Diagnosis			
I	64	(69%)	
II	23	(24%)	
III A	7	(7%)	
Type of Lung Cancer			
Adenocarcinoma	49	(52%)	
Squamous Carcinoma	25	(27%)	
Bronchioalveolar	6	(6%)	
Large Cell	3	(3%)	
Other	11	(12%)	
Type of Surgical Procedures			
Lobectomy	74	(79%)	
Pneumonectomy	8	(9%)	
Wedge Resection	12	(13%)	

Table 2

Tobacco and nicotine dependence history Tobacco history at baseline (1 month after surgery) (n=94)

Smoking status	N (%)
Never smoker	10 (11%)
Ever smoker	84 (89%)
Former smoker	68 (81%)
Quit smoking before diagnosis	47 (56%)
Quit smoking after diagnosis	21 (25%)
Current smoker	16 (19%)
Continued smoking in household members	18/69 (26%)
Exposure to ETS	
Less than one day/week	46/93 (49%)
Several days/week	14/93 (15%)
Every day	33/93 (36%)
Tobacco history for ever-smokers	Mean (sd)
Age at initiation	17 years (5)
Number of years smoked	37 years (13)
Number of years since quit	8 years (12)
Number of cigarettes smoked per day	17 (14)
<u>Dependence history for current smokers at baseline (self-report) (n=11)</u>	
Time to smoke the first cigarette in the morning n (%)	
Within 5 minutes ⁺	5 (45%)
Between 6–30 minutes ⁺	4 (36%)
Between 31–60 minutes	0 (0%)
After 60 minutes	2 (18%)

⁺ highly nicotine dependent smoker

Table 3

Cessation strategies used to quit at diagnosis (among 35 who smoked at diagnosis)

	N	%
Assistance	16	46
Type of assistance provided		
Counseling only	1	6
Bupropion only	4	24
Nicotine replacement	4	24
Bupropion and Nicotine replacement	1	6
Bupropion and Information	1	6
Information and Nicotine replacement	3	18
Information and counseling	1	6
Combined treatment with counseling and Pharmacotherapy *	1	6

* recommended standard for tobacco dependence treatment.

Table 4
Table of unadjusted logistic regressions for ever-smokers who smoked after lung cancer surgery (n= 84)

Variable	Referent	Quitters	SR	OR*	CI	P-value
Quit Status	1 year + since quit	36(73%)	10(29%)	1.00	-	-
	6 months to 1 year since quit	2(4%)	1(3%)	1.80	0.15,21.94	0.72
	Less than 6 mos since quit	11(22%)	24(69%)	7.86	2.89,21.35	0.0001
Comorbidity	Age	67±9	58±9	0.90	0.84,0.95	0.0004
		1.7±1.2	1.2±1.1	0.72	0.49,1.07	0.11
Gender	Female	28(57%)	16(46%)	1.00	-	-
	Male	21(43%)	19(54%)	1.58	0.66,3.79	0.30
Dyspnea	None	17(35%)	13(37%)	1.00	-	-
	Present	32(65%)	22(63%)	0.90	0.36,2.22	0.82
SCFS		11.4±5.5	13.4±5.7	1.06	0.98,1.15	0.12
BPI- Presence of pain	None	24(50%)	6(18%)	1.00	-	-
	Present	24(50%)	27(82%)	4.50	1.58,12.86	0.005
Education	<HS	8(16%)	14(40%)	1.00	-	-
	HS	41(84%)	21(60%)	0.29	0.11,0.81	0.02
CESDtotal		11±10	15±12	1.03	0.99,1.08	0.12
Depression	Not Depressed	30(71%)	20(61%)	1.00	-	-
	Depressed	12(29%)	13(39%)	1.63	0.62,4.28	0.33
BPI- Worst pain over last 24 hours		3.7±2.6	5.4±2.5	1.28	1.06,1.55	0.01
BPI- Pain Interference with activities		19.5±20.2	23.7±19.1	1.01	0.99,1.04	0.37
BPI Severity of pain		10±8	14±9	1.06	1.00,1.12	0.05
Family smoker	No	42(86%)	25(71%)	1.00	-	-

Bold text= factors significantly related to smoking relapse (SR)

* Odds Ratio is measuring the odds of ever-smokers relapsing after lung surgery versus those who did not relapse

Table 5

Multivariate logistic regression for factors related to smoking relapse (n=84)

Variable	Referent	OR (CI)	P-value
When quit	<6 mo vs. 1+ yr	9.36 (2.43, 36.05)	0.001
	6–12 mo vs. 1+ yr	1.30 (0.06, 26.81)	0.86
Gender	M vs. F	2.96 (0.79, 11.06)	0.11
Number of comorbidities		0.55 (0.30, 1.01)	0.05
Age		0.92 (0.85, 0.99)	0.04
Education	HS+ vs. <HS	0.23 (0.05, 1.03)	0.05
Presence of Pain	Yes vs. No	3.24 (0.80, 13.11)	0.10

Bold text= factors significantly related to smoking relapse (SR)

* Odds Ratio is measuring the odds of ever-smokers relapsing after lung surgery versus those who did not relapse