A Brief Report of Smoking Behaviors in Patients with Incidental Pulmonary Nodules: Associations with Communication and Risk Perception

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ABSTRACT

INTRODUCTION: Incidental pulmonary nodules (IPNs) are commonly found on routine chest imaging. Little is known about smoking behaviors among patients with IPNs or characteristics of patient-clinician communication that may contribute to these behaviors. We assessed the association of patient characteristics and communication quality with smoking behaviors and stage of change for tobacco cessation among patients with IPNs.

MATERIALS AND METHODS: Prospective, repeated-measures, cohort study of current smokers and past-year quitters with IPNs treated within the Veterans Affairs Portland Health Care System. Eligible patients had newly reported, incidental nodules <3 cm planned for non-urgent computed tomography (CT) follow-up. Our primary outcomes were changes in amount smoked and stage of change for tobacco cessation throughout the follow-up period. We used multivariable-adjusted generalized estimating equations for analyses.

RESULTS: We identified 37 current smokers and 9 recent quitters. By the final visit, 8 of 36 (22%) baseline smokers had quit and 2 of 7 (29%) recent quitters had resumed smoking. Of 40 respondents, 23 (58%) reported receiving any tobacco treatment (recommendation to quit, medication, and/or behavioral treatment) at least once during follow-up. We found no significant associations of high-quality communication, patient distress, self-perceived risk of lung cancer, and self-reported clinician-recommended smoking cessation interventions with decrease in amount smoked or positive stage of change.

CONCLUSIONS: Many smokers and recent quitters with IPNs quit during follow-up, though nearly half reported no quit support. We found no association between communication quality or quit support and decreased smoking. The intensity of tobacco treatment offered may have been insufficient to affect behavior.

KEYWORDS: pulmonary nodule, lung cancer, health communication, tobacco cessation

Introduction

Incidental pulmonary nodules (IPNs) are commonly found on routine computed tomography (CT) imaging of the chest, present on as much as 31% of scans performed for other indications.[1] Most are determined to be benign[2] after a process of repeated chest imaging over a period of years, performed according to a set of guidelines specific to IPNs.[3] This process is similar to lung cancer screening (LCS). Systematic reviews have suggested that while the process of undergoing LCS itself has little effect on smoking behaviors,[4] identification of a pulmonary nodule is associated with an increased likelihood of quitting.[5] The mechanism of this association is unknown, but may

be related to the communication between the patient and provider at the time of nodule identification, or may be due to a "teachable moment" increasing motivation to quit.[6,7] Many patients with IPNs will be past or current smokers.[8] It is possible that like LCS patients, the incidental discovery of a potentially cancerous nodule may prompt a positive change in smoking behavior. Little is known about smoking behaviors among patients with IPNs or the characteristics of patient–clinician communication that may contribute to these behaviors. This is due in part to the challenges of studying tobacco behaviors in patients with IPNs that may be attributable to their IPN care. Such studies require longitudinal designs temporally

linked to imaging exams and assessments of communication practices. Behavioral intentions are important to assess in addition to quit behaviors, as they may identify missed opportunities for clinicians to assist a motivated patient. We sought to assess longitudinal quit behaviors among a cohort of patients with IPNs and to explore the association of patient characteristics and communication quality with smoking behaviors and stage of change. A portion of the results were previously presented in abstract form.[9]

Methods

We conducted a prospective, repeated-measures cohort study of patients with IPNs treated within the Veterans Affairs Portland Health Care System (VAPORHCS) from June 2011 to September 2015. Patients were eligible if they had newly reported, incidental (not screen-detected) nodules less than 3 cm in diameter that were planned for non-urgent CT follow-up. This study was approved by the VAPORHCS Institutional Review Board (no. 2630), and all participants completed informed consent.

The recruitment, exclusion criteria, and most of the methods for this study were previously reported.[10] Subjects were limited to cognitively intact, community-dwelling adults without a previous diagnosis of lung cancer or terminal illness. Focusing on previously undescribed methodologies, patients were categorized at baseline as never smokers/long-term quitters, recent quitters, or current smokers based on survey responses. Recent quitters were those who quit within the past year, defined as reporting that their age at the time of quitting was within 1 year of their calendar age at baseline. Average cigarette use was quantified in half-pack increments up to 2 packs per day and then in pack increments if the subject smoked an average of 3 or more packs for the duration of smoking. Pack-years were estimated by multiplying the midpoint of this increment by the number of years smoked. At each visit, participants reported their current amount of smoking compared with baseline and their stage of change[11] regarding tobacco use. The participant's trajectory for amount of cigarettes smoked was classified as positive if it was reported as "still not smoking," "quit," or "cut down" and negative if "no change" for current smokers or "increased" for either current or former smokers. The stage of change was categorized as positive if the patient reported "thinking about quitting," "planning to quit," "quitting now," or "successfully quit," otherwise negative. Participants reported whether their clinician had recommended smoking cessation interventions such as nicotine replacement, bupropion, varenicline, and/or behavioral interventions such as cessation classes. We continued with study visits until patients completed their planned follow-up for their IPN.

We used generalized estimating equations (GEE) clustered on the individual participant with a logit link and an exchangeable correlation matrix to measure associations with self-reported changes in amount of cigarettes smoked and stage of change. Models were adjusted a priori for age, income, and self-reported depression at baseline. For the exposure variables, we measured self-reported communication quality (excellent vs not excellent), distress regarding the nodule (at least mild vs none), self-perceived risk of lung cancer (>30% vs ≤30%),[10] and self-reported receipt of clinician-prescribed smoking cessation interventions (any vs none). These analyses were pre-planned as hypothesis-generating secondary analyses and so were not adjusted for multiple testing.

Results

From the total cohort of 121 participants, 46 were included in our analysis, with 37 current smokers and 9 recent quitters. Three subjects did not have data on smoking behaviors after the baseline assessment, leaving 43 participants with 127 follow-up assessments. By the participants' final visit, 8 of 36 (22%) current smokers at baseline had quit and 2 of 7 (29%) recent quitters had resumed smoking, demonstrating an overall decrease in the proportion of smokers. Of 40 respondents, 23 (58%) reported receiving advice to quit from their provider, medication prescriptions, and/or behavioral therapy sessions to help quit smoking at least once during follow-up. None of the never smokers or long-term quitters reported smoking at any time during the study.

Table 1 shows the characteristics of the cohort, stratified by self-report of at least one positive smoking behavior change (quit or decreased number of cigarettes smoked per day). Most of the subjects (31 of 43, 72%) reported at least one positive change in smoking behavior. No patient characteristic was significantly associated with changes in the amount of cigarettes smoked.

When examining behavioral intention as quantified by stage of change, we found that a minority of participants (6 out of 43, 14%) reported never having a positive stage of change for tobacco cessation, while most reported thinking about, planning, or actively quitting at least once during follow-up. In unadjusted GEE analyses, self-report of positive smoking stage of change was strongly associated with a positive change in the amount smoked (OR = 6.1, *P* = .008).

Finally, we performed multivariable-adjusted GEE analyses to evaluate the association of high-quality communication, distress, self-perceived risk of lung cancer, and self-reported clinician-recommended smoking cessation interventions with change in smoking amount and stage of change. None of these associations were statistically significant, though several associations were in the expected direction (Table 2).

Discussion

In this longitudinal analysis of smoking behaviors among patients with IPNs, current smokers quit and former smokers relapsed at similar rates to LCS participants[12,13] and older smokers in general.[14] Most of the patients reported quitting

Table 1. Cohort characteristics stratified by changes in the self-reported amount of cigarettes smoked and odds ratios for each characteristic using generalized estimating equations.

CHARACTERISTIC AT BASELINE	AMOUNT OF CIGARETTES SMOKED		ODDS RATIO (95% CI)
	PARTICIPANTS WHO NEVER CUT DOWN (N=12; N (%) OR MEAN ± SD)	PARTICIPANTS WHO CUT DOWN AT LEAST ONCE (N=31; N (%) OR MEAN ± SD)	
Age (years)	61.9 ± 6.3	61.8 ± 8.0	1.0 (0.9–1.0)
Men	12 (100%)	30 (96.8%)	1.6 (1.0–2.5)
Non-white	2 (18.2%)	4(13.8%)	0.7 (0.2–1.9)
Socioeconomic characteristics			
Education ⩾college	6 (50.0%)	18 (58.1%)	0.7 (0.3–1.7)
Currently married	3 (25.0%)	15 (50.0%)	1.6 (0.6–4.0)
Income ⩾US$30 000/year	3 (25.0%)	14 (51.9%)	1.3 (0.5–3.4)
Smoking status			
Smoking duration (years)	44.8 ± 7.7	46.9 ± 8.7	1.0 (0.9–1.1)
Pack years	55.8 ± 29.9	76.1 ± 45.7	1.0 (1.0–1.0)
Comorbidities			
COPD	3 (25.0%)	13 (41.9%)	1.6 (0.7–4.1)
Depression	4 (33.3%)	18 (58.1%)	1.6 (0.7–4.1)
PTSD	4 (33.3%)	10 (32.3%)	1.0 (0.4–2.5)
Nodule/imaging characteristics			
Nodule size (in mm)	4.8 ± 1.8	6.0 ± 2.2	1.2 (1.0–1.4)
Pulmonologist involvement	1 (8.3%)	9 (29.0%)	2.3 (0.8–6.2)
How the participant was informed			
Letter	7 (58.3%)	15 (48.4%)	Reference category
Phone	3 (25.0%)	8 (25.8%)	0.9 (0.3–2.7)
Person	2 (16.7%)	8 (25.8%)	1.2 (0.4–4.1)
Who informed the participant			
Primary care provider	6 (50.0%)	9 (29.0%)	Reference category
Research	3 (25.0%)	11 (35.5%)	2.8 (0.8–8.9)
Other	3 (25.0%)	11 (35.5%)	1.4 (0.5–4.2)
Participant-reported risk of lung cancer[a]			
⩽30%	3 (25.0%)	6 (19.4%)	Reference category
>30%	7 (58.3%)	21 (67.7%)	1.3 (0.5–3.1)
Self-perceived lung cancer risk	0.42 ± 0.20	0.55 ± 0.23	1.2 (1.0–1.4)
Actual lung cancer risk (calculated risk)[b]	0.15 ± 0.24	0.11 ± 0.11	0.9 (0.6–1.3)
PCC summary			
Not excellent	6 (50.0%)	5 (16.1%)	Reference category
PCC excellent	5 (41.7%)	18 (58.1%)	0.6 (0.2–1.9)

(Continued)

Table 1. (Continued)

CHARACTERISTIC AT BASELINE	AMOUNT OF CIGARETTES SMOKED		ODDS RATIO (95% CI)
	PARTICIPANTS WHO NEVER CUT DOWN (N = 12; N (%) OR MEAN ± SD)	PARTICIPANTS WHO CUT DOWN AT LEAST ONCE (N = 31; N (%) OR MEAN ± SD)	
Distress			
None	8 (80.0%)	14 (51.9%)	Reference category
Mild	2 (20.0%)	11 (40.7%)	0.6 (0.2–1.7)
Moderate	0 (0.0%)	1 (3.7%)	1.0 (0.2–4.6)
Severe	0 (0.0%)	1 (3.7%)	3.2 (0.4–26.1)
Clinician-recommend cessation intervention			
None	5 (41.7%)	12 (38.7%)	Reference category
At least once	7 (58.3%)	16 (51.6%)	1.5 (0.7–3.2)

Abbreviations: CI, confidence interval; COPD, chronic obstructive pulmonary disease; OR, odds ratio; PTSD, post-traumatic stress disorder; PCC, patient-centered communication.
ORs are from unadjusted generalized estimating equations based on repeated measures. For ordinal variables (eg, years and nodule size), the OR is reported for each one unit (year or millimeter) increment. For dichotomous variables, reference is the opposite variable (eg, for gender OR, reference is women).
[a]Percents of values may not add up to 100% because of rounding or due to missingness.
[b]Based on the Mayo model.

Table 2. Adjusted associations of high-quality communication, distress, self-perceived risk of lung cancer, and receipt of clinician-recommended smoking cessation interventions with a positive change in the amount of cigarettes smoked or a positive change in the stage of change for smoking cessation.

CHARACTERISTIC	ADJUSTED OR (95% CI)
Positive change in the amount of cigarettes smoked	
Excellent patient-centered communication	1.0 (0.2–4.6)
≥Mild distress	0.7 (0.3–1.8)
>30% self-perceived risk	1.8 (0.7–4.4)
Smoking cessation intervention recommended	1.5 (0.6–3.4)
Positive change in the stage of smoking	
Excellent patient-centered communication	1.5 (0.5–4.4)
≥Mild distress	1.3 (0.4–4.2)
>30% self-perceived risk	1.0 (0.3–2.8)
Smoking cessation intervention recommended	1.7 (0.3–9.6)

Abbreviations: CI, confidence interval; OR, odds ratio.
ORs are from adjusted (for age, income, and self-reported depression) generalized estimating equations based on repeated measures. The ORs are based on dichotomous variables and the references are the opposite (eg, communication quality was reported not excellent).

or cutting down at least once during follow-up, highlighting that quit attempts are very common in this population. Our study underscores the utility of a repeated-measures design that includes assessments of cessation behavior and behavioral intention over time, showing much higher rates of positive

stage of change than cross-sectional data. Our results demonstrate that more than 80% of patients intended to quit smoking at some point during their nodule follow-up, but only half were assisted in this intention by a clinician. Although we lack information on the quality or intensity of smoking cessation interventions among the patients who did receive cessation support, patient-reported cessation treatment and advice were not associated with change in tobacco use. In general, higher intensity smoking cessation support is more strongly associated with positive changes in smoking behavior.[15] We suspect that the intensity of support offered by clinicians to the patients in this study was inadequate to cause a consistent change in smoking behavior. Clinicians may not address smoking cessation in a systematic way at the time of nodule identification.

We included measures of patient-clinician communication to provide information on ways in which the finding of an IPN may influence quit behaviors. However, we found no statistically significant associations of modifiable program characteristics such as high-quality communication or how the patient was informed of the nodule (letter, phone, in person) with smoking behaviors. Some of the findings were in the expected direction, such as the association of a high perceived risk of cancer with quitting or cutting down, but did not attain statistical significance. This is may be due to the small sample size.

Our study has limitations. These include the single-center nature of the design, the relatively small sample size, and the lack of granular detail about tobacco treatment quality. However, the repeated-measures design increases the statistical power and allows for a novel assessment of changes in tobacco

behaviors and intentions over time in a population whose smoking behaviors have rarely been studied.

In summary, we found no significant associations between measured program-modifiable characteristics and cessation. Despite the strengths of utilizing a repeated-measures design, these results may be subject to Type II error. Still, our study is hypothesis generating for future research examining the link between abnormal imaging findings and smoking behaviors and provides a framework of methodology for studying the contribution of clinician communication to these behaviors.

Authors' Note

A portion of the results were previously presented in abstract form at the American Thoracic Society International Meeting May 22, 2018, San Diego, CA.

Author Contributions

CGS, RSW, ACM, SEG, and JMI all contributed to conception, design, and interpretation. CGS performed primary analysis. ACM and CGS performed primary drafting, and RSW, JMI, and SEG contributed extensively to editing and intellectual content. All authors contributed to and have approved the manuscript in its final form.

Disclaimer

The Department of Veterans Affairs did not have a role in the conduct of the study; in the collection, management, analysis, and interpretation of data; or in the preparation of the manuscript.

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