Dig Dis Sci (2012) 57:1026–1032
DOI 10.1007/s10620-012-2038-2

ORIGINAL ARTICLE

Assessment of Variables Associated with Smoking Cessation in Crohn's Disease

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Received: 26 August 2011 / Accepted: 4 January 2012 / Published online: 7 February 2012

Abstract
Background Patients with Crohn's disease (CD) who smoke have a more complicated disease course.
Aims Our primary objective was to assess smoking related variables that were associated with smoking cessation versus continued smoking in patients with CD.
Methods A multi-center study identified CD patients who were seen at the University of Chicago and University of Calgary IBD clinics. Patients were categorized into three subgroups: lifetime non-smokers, current smokers, or ex-smokers. Participants completed questionnaires assessing their cigarette smoking behavior. Current smokers were prospectively followed for 6 months to assess smoking status and attempts to quit. Logistic regression analysis was performed to identify factors associated with smoking cessation.
Results Three hundred patients were enrolled with 148 identifying themselves as lifetime non-smokers, 70 as current smokers, and 82 as ex-smokers. Patients who reported their first cigarette within 5 min of waking were more likely to be current smokers (OR = 21; 95% CI 3.94–107.3) as compared to patients who waited greater than 60 min. Current smokers were more likely to have one or more household members who smoked compared to ex-smokers ($P < 0.05$). Nearly half (49%) of the current smokers were in the precontemplation stage of change

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(i.e. no intention to quit smoking). At the 6-month follow-up, only 11% reported they quit smoking.
Conclusions Patients who report a short time to first cigarette in the morning may have more difficulty in smoking cessation. Current smokers were more likely to have another smoker in the household compared to ex-smokers. Current smokers had low levels of motivation to quit smoking and consequently with no intervention, very few quit 6 months after the baseline assessment.

Keywords Crohn's disease · Cigarette smoking · Smoking cessation · Nicotine dependence

Introduction

Smoking is a risk factor for the development of Crohn's disease (CD) [1, 2]. Additionally, smoking cigarettes is associated with a worse prognosis. CD patients who continue to smoke after diagnosis have an increased risk of relapse [3–5], are more likely to be prescribed immunosuppressants [6], and have higher rates of surgery for Crohn's disease [7, 8].

A cross-sectional survey of 50 CD patients who were smokers showed that few were motivated to quit, with 41% in the precontemplation stage of change meaning they have no plans to quit smoking and 44% in the contemplation stage of change meaning they have plans to quit within the next 6 months [9], as outlined in the model by Prochaska and DiClemente [10].

In a European cohort, Cosnes et al. found that physician factors, previous intestinal surgery, and high socioeconomic status were correlated with higher rates of smoking cessation. However this study did not look at baseline preparedness to quit [6].

The majority of studies in CD and smoking evaluated disease onset and course comparing CD patients who smoke to CD patients who have never smoked. What is less known is the smoking related behavior that determines whether a patient continues to smoke or is able to successfully quit.

Our primary objective was to assess smoking related variables that were associated with smoking cessation versus continued smoking in patients with CD.

Methods

Study Population

Patients with CD were identified at two tertiary care IBD clinics (i.e. University of Calgary IBD Clinic and University of Chicago IBD Center) at the time of their clinic visit for their CD. Over a 3-month period, patients with CD were asked by the research assistant or gastroenterologist to participate in a questionnaire study assessing current or previous smoking habits that was completed during their clinic visit. As this was designed to be an observational study, the treating physicians and nursing staff were not specifically directed to give advice about smoking cessation. Compensation was not offered for participation.

Inclusion Criteria, Study Variables, and Definitions

Definitions of smoking status were defined from previous smoking cessation literature. Lifetime non smokers were defined by a history of smoking less than 100 cigarettes in their entire life. Current smokers were defined by a history of smoking at least 100 cigarettes in their entire life who continued to smoke for some or all days prior to completing the questionnaire [11, 12]. Ex-smokers were defined by a history of smoking at least 100 cigarettes in their entire life who completely stopped smoking for at least the last 6 months [11, 12]. Ex-smokers were also stratified by time of quitting smoking: (a) before diagnosis of CD and (b) after diagnosis of CD.

All participants were asked to fill out a self-report questionnaire that included items on demographics and disease history. Current and ex-smokers completed a more comprehensive questionnaire. The questionnaire included items on demographics, surgical history, quantity and duration of smoking, quit attempts, prior use of smoking cessation aids, and smoking status of household members. We also included a validated measure of nicotine dependence, the Fagerström Test of Nicotine Dependence (FTND) [13]. The FTND asks patients six questions regarding their dependence on smoking in the morning, difficulty in not smoking in public places or when ill, and number of cigarettes smoked per day. Scores of 0–2 indicate mild dependence, 3–5 moderate, and 6–10 severe dependence. Ex-smokers were directed to answer their questions retrospectively, based on their previous smoking behavior.

The Contemplation Ladder (Table 1) is a validated measure of readiness to consider smoking cessation consisting of ten intervals corresponding to different statements on preparedness to quit [14]. A score of 6 "I definitely plan to quit smoking in the next 6 months" or higher identifies patients who are prepared to quit. Current smokers were asked to rate their level of preparedness to quit.

Follow-Up

CD patients that were current smokers at enrollment were followed prospectively. Smokers were interviewed 6 months after administering the questionnaire. The interviewer used a standardized phone script to ask patients about their present

Table 1 Contemplation ladder

Score	Statements on preparedness to quit smoking
10	I have quit smoking and I will never smoke again.
9	I have quit smoking, but I still worry about slipping back, so I need to keep working on living smoke-free.
8	I still smoke, but I have begun to change, like cutting back on the number of cigarettes I smoke. I am ready to set a quit date.
7	I definitely plan to quit smoking within the next 30 days.
6	I definitely plan to quit smoking in the next 6 months.
5	I often think about quitting smoking, but I have no plans to quit.
4	I sometimes think about quitting smoking, but I have no plans to quit.
3	I rarely think about quitting smoking, and I have no plans to quit.
2	I never think about quitting smoking, and I have no plans to quit.
1	I enjoy smoking and have decided not to quit smoking for my lifetime. I have no interest in quitting.

Adapted from Biener and Abrams [14]

smoking status, quit attempts since completion of the questionnaire, and use of smoking cessation aids.

Data Analysis

In univariate analysis, differences between lifetime non-smokers, current smokers and ex-smokers were examined using χ^2 tests for binary and categorical variables, whereas continuous variables were reported as medians with interquartile ranges (IQR) and compared using Wilcoxon rank-sum test. Two-sided P values were reported with a significance level (alpha) of 0.05.

We performed multivariate logistic regression to evaluate factors that differentiated current from ex-smokers among CD patients. Risk estimates were represented as adjusted odds ratios (OR) with 95% CI. Characteristics evaluated were age (continuous variable), gender, number of surgeries (1–3 vs. 0, >3 vs. 0), age at initiation of smoking (≤19 vs. >19), and time to first cigarette in the morning (within 5 min, 6–30 min, 31–60 min and >60 min). A sensitivity analysis was performed excluding CD patients who quit smoking before the diagnosis of CD or if the date of smoking cessation was unknown ($n = 28$).

All statistical analyses were performed using SAS (version 9.2, Research Triangle Institute, North Carolina).

Ethical Considerations

The study was approved through the Institutional Review Boards at both institutions.

Results

Three hundred patients were enrolled with 70 identified as current smokers, 82 identified as ex-smokers, and 148 identified as lifetime non-smokers. We were unable to define smoking status in four subjects due to missing data. Twenty patients defined as ex-smokers quit smoking before the diagnosis of CD, and in eight ex-smokers there was no information on duration of smoking cessation. Table 2 summarizes the baseline characteristics of each group.

Smoking Behavior

Current smokers smoked a median number of 25 years as compared to ex-smokers who smoked a median number of 15 years before smoking cessation ($P = 0.0004$) (Table 3). Age of initiation of smoking was similar between current smokers and ex-smokers, with a trend to current smokers initiating at a younger age ($P = 0.06$). The FTND was similar between the two groups. Overall, 47% of patients were defined as having mild nicotine dependence, 34% moderate and 19% severe. However, when the FTND was analyzed by each item, current smokers had a shorter time to first cigarette in the morning compared to reports by ex-smokers. As summarized in Table 3, 26% of the current smokers were able to wait more than 1 h to smoke their first cigarette compared to 48% of ex-smokers ($P = 0.0056$).

Household Contacts

Among current smokers, 50% (35/70) reported no household members who were smokers and 50% (35/70) reported one or more household members who smoked. For ex-smokers, recall of household smoking revealed 79% (65/82) had no household members who smoked, and 10% (8/82) recalled one or more household contacts that smoked (missing data on nine patients). In summary current smokers were more likely to have one or more household members who smoked compared to ex-smokers ($P < 0.05$).

Quitting Behavior

Table 4 summarizes the longest duration of smoking cessation for current smokers. Approximately 70% of current smokers reported a history of being able to quit smoking for at least 1 month.

Multivariate Analysis

Patients who reported their first cigarette within 5 min of waking were more likely to be current smokers (OR = 21;

Table 2 Patient characteristics

Characteristic	Total $n = 300$	Current smoker $n = 70$	Ex-smoker[a] $n = 82$	Never smoker $n = 148$	P value
Age (median, IQR)	39 (30.5–50)	42 (31–49)	47 (35–57)	36 (27–44)	<0.001
Gender (%); data from one patient missing					
Male	43.81	35.71	38.27	50.68	0.058
Female	56.19	64.29	61.73	49.32	
Race (%); two patients missing					
White	89.93	87.14	86.42	93.20	0.215
Black/African A	6.71	10.00	7.41	4.76	
Hispanic	1.34	1.43	2.47	0.68	
Asian	1.01	0	1.23	1.36	
American Indian/Alaskan Native	0.67	0	2.47	0	
Native Hawaiian/Pacific Islander	0	0	0	0	
More than one	0	0	0	0	
Other	0.34	1.43	0	0	
Education (%); one patient missing					
Grade school	1.67	1.43	3.70	0.68	<0.001
Some high school	6.69	11.43	6.17	4.73	
High school diploma	37.79	50.00	44.44	28.38	
College degree	36.45	30.00	37.04	39.19	
Graduate degree	17.39	7.14	8.64	27.03	
Overall duration of disease (median, IQR), three patients missing	12 (5–21)	14 (8–25)	17.5 (6.5–25)	10 (5–17.25)	0.002
Number of surgeries (%); ten patients missing					
0	44.83	36.23	56.76	42.86	0.008
1	25.17	21.74	28.38	25.17	
2	9.31	8.70	6.76	10.88	
3	6.21	5.80	5.41	6.80	
>3	14.48	27.54	2.70	14.29	
Center					
Chicago	49.33	35.71	46.34	57.43	0.009
Calgary	50.67	64.29	53.66	42.57	

[a] 20/82 patients quit before the diagnosis of Crohn's disease (24%)

95% CI 3.94–107.3) as compared to patients who waited greater than 60 min before their first cigarette. Patients with greater than three surgeries as compared to patients with no history of surgeries were also more likely to be current smokers (OR = 23; 95% CI 4.2–124.5). In a sensitivity analysis, both of these findings remained statistically significant after excluding patients who quit smoking before the diagnosis of CD (Table 5). When patients who quit smoking before the diagnosis of CD were excluded the OR for smoking within 5 min of waking compared to waiting greater than 60 min was 18 (95% CI 3.0–110.4).

Preparedness to Quit

Out of 70 current smokers, 34 (49%) were in the precontemplation stage, indicating that they had no plans to quit. Twenty-one patients (30%) were in the contemplation stage and planned to quit smoking within the next 30 days to 6 months and 15 patients (21%) had already begun to cut back.

Six-Month Prospective Data

At 6 months, 17/70 (24%) patients were lost to follow-up. At 6 months, the majority of patients continued to be smokers, i.e. 47/53 (89%).

In this prospective cohort of the 47 patients who continued to smoke, 45% (21/47) had no household contacts who smoked, and 55% (26/47) had one or more household contact that smoked. Of the patients who reported smoking cessation, 67% (4/6) had no household contacts who smoked, and 33% (2/6) had one or more household contacts who smoked.

Table 3 Smoking characteristics

Characteristics	Total $n = 152$	Current smoker $n = 70$	Ex-smoker[a] $n = 82$	P value
Years of smoking (median, IQR); data from 14 patients missing	18 (9–29)	25 (15–32)	15 (8–22)	0.0004
Age smoking started (median, IQR); ten patients missing	17 (15–19)	16 (14–18)	17 (15–20)	0.0622
Cigarettes/day (%); six patients missing				
10 or less	47.26	47.14	47.37	0.1598
11–20	34.93	35.71	34.21	
21–30	14.38	17.14	11.84	
31 or more	3.42	0	6.58	
Time to first cigarette (%); nine patients missing				
After 60 min	37.06	25.71	47.95	0.0056
31–60 min	21.68	30.00	13.70	
6–30 min	29.37	27.14	31.51	
Within 5 min	11.89	17.14	6.85	
Fagerström score; nine patients missing				
Mild (0–2)	46.85	42.86	50.68	0.6511
Moderate (3–5)	34.27	37.14	31.51	
Severe (6–10)	18.88	20.00	17.81	

[a] 20/82 patients quit before the diagnosis of Crohn's disease (24%)

Table 4 Duration of smoking cessation

Variable	Current smoker $n = 70$	Ex-smoker[a] $n = 82$	P value
Longest quit length (%); data on six patients missing			
0–23 h	0	Not applicable	
24 h–1 week	17.19		
1 week–1 month	10.94		
1 month–6 months	43.75		
6 months–1 year	10.94		
More than 1 year	17.19		
Serious quit attempts (median, IQR); 13 patients missing	3 (2–5)	2 (1–4)	0.0015
Time since quitting; five patients missing			
Less than 1 week	Not applicable	0	
1 week–1 month		0	
1 month–6 months		0	
6 months–1 year		6.49	
More than 1 year		93.51	

[a] 20/82 patients quit before the diagnosis of Crohn's disease (24%)

Of the 47 patients who continued to smoke, 53% (25/47) attempted to quit smoking but were unsuccessful. The majority of these patients (17/25) did not use any smoking cessation aids in their attempt to quit smoking.

Baseline median score on the contemplation ladder was 5 for patients who continued to smoke at 6 months (IQR 5–6) compared to 6.5 for patients who were able to quit at 6 months (IQR 6–8).

Discussion

In this study of two referral IBD centers, CD patients who smoked reported a shorter time to first cigarette in the morning as compared to CD patients who were ex-smokers. Current smokers were also more likely to have household contacts who smoked. Over a 6-month follow-up period, a total of 53% of the smokers attempted to quit with the majority using no smoking cessation aids. Nearly half (49%) of the smokers were in the precontemplation stage of behavioral change, indicating that they had no plans to quit, and very few patients (6/53) reported smoking cessation during our 6-month follow-up. A strength of this study was the use of patients from two countries with similar prevalence of smoking [15, 16] and similar prevalence of CD [17, 18]. We did not find significant differences in the smoking behavior of CD patients from Chicago or Calgary.

Our data on time to first cigarette in the morning was consistent with data from the general smoking cessation literature. Baker et al. [19], using data from four large placebo-controlled smoking cessation trials and an international epidemiological study, found that much of the predictive validity of the FTND was attributed to the time to first cigarette item, which had greater validity than any other single measure. The overall score from the FTND in our study did not distinguish between successful versus unsuccessful smoking cessation. Due to the small numbers of patients who were able to quit in the prospective cohort we were unable to formally evaluate whether the FTND predicted smoking cessation in our patient population. Baker et al. suggested that a short time to first cigarette in the morning describes a pattern of heavy, uninterrupted and automatic smoking behavior and thus, may be a good single-item measure of nicotine dependence in place of using the whole score. This was in keeping with our results as patients who needed to smoke within 5 min of waking were 20 times more likely to be a current smoker than if they could wait more than 60 min.

Current smokers tended to initiate smoking at a younger age, which was also consistent with the general smoking literature [11]. We did not find that the number of daily cigarettes distinguished between the group of current

Table 5 Multivariate regression analysis of independent characteristics of current smokers as compared to (a) all ex-smokers and (b) ex-smokers who quit after the diagnosis of Crohn's disease (CD)

Characteristics	Current vs. all ex-smokers		Current vs. ex-smokers who quit after diagnosis of CD[a]	
	Odds ratio	95% CI	Odds ratio	95% CI
Age	0.96	0.92–0.99	0.97	0.93–1.01
Gender				
Female versus male	0.68	0.29–1.59	0.66	0.27–1.62
Surgeries				
1–3 versus 0	1.19	0.50–2.84	0.70	0.27–1.81
>3 versus 0	22.94	4.22–124.55	12.92	2.32–71.92
Age smoking started				
<19 versus >19	2.57	0.82–8.07	2.96	0.88–9.95
Time to first cigarette				
31–60 min versus >60 min	7.26	2.28–23.11	6.61	1.99–21.95
6–30 min versus >60 min	2.38	0.84–6.74	2.77	0.92–8.37
<5 min versus >60 min	20.56	3.94–107.30	18.10	2.97–110.38

[a] 20 CD patients were excluded who quit smoking before diagnosis of CD

versus ex-smokers in contrast to a large community intervention study of smokers followed for 5 years, which found that both lower levels of daily cigarettes and longer time to first cigarette most strongly correlated with smoking cessation [11]. This difference may be due to the smaller number of patients in our study.

In ex-smokers we calculated the number of surgeries prior to smoking cessation in order to see if previous surgery was associated with smoking cessation. Because ex-smokers had fewer surgeries compared to current smokers, the number of Crohn's related surgeries likely did not play a major role in the decision to quit smoking. In current smokers, whether the disease burden as measured by number of surgeries made quitting more difficult or that continued smoking independently worsened the disease course was not clear from this study.

Our study was also unique in that it described patients' preparedness to quit, self reported quit attempts and cessation rates. Few patients were able to quit smoking over the 6-month follow-up period (6/53). We were limited by our small numbers to make formal statistical comparisons in our prospective cohort, but we identified trends in our population consistent with the published literature on smoking cessation. Baseline median score on the contemplation ladder tended to be higher for patients who reported smoking cessation at the 6-month follow-up. Previous work in patients with cardiovascular disease demonstrated that patients who identified themselves as being prepared to quit had a higher chance of smoking cessation [20]. Current smokers were more likely to have household contacts who smoked compared to ex-smokers. We specifically asked ex-smokers about the number of household contacts during the years they were smoking. Furthermore, in four out of six of the patients who self reported smoking cessation at 6 months there were no household members who smoked. Presence of other smoking household members is associated with lower abstinence rates [21]. Our patients were also similar to the general smoking population in terms of smoking cessation attempts. In a national survey of 1,200 smokers seen in emergency departments almost 50% of patients reported at least two previous quit attempts, which is similar to our data [22]. Over a 6-month period 25/53 of our patients reported a smoking cessation attempt, yet the majority did not use any smoking cessation aids. This is similar to published studies in the non CD population that report minimal use of cessation aids [23, 24].

Limitations of our study included the retrospective nature of the data collection as information from ex-smokers was subject to recall bias. However smoking cessation studies have used similar methodology to obtain information from ex-smokers and other studies have demonstrated that ex-smokers have adequate recall of smoking habits [24, 25]. The FTND has been found to be reliable up to 12 years after cessation when compared to responses at the time of cessation [26]. Furthermore, we acknowledge that our study population may have been subjected to referral bias given the tertiary clinic location of these CD patients. Finally, given that we did not know a priori the composition of our smoking population, we were not able to power the study to evaluate independent predictors of smoking cessation among the current smokers. Nonetheless, the results of this study provide helpful information for future prospective and adequately powered intervention trials [27, 28].

In summary, our study reveals that CD patients who report a short time to first cigarette in the morning may have more difficulty in smoking cessation. A large number of current smokers in this tertiary population had a history of being able to quit for at least a month, and even over a 6-month period attempted to quit but were unsuccessful. In clinical practice this study has important implications for busy clinicians, who can ask about the time to first cigarette in the morning and the presence of other smokers in the household as factors that identify patients who may require a more intensive approach to smoking cessation.

Acknowledgments Dr. Kaplan is supported through a New Investigator Award from the Canadian Institute of Health Research and a Population Health Investigator Award from the Alberta Heritage Foundation for Medical Research.

Conflict of interest None.

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