

Smoking behavior after coronary artery bypass surgery: Quit, relapse, continuing

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ABSTRACT

Objective: Tobacco smoking represents a major risk factor for coronary artery disease. Our study aimed to investigate whether Coronary Artery Bypass Graft (CABG) surgery could act as a motivating factor to enforce smoking cessation. Specifically, we observed the success rate in individuals who quit smoking, along with the number and reasons of relapse(s) at least one year after the operation.

Methods: The pre-operative characteristics, pre-operative tobacco exposure, socioeconomic factors and perioperative complications in patients who underwent isolated Coronary Artery Bypass Graft surgery in our Department from June 2012 to September 2016 were reviewed. Our survey was conducted via phone interview and using a standardized questionnaire. Only patients who were current smokers at the time of surgery were interviewed.

Results: Our study group consisted of a total of 120 patients, 91 (75.8%) reported initially quitting tobacco smoking. Because of relapse(s), one year after the procedure the number of patients who were still non-smokers dropped to 69 (57.5%). Smoking cessation attempts were not supported by professional assistance.

Conclusions: Our findings demonstrate that there is a desire from CABG patients to quit smoking, as indicated by the high percentage of initial attempts in early postoperative period. However, a year after the procedure, only 57.5% of CABG patients were able to achieve or maintain smoking cessation. Patients who were retired or who were unemployed at the time of the surgery, found it easier to stop smoking than patients who were active employees. Patients who lived alone at the time of surgery also found it harder to stop smoking. Finally, patients with COPD also found quitting smoking harder in the post-operative period.

Keywords: Chronic obstructive pulmonary disease, coronary artery bypass, current smoking, smoking cessation

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INTRODUCTION

Smoking represents the number one preventable cause of death across the world. There is an annual increase in mortality rate associated with tobacco-related diseases, while there is an estimation of 8 million tobacco-related deaths by 2030.^[1] Many chronic cardiovascular disorders

are associated with the negative impact of tobacco smoking such as atherosclerosis, coronary heart disease, stroke, peripheral artery disease and aortic aneurysms. Smoking is associated with endothelial dysfunction, oxidative stress and higher serum concentrations of total cholesterol and triglycerides.^[2] Current smokers are mentioned as having

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more respiratory complications after coronary artery bypass surgery, while mortality doesn't appear to be affected.^[3] Smoking effects are worse in patients over 75 years old and mortality is also higher in this group of smokers.^[4] About 50% of cardiac surgery patients stop smoking during the first months after the surgical procedure.^[5] In cases of percutaneous coronary interventions (PCI), the quitting rate in current smokers at the time of the procedure is about 45% and is associated with survival benefits.^[6] Specifically, the estimated life expectancy in ex-smokers who underwent PCI is 18.5 years, compared to 16.4 years in persistent smokers.^[7] Improving a patient's lifestyle means the engagement of Mediterranean diet, physical activity and smoking cessation and it is a crucial issue for secondary coronary disease prevention.^[8] A high percentage (almost 70%) of smokers with smoking related diseases have the desire to quit smoking.^[9] The most difficult part of cessation is not the initial attempt, but the efforts to maintain the non-smoker status in the long term. The relapse rate a year after quitting is nearly 51%, even in patients who were under professional support provided by smoking cessation centers.^[10]

Our study examines the frequency and relapse rate of smoking cessation in coronary artery bypass graft (CABG) surgery patients, a topic in which there is a very limited amount of literature-based data. There are numerous of publications which examine the relationship between chronic illnesses and smoking cessation, analyzing if a chronic illness or a specific health status can affect the smoking behavior of a patient, but no study defines exactly how a surgical procedure and specifically CABG surgery can act as a motivational factor for changing smoking behavior.^[11,12] The impact of age, sex, marital and occupational status, pre-operative tobacco exposure, unemployment, preoperative comorbidities and the development of postoperative complications after CABG has also been investigated regarding the smoking cessation success. Through our questionnaire we investigated the motivations for quitting and the reasons for smoking relapse.

METHODS

From June 2012 to September 2016, preoperative characteristics, comorbidities, intraoperative factors and postoperative complications of all adult cardiac surgical patients admitted to George Papanikolaou General Hospital of Thessaloniki, Greece, were prospectively collected.

We identified patients who underwent isolated CABG with the use of cardiopulmonary bypass. CABG patients

were classified in 2 groups regarding their smoking habit. Specifically, we defined the smoking group as smoking up to 2 months before the surgical procedure. Patients who were no smokers or ex smokers consisted the control group. Inclusion criteria were all adult patients who were current smokers at the time of CABG. Patients who underwent off-pump surgery, combined procedures and patients who died during their hospital stay were excluded from the study. Demographic and perioperative data were extracted from our Clinic's electronic database. Information provided by the questionnaire-based phone conducted interviews are shown in Table 1. The telephonic survey was a one-time contact with the patients. COPD diagnosis was based on spirometry values (FEV1/FVC ratio <70%). Diabetes mellitus diagnosis was based on insulin and/or oral hypoglycemic agents' requirement. Dyslipidemia was defined as elevated total or low-density lipoprotein (LDL) cholesterol levels, or low levels of high-density lipoprotein (HDL) cholesterol, or treatment with hypolipidemic agents. Systemic hypertension was defined as systolic blood pressure (SBP) >140 mmHg and/or diastolic blood pressure (DBP) >90 mmHg or undergoing antihypertensive therapy. We used cigarette pack years as a measure for pre-operative smoking exposure. Non-Invasive Ventilation (NIV) was delivered either by portable machines or by the ICU ventilators, and was applied in case of hypoxemia and/or hypercapnia, tachypnea and dyspnea. KDIGO criteria were used for acute kidney injury diagnosis. Deep sternal wound infection diagnosis was based on Centers for Disease Control and Prevention (CDC) guidelines.^[13] Prolonged ventilation was defined as mechanical ventilation for more than 24 hours.

Table 1: Questionnaire components

Age
Gender
Living with partner
Employment
Tobacco pack years
Smoking status after CABG
Was CABG the major motivation to stop smoking in case of cessation or was any other reason
Still smoker but with desire to stop
Visit smoking cessation center
Pharmacological therapy for smoking cessation
Electronic cigarette
Relapses and how many
Reason for relapse
Current number of cigarettes
Hospitalization for any reason
Any of the following postoperative complications:
sternal wound infections
prolonged mechanical ventilation (>24 h)
use of Non-invasive ventilation because of respiratory complications (NIV)
acute kidney injury

Patients who were interviewed for smoking cessations were fully informed about the purpose of our questionnaire and approved to co-operate. The study protocol was approved by the Institutional Ethics Committee.

Statistical analysis

Patients were sorted into 2 groups for each of the parameters studied, and for each value, a separate statistical analysis was conducted. We compared the following 3 groups of parameters: pre-operative characteristics, comorbidities of the patients and the development of postoperative complications. All the categorical variables were presented as numbers and percentages for each sub-group. Separate Chi-square tests were conducted each time with the Chi-square statistics and the *P* values presented, as appropriate. For the non-categorical values, means and confidence intervals are being shown. We present tables and flow diagrams when needed. Statistically significant results were defined as having a *P* value of <0.05. Statistical analysis was performed for every value with the SPSS software Version 22.0 software package.

RESULTS

A cohort of 967 patients underwent isolated non-emergent CABG procedure with the use of cardiopulmonary bypass from June 2012 to September 2016 at our institution. The patients who were current smokers at the time of surgery and fulfilled the survey's criteria were 302 (32.1%). During the follow-up period, 8 patients died. A total of 120 patients (9 females) agreed to participate in our questionnaire, thus constituting the study population. The rest of them either refused to participate in our survey or were not found. The mean age of the study participants was 59.6 ± 8.3 and 6.7% were females.

TOBACCO QUIT AND RELAPSE RATE RESULTS

A total of 91 (75.8%) current smokers at the time of surgery stopped tobacco smoking. All of them reported the day of surgical procedure as the quit day. Of all the smoking quitters, 22 patients had at least 1 relapse (relapse rate 24.1%). At least one year after CABG, 69 (57.5%) patients successfully stopped smoking without relapse,

while 51 patients either stopped smoking but relapsed or never quitted it [Figure 1. Flow Diagram].

We first investigated the pre-operative characteristics, specifically the correlation between the parameters of age, gender, pre-operative tobacco exposure, job-status and partnership-status with regards to their relationship with smoking cessation [Table 2].

With regard to age and smoking cessation 1 year post-operatively, Group A consisted of the younger patients (≤ 60 years old) and Group B consisted of the older patients (>60 years old). For the parameter of gender, Group A consisted of the male patients and Group B of the females. As for pre-operative tobacco exposure in terms of pack/years, Group A consisted of those patients who smoked up to 40 packs/years prior to surgery and Group B of those patients who smoked more than 40 packs/years prior to surgery and who could be described as heavy smokers or long-time smokers. For the parameter of unemployment, Group A consisted of the patients who

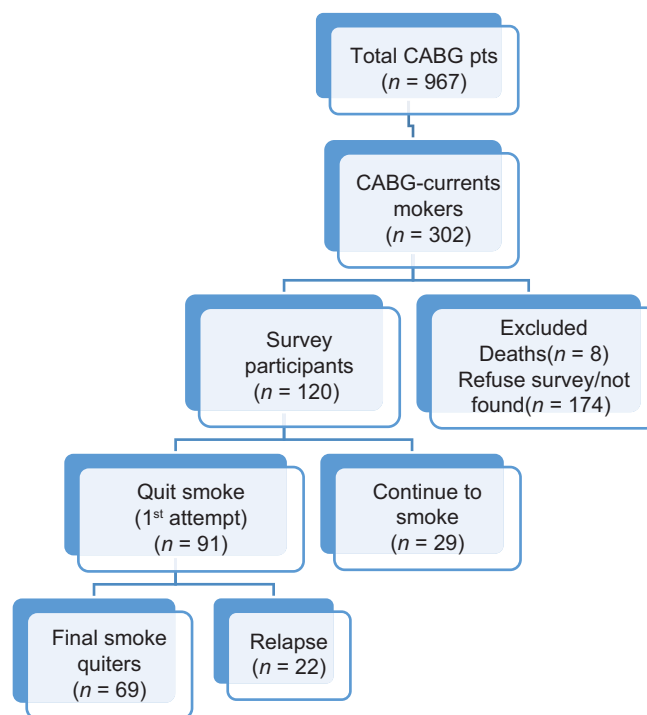


Figure 1: Flow diagram of the study

Table 2: Pre-operative characteristics

	Age		Gender		Tobacco exposure		Job		Partnership	
	≤ 60 years	>60 years	Male	Female	≤ 40 py	>40 py	Works	Unempl.	With	Alone
Patients	69/51		112/8		49/71		28/92		111/9	
Cessation	43 (62.3%)	27 (52.9%)	69 (61.6%)	7 (87.5%)	29 (59.1%)	47 (66.2%)	12 (42.8%)	64 (69.6%)	75 (67.6%)	3 (33.3%)
Continue	26 (37.7%)	24 (47.1%)	43 (38.4%)	1 (12.5%)	20 (40.9%)	24 (33.8%)	16 (57.3%)	28 (30.4%)	36 (32.4%)	6 (66.6%)
Chi-square statistic	1.06		2.16		0.61		6.59		4.29	
<i>P</i>	0.3		0.14		0.43		0.01		0.04	

were active employees and Group B of the unemployed patients. With the term unemployment, we mean all those patients who either didn't have a job or had been retired. Finally, for the parameter of partnership, Group A consisted of those patients who lived with a partner and Group B of those patients who lived alone.

Parameters of age ($P = 0.3$), gender ($P = 0.14$) and pre-operative tobacco exposure ($P = 0.43$) were not statistically significant, meaning that smoking cessation has no connection with the three aforementioned parameters. On the other hand, employment ($P = 0.01$) and partnership ($P = 0.04$) were statistically significant, so we can conclude that those patients who had been retired or didn't have a job at the time of the surgery, were more successful in quitting than the patients who were active employees. For those patients who lived alone at the time of the surgery quitting smoking was more difficult than for those who lived with a partner.

In the same fashion, we included in our study the comorbidities of the patients who underwent CABG such as Diabetes mellitus, dyslipidemia, systemic hypertension and COPD. In the table below [Table 3], we present the statistical data for these 4 parameters.

We concluded that Diabetes ($P = 0.23$), Dyslipidemia ($P = 0.35$) and Systemic Hypertension ($P = 0.14$) have no statistically significant correlation with smoking cessation. On the other hand, COPD was found to be statistically significant ($P < 0.01$) with regard to smoking cessation. In other words, patients suffering from COPD were less successful in smoking cessation after surgery.

Last, but not the least, we investigated whether development of post-operative complications including AKI, sternal wound infections, respiratory complications requiring NIV or prolonged ventilation (mechanical ventilation >24 hours) are in association with the success of quitting smoking. We present the results in the next table [Table 4].

No statistically significant difference was found for AKI ($P = 0.27$), sternal wound infection ($P = 0.69$), NIV ($P = 0.105$) and prolonged ventilation ($P = 0.89$). It seems that post-operative complications have no impact on CABG patients' decision to quit smoking.

Motivations and reasons for relapse

Undergoing surgery was the motivating factor in terms of the initial attempt of cessation for all patients. None of the patients visited a smoking cessation center. One patient had pharmacologic treatment with nicotine patches without

Table 3: Comorbidities

	Diabetes	Dyslipidemia	Hypertension	COPD
Patients	77	76	79	13
Cessation	49 (63.6%)	49 (64.5%)	47 (59.5%)	1 (7.7%)
Continue	28 (36.3%)	27 (35.3%)	32 (40.5%)	12 (92.3%)
<i>P</i>	0.23	0.35	0.14	<0,01

Table 4: Postoperative complications

	AKI	Sternal wound inf.	NIV	Prolonged ventilation
Patients	3	2	4	13
Cessation	1 (33.3%)	1 (50%)	1 (25%)	8 (61.5%)
Continue	2 (66.6%)	1 (50%)	3 (75%)	5 (38.5%)
<i>P</i>	0.27	0.69	0.1	0.89

success. Electronic cigarettes were used by 7 (5.8%) patients who didn't eventually succeed in quitting.

The reasons for relapse were the following: 3 (13.6%) patients reported addiction, 12 (54.5%) reported a deep desire to smoke and 5 (22.7%) patients reported anxiety as the main reason. The rest of the quitters (9.1%) who relapsed could not describe any specific reason. From the 51 patients who continued to smoke, 31 (60.8%) expressed the desire to quit smoking. A total of 93 (77.5%) patients had the desire to stop smoking early in the postoperative period.

DIFFERENCE IN PRE AND POSTOPERATIVE SMOKING HABIT

From the 51 patients who continued smoking, no one smoked more cigarettes than the pre-operative cigarette number, while 33 (64.7%) patients smoked the same number. Reduction in cigarette number per day was recorded in 18 (35.3%) patients. In the subgroup of patients in whom CABG procedure led to a decrease of the number of cigarettes, the new average number of daily cigarettes was 14.6 ± 11.7 , compared to 36.6 ± 17.1 before surgery. For all those patients, the surgical procedure was the main reason for reduction of smoke exposure.

DISCUSSION

Our study demonstrates findings regarding smoking behavior after CABG. From the 120 patients of the study group a total of 69 (57.5%) were able to quit smoking successfully after at least one year of the operation. In a similar survey, Pietrobon *et al.* reported a smoking quit rate of 93.15%, but this percentage was only for the first 90 post-operative days.^[14] We also found a high percentage of tobacco cessation attempt immediately after the procedure in about 75.8%, but because of a relapse rate of about 24%, this percentage was reduced at the 1-year timepoint. When

we compare our results with general population surveys, about 70% of all adult USA smokers have the desire to stop smoking, half of them make efforts, but only 6% from people who tried, succeed in quitting.^[15,16]

Older age, female gender, being married and higher income are reported to be associated with more success in quitting efforts.^[17] In our study, patients living with a partner seems to be more successful in quitting. It also seems to be the case, that unemployed or retired patients had better results in term of smoking cessation. This can be attributed to financial factors. Overall, the effects of the decline in the Greek economy could also be contributing to smoking reduction rates.^[18]

COPD patients—although in urgent need to quit smoking—represent a difficult target group with low success rates and common relapses. In a recent study, among 4600 smokers, the existence of comorbidities such as Diabetes Mellitus or hypertension didn't affect the result of the effort to quit smoking. In our study, history of COPD, Diabetes mellitus, systemic hypertension or dyslipidemia didn't show any difference in the success rate of smoking cessation.^[19] Furthermore, our study confirms the difficulty for smoking cessation for this group of patients.

We also investigated whether the development of postoperative complications enhanced the desire and decision of patients to quit smoking. We chose complications which result in an extension of ICU and/or hospital stay such as AKI, prolonged ventilation and use of NIV because of respiratory complications or with extended postoperative morbidity. We also chose complications associated with many hospital visits such as deep sternal wound infections. We found that these complications did not strengthen the motivation for smoking cessation.

Both behavioral support and pharmacotherapy showed positive results in smoking cessation among cardiac patients including CABG patients.^[20]

In reference to pharmacotherapy, 3 types of medication are strongly suggested: nicotine replacement products, bupropion, and varenicline.^[21] There are some concerns about nicotine replacement therapy. These medications should only be prescribed to stable patients since in the study of Pacciulo *et al.* an increase in mortality was found after postoperative use in CABG patients.^[22] Bupropion seems to be quite safe in patients after myocardial infarction.^[23] Varenicline use showed satisfactory results for helping smoking cessation but US Food and Drug

Administration (USFDA) recommends caution because of possible adverse cardiovascular events.^[24]

According to a scientific statement by Kulik *et al.* about secondary prevention after coronary artery bypass surgery, all types of pharmacotherapy assisted smoking cessation were recommended as Class IIa; Level of Evidence B. On the other hand, counseling all smokers during and after hospitalization for CABG to optimize short- and long-term clinical outcomes after surgery is recommended as Class I; Level of Evidence A.^[25] In a recent meta-analysis including hospitalized patients, it was demonstrated that intense counseling during hospitalization and continuing the behavioral support for at least 1 month after discharge in smokers was an effective strategy.^[26]

Although 31.8% of the patients in our study who had relapsed didn't offer a reason, the rest reported addiction, anxiety and deep desire as reasons for relapse. We can thus infer that if a comprehensive and continuous advice and support strategy had been offered to those patients, the relapse rates could have been reduced.

Healthcare professionals in Cardiac Surgery Departments have a very crucial role in helping with the smoking cessation process as well as playing a preventative role with regard to support in order to avoid relapse. Providing information for the adverse effects of smoking, cessation counselling and encouraging patients to visit specialized smoking cessation centers may contribute to successful results. Doctors and nurses should obtain appropriate training for this purpose. More specifically, we believe that Cardiac Anesthesiologists could play a very supportive role during the pre-anesthetic visiting and of course in the pre-discharge period. Not only could they inform the patients about the pernicious results of smoking during the induction, maintenance and waking up from the anesthetic state, but also about reminding every patient how the physical, emotional and health status of a person could change having a smoking-free life. Many patients see Cardiac Anesthesiologists as threats, but Cardiac Anesthesiologists should only play an informative and encouraging role on smoking cessation.^[27]

None of our patients had professional assistance, which is something that we in our clinic should strive to improve. Only one patient tried nicotine patches with no success and 7 patients tried using electronic cigarettes without any positive results. E-cigarette use is overall a controversial issue. In recent studies, it was found to be less harmful than tobacco and its use led to cigarette number reduction.^[28]

Smoking reduction should be the second goal. In our study, 35.3% of non-quitters reduced the number of cigarettes and CABG procedure was the motivating factor for such a decision in all patients. Patients who succeed in reducing the number of cigarettes are more confident and are more likely to quit smoking in the future which should always be the main goal.^[29]

Limitations

This is a retrospective study from a single center experience.

CONCLUSIONS

Smoking cessation is a very important issue. In this study, success rate for post-operative smoking cessation after CABG was found to be 57.5%.

We believe that this rate should be increased and the best way is to perform behavioral management and advise patients to visit smoking cessation centers.

CABG is an event with many teaching elements for smokers. CABG can act as a strong motivating factor to change smoking behavior.

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Conflicts of interest

There are no conflicts of interest.

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